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Master Thesis
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The Norwegian Housing Market

Will house prices in Akershus and East and West of Oslo respond differently to financial variables?

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Abstract

The Housing market in Oslo and Akershus areas experience some of the most expensive house prices in Norway. But within the neighbourhoods and regions there are local differences in prices. The first and main part of the paper examines how financial and economic variables affect house prices in the different areas in Oslo and Akershus by using regression analysis. Since house price levels are varying, there should be a reason to believe that the different areas respond differently to changes in income, net wealth, unemployment, interest rate and GDP. The second part of the paper investigates the relationship between house prices and consumption. By using Granger Causality test we investigate if house prices in each local area are a significant driver on private consumption. Since housing wealth describes much of peoples total wealth, housing wealth might specify how people allocate their assets. This can indicate that changes in house prices will cause changes in private consumption.

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Oslo, 30/08-12

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1. Introduction

There is reason to believe that the Norwegian housing market is affected by financial variables due to the connection with Norway's economy. Approximately 80 percent of the Norwegian population owns their home (SSB 2008). This indicates that housing plays an important role for the country's economy. We want to investigate how income, net wealth, unemployment, interest rate and GDP influence house prices in Oslo neighbourhoods and Akershus regions.

The Norwegian housing market did only experience a small depression during the last financial crisis. Strict and robust monetary policy setting by Norges Bank to ensure financial stability explains why the Norwegian housing market did not collapse (Norges Bank 2011). The Norwegian housing market is today in a growing position (DNB 2012); house prices are increasing, people's economic situation is growing, and the activity in the housing market is booming.

In according to Røed Larsen and Weum (2008), house prices in Norway tend to have moderate fluctuations. Previous literature (Case, Quigley and Shiller 2005) states that the housing market is earmarked for long term investments because people are generally less aware of the short-run changes in housing wealth. In addition, Oikarinen and Kahra (2002) state that housing markets experience "bull and bear" markets like stock markets. However, house prices are less volatile due to moderate fluctuations and thus more suitable for long-term investments. Having a place to live is seen as a necessary need and everyone will be affected by the housing market sometime during their lifetime. Other interested observers of house prices are financial authorities and central bankers. According to Røed Larsen and Sommervoll (2004, 77); "*housing loans make up a large proportion of credit creation in an economy"*. The security of mortgages is affected by changes in the housing values, which further affect the macroeconomic performance.

1.1 Oslo and Akershus area

The housing markets in Oslo and in the neighbour county Akershus have experienced rapid increases in house prices the last decade (OBOS 2011). Especially in Oslo, the demand for houses has increased due to immigration while the building of new houses has not increased with the same proportion. The

increase in house prices are thus caused by this population density. We will keep this outside the thesis and concentrate on the financial aspect.

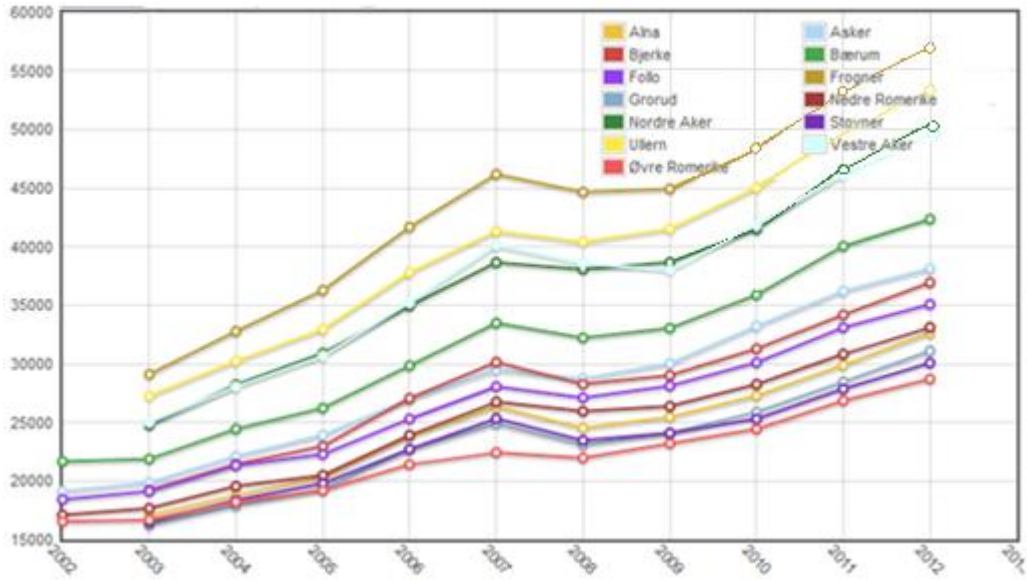

Figure 1.1 Graph of the development in house prices per square meter for apartments in Oslo and Akershus

Neighbourhoods in East of Oslo: Alna, Bjerke, Grorud, Stovner

Neighbourhoods in West of Oslo: Frogner, Northern Aker, Ullern, Western Aker

Regions in Akershus: Asker, Bærum, Follo, Northern Romerike, Southern Romerike

Source: Norwegian Association of Real Estate Agents (NEF)

Prices, population and demand vary a lot in the different areas in Oslo and Akershus (Tennøy 2002). The most concentrated areas are the Western part of Oslo and Akershus with the highest house prices per square meter (see figure 1.1). The lowest house prices per square meter are in the East of Oslo and the Northern part of Akershus. Another important aspect is the variety of house types across the areas. In the neighbourhoods in Oslo one find mostly apartments and smaller homes, while in the suburb areas in Akershus, with less density population, one find mainly detached villas in addition to smaller houses and apartments. Nevertheless, the housing markets in Oslo and Akershus are closely connected since they, to a large extent, share the same labour market (Tennøy 2002). Oslo is the city in Norway with highest credit creation in the economy (Business Insider 2012). Approximately 20 percent of the Norwegian population live in Oslo and Akershus and many of Akershus' inhabitants work in Oslo and pay taxes to their own hometown (SSB 2011). Oslo and the suburb areas, with easy access to work in Oslo, tend to have the highest income per habitant and the highest house prices in Norway. This might indicate equal demographical areas (Tennøy 2002).

In our research, we have for Oslo chosen to only include neighbourhoods in the East and the West since we wanted to investigate the areas that are likely to respond most different to financial variables and we therefore decided to exclude the Centrum- and South neighbourhoods. For Akershus, we have chosen to include all the regions, since these regions are located nearby the East and West of Oslo and therefore might respond similar to financial changes. We also included the south region in Akershus since it is much similar to the other regions.

Figure 1.2 Map of Oslo neighbourhoods and Akershus regions

Source: Oslo kommune (2006) and Akershus fylkeskommune (2009)

Figure 1.2 above illustrates two maps; the left map consists of the neighbourhoods in Oslo and the right map consists of the regions in Akershus. As one can see from the right hand side map, Oslo is surrounded by the Akershus regions Asker and Bærum in the West, Northern Romerike in the North, Southern Romerike in the East and Follo in the South. The left hand side map illustrates neighbourhoods in Oslo. From the map, one can see that the West of Oslo consists of the neighbourhoods Frogner, Northern Aker, Ullern and Western Aker. The East of Oslo consists of the neighbourhoods Alna, Bjerke, Grorud and Stovner. The border between East and West goes between Northern Aker in the West and Bjerke in the East.

In this paper, we want to investigate how these particular areas respond to financial changes in the economy and find out which variables that are most affecting house prices in each area. Do we see the same trends in Oslo as in

Akershus? On the other hand, do we observe differences within the East and West of Oslo and within the regions in Akershus? There should be a reason to say so.

Some research has been conducted on the housing market in Oslo and Akershus earlier; research by Røed Larsen and Sommervoll (2004) using data on hedonic house prices for tenants on all housing transactions in Norway, argue that the challenge of identifying each dwelling uniquely is one of the main reasons. In our research, on the other hand, we have chosen to use the house price index per square meter. Prices per square meter vary when it comes to location and size of the dwellings. In Oslo, smaller apartments tend to have higher price per square meter than bigger apartments (NEF). We have therefore chosen to analyse apartments of the same size, 70 square meters, to get comparable data.

1.2 Housing as an asset

Housing is one of the most important assets for households. Unlike other assets, a house is both a store of wealth and a consumption good (Bjørnland and Jacobsen 2010). Asset prices are naturally forward looking in the sense that households' believes about future house prices affect their behaviour in according to their housing wealth. House prices might therefore be used as leading indicators in the economy[1]. Changes in the house prices will change households' wealth, which again might affect their allocation of consumption and saving. Increases in house prices will thus have subsequent effects on consumption since the availability of credit for borrowing-constrained owners will increase (Bjørnland and Jacobsen 2010). Case, Quigley and Shiller (2011) found that there is a generally pro cyclical relationship between wealth and consumption. Thus, we have reasons to believe that changes in housing wealth have an effect on households' consumption.

1.3 Research question

In the first research question, we use monthly data from the period 2005 to 2010 for Oslo and 2002 to 2010 for Akershus. For the second research question, we use the time period 2006 to 2009 for both areas. Based on the assumption that there are demographic differences in Oslo and Akershus, we want to test the following research questions:

[1] Bjørnland, H. C. 2011. Lecture notes from "GRA 6639 Topics in Macroeconomics" , lecture 6

1. Will house prices in regions of Akershus and neighbourhoods in East and West of Oslo respond differently to financial variables such as income, net wealth, unemployment, interest rate and GDP?

2. Do house prices in Oslo and Akershus cause households' consumption?

Based on these research questions, we find it appropriate to test the following hypotheses:

H_1: There is no significant difference between how house prices will be affected in the Akershus regions and East and West neighbourhoods in Oslo

H_2: House prices do not cause consumption

2. Literature Review

Some research has been conducted on the Norwegian housing market in Oslo and Akershus. Articles related to our topic are the work of Røed Larsen and Sommervoll (2004) and Røed Larsen and Weum (2008). The housing market in Oslo and Akershus have the last two decades experienced rapid increases in house prices except for the recessions in the early 1990s and in the middle of the 2000s with some fall in the house prices. In general, house prices in Norway are characterized by small fluctuations. In according to Røed Larsen and Weum (2008), the housing market in and around Oslo is considered as inefficient since it does not follow a stochastic process. Because of an emerging housing market where house prices do not develop in market equilibrium, one observes market losses.

2.1 Relationship between monetary policy and house prices

There has been some literature concerning the relationship between monetary policy and house prices. The work of Bjørnland and Jacobsen (2010) analyse the interdependent relationship between house prices and interest rate, inflation and GDP in Sweden, Norway and United Kingdom. They found that there are strong effects of monetary policy shocks on house prises, but that the timing and strength of response are different among the countries. The housing market contributes less in the economy in Sweden than in Norway and United Kingdom; this might be

because the owner-occupied rate is smaller in Sweden. Since Norway's owner-occupied rate is approximately 80 percent (SSB 2008), it is clear that housing plays an important role in the economy. In that sense, the interdependent relationship between house prices and monetary policy is important for the interest rate setting.

Past research by Rahman (2010) indicates that increases in house prices tend to have a positive effect on housing wealth, employment, aggregate demand and GDP. House prices are also mainly determined by demand and supply factors since house prices tend to increase when demand for houses exceeds supply. Changes in the interest rate influence the mortgage repayments. This will affect how much households are able to borrow at the given repayment-to-income ratio. Consequently, this results in changes in housing demand and house prices.

GDP is the value of changes in production and prices in a country's economy (Steigum 2010). During the recent years, low interest rate, increased real income, stable inflation and employment in Norway have resulted in increased production, prices and demand, and lead to stable growth in GDP (Norges Bank 2011). Empirical study from Helbling and Terrones (2003) found that GDP is positively affected by increased house prices in certain countries. This is in accordance with what we observe for Norway; growth in GDP and increased house prices over the recent years (Norges bank 2011).

2.2 Relationship between house prices and consumption

There exists moderate literature concerning the relationship between housing wealth and consumption. An article that includes parts of our research is the work of Case et al. (2011). The article investigates the linkage between stock market wealth, housing wealth and households' consumption in the time period 1979 to 2009. Case et al. (2011) argue that in according to the life cycle savings hypothesis, households will allocate increases in expected wealth over time, thus a proportional effect between wealth and consumption will exist in the long run. It is important to keep in mind that Case et al. (2011) look at longer time periods that we do in our research. We are therefore not able to draw the long run conclusions that Case et al. did in their research.

Research by Oikarinen and Kahra (2002) and Paiella (2009) found that households' consumption increase as a result of rising house prices. This leads to reduced credit constraints and permit households' to take more loans and smooth consumption over time. Case et al. (2011) stress the importance that consumption is differently affected by the stock market than the housing market. Their findings strongly support that consumption is affected by variations in housing market wealth. Since consumers do not receive regular information about the value of their housing assets, they might be less affected by short-run changes. The holding periods for houses are normally longer than for stocks, thus the long-run effects of housing wealth on consumption seems more important (Case et al. 2011). Earlier research by Case et al. (2005) conducted on the same topic drew the same conclusions. Though, the updated version (2011) found even stronger correlation between the housing wealth and consumption during the financial crisis. The tightening consumption behaviour during that period reflects the unusual decline in house prices. However, this provides information of how house price declines affect consumption during major recessions.

2.3 Previous methodology literature

In the work of Røed Larsen and Sommervoll (2004), time series are applied in testing possible inequalities between different house types over a period with increased house prices. Using least squares approach, they found that prices of repeated-sales of the same house objects in Oslo over an eleven years period increased, and that smaller apartments had a larger price increase than bigger apartments. Based on varying developments for house prices in different house types, we decided to use the house price index per square meter for apartments of the same size in our estimations.

The article by Case et al. (2011) conducts Ordinary Least Squares (OLS) when estimating wealth effects on consumption. The dataset consists of time series data to see whether housing wealth or financial wealth has the most significant effect on consumer's wealth. Case et al. (2011) stress the importance of testing the dataset for robustness and time trends in the data to make sure the data are stationary. Ordinary Least Squares is applied to estimate consumption effects caused by changes in house wealth and stock wealth, and they found that the

correlation between consumption and house wealth was stronger than the correlation between consumption and stock wealth.

Time series are also conducted by Røed Larsen and Weum (2008) in their article about the efficiency of the housing market in and around Oslo. They ran OLS regressions on real data to investigate whether there is any time structure in the house prices over an eleven years period. Like Røed Larsen and Sommervoll (2004), Røed Larsen and Weum (2008) and Case et al. (2011), we will use time series since we will estimate financial variables' effect on house prices over time. In order to validate the model, Røed Larsen and Weum (2008) divided the time series into two sub-samples and ran the same tests to make sure they obtained equal results with the full model. Cross-validation will also be applied in the end of research question one in this paper.

The work of Wuensch, Jenkins and Poteat (2002) use the method of Student`s t-test to investigate whether there are significant similarities between slope coefficients in two independent samples; idealists and nonidealists. They used information from the regression analyses to compute the difference between the two slopes and divided by the standard error of the difference between the slopes. The t-statistic was compared with the critical value on N - 4 degrees of freedom. Their conclusion was that the slopes of the two samples were significantly different. We will do the same in order to investigate if the areas in Oslo and Akershus respond significantly different to the same financial variables in the economy.

The work of Comincioli (1995) investigates whether there is a causal relationship between the two variables stock prices and GDP; meaning that stock prices can be used as an indicator to predict growth in the economy or vice versa. He uses a simple Granger causality test to find any significant causal relationship between the two variables with included lags. He found that there is a causal relationship on the direction from stock prices to GDP, which means that lagged stock prices cause changes in the GDP. An important aspect in this test is the use of stationary data, thus Comincioli (1995) uses percentage change in stock prices and GDP to investigate the relationship. This is also in accordance with the work of Foresti (2006), which found the same unidirectional relationship from stock prices to

GDP using the Granger causality test. In order to investigate whether house prices drive households' consumption, we will run the Granger causality test in research question 2, to investigate the relationship between house prices and consumption in Oslo and Akerhus.

3. Data description

Since our aim is to study how house prices react to financial variables in the economy, we collected historical data on house prices, income, net wealth, unemployment, interest rate, GDP and consumption. The data were collected in nominal terms and converted to real data[2]. Because of the volatile and short time period we used the percentage change in each variable in order to get stationary data. In the following part we will explain how the variables are collected and we made some comments to the data.

3.1 House prices

Our sample consists of house prices collected from Norwegian Association of Real Estate Agents (NEF)[3]. We use monthly data from the house price index per square meter for apartments of 70 square meters to get comparable analyses. As we know, there are differences in house types in the different areas in Oslo and Akershus, thus there will be appropriate to analyse house prices per square meter for the same house type and size.

There was a reduction in the number of neighbourhoods from 25 to 15 in Oslo in 2004 (SSB 2006). The complex redrawing of borders made it thus difficult to collect data from the 25 neighbourhoods and reconstruct data for the 15 neighbourhoods (SSB 2006). In order to get comparable analyses of the same neighbourhoods in Oslo, we therefore collected monthly data on house prices from 2005 to 2010[4]. For Akershus we collected monthly data on house prices from 2002 to 2010[5]. This extended time period, compared to Oslo, gave us the

[2] The Consumer Price Index (CPI) was collected from Statistics Norway (SSB). Dividing house prices, income, net wealth, GDP and consumption on the CPI gave us the real data. The real interest rate was found by taking the difference between the nominal interest rate and the inflation.

[3] NEF is in Norwegian called "Norges Eiendomsmeglerforbund". NEF publish monthly house prices per square meter for all regions in Norway.

[4] Data on income and net wealth for Oslo in 2011 are not available before autumn 2012.
[5] Monthly data on house prices in Akershus is only available from January 2002. Data on income and net wealth for Akershus in 2011 are not available before autumn 2012.

opportunity to investigate if we could see the same trends over a longer time period.

In Oslo, the West area consists of the neighbourhoods Frogner, Northern Aker, Ullern and Western Aker, while the East area consists of the neighbourhoods Alna, Bjerke, Grorud and Stovner (Oslo kommune 2006). Since Oslo is geographical surrounded by the regions in Akershus, we included all the regions to investigate whether we can observe the same trends in the nearby areas. Akershus is divided into the regions Follo, Northern Romerike, Southern Romerike and the West Region (Akershus fylkeskommune 2009). Follo consists of the municipalities Oppegård, Ski, Ås, Frogn, Vestby, Nesodden and Enebakk. Southern Romerike consists of the municipalities Aurskog-Høland, Sørum, Nittedal, Fet, Rælingen, Skedsmo and Lørenskog. Northern Romerike consists of the municipalities Hurdal, Eidsvoll, Nannestad, Ullensaker, Gjerdrum and Nes. The West region consists of the municipalities Asker and Bærum. Because of the high population, we analyse the municipalities in the West region separately.

3.2 Financial variables

We use the variables income, net wealth, unemployment, interest rate and GDP in the analysis of our first research question, since they describe much of the financial aspects in the economy (Norges Bank 2011). As earlier mentioned, all the variables, except unemployment[6], are in real percentage changes adjusted for inflation. Since inflation[7] is connected to the interest rate and describes how the country's economy develops over time (Steigum 2010), inflation was originally included in the analysis with the real percentage change data, but the results were unaffected by excluding it. The regression analysis gave even better R^2 results without the inflation variable. We therefore excluded inflation in the analysis, since it did not change the main conclusions, even though it still might capture some changes in the economy. In the following, we will give a short explanation of the variables included in this paper.

[6] Unemployment is not adjusted for inflation since it is numbers of unemployed.

[7] Inflation is the rise in the price level of goods and services in a country's economy

3.2.1 Income

Data on average annual gross income is collected from Statistics Norway (SSB)[8]. The annual data on gross income is converted to monthly data using EViews[9]. For many years, there has been a rapid income growth in Norway, which has led to an increase in the margins in many households (Norges Bank 2011). This has reduced the sensitivity to interest rate changes for many households. Income level affects the households' purchasing power, which in turn might influence demand for houses. We observe that the income level differs within the Oslo and Akershus areas. This can be seen in conjunction with the varying house price levels in the respective areas.

3.2.2 Net Wealth

In order to find net wealth, we used average taxable gross wealth, collected from SSB. The annual net wealth data is converted to monthly data using EViews[10]. Rapid house price increases has resulted in substantial housing wealth for many households. Increased total net wealth might be considered as a safety net against unexpected changes in the interest rate to sustain current consumption level.

3.2.3 Unemployment

Monthly data on unemployment is collected from Norwegian Labour and Welfare Administration (NAV)[11]. Changes in unemployment are caused by changes in the labour market, and with economic growth follow lower unemployment. The demand for goods and services increases as a consequence of emerging activity in the market, which results in higher house prices. Norway has experienced a low and stable unemployment the last decade compared to many other countries (NAV 2011). For the monetary policy, it is important to keep the unemployment level low and stable to avoid social and economic problems that might develop during recessions.

[8] The data is only available until 2010, since data on income for 2011 will not be available before autumn 2012.

[9] We used the frequency conversion method Linear-match last which performs linear interpolation on the missing values.

[10] We used the frequency conversion method Linear-match last which performs linear interpolation on the missing values.

[11] Except data for January 2005 which was missing.

3.2.4 Interest rate

Norges Bank determines the interest rate to ensure stable and low inflation. The monthly average Norwegian Inter Bank Offered Rate (NIBOR) of daily observations was collected from Norges Bank. Changes in interest rate stimulate the activity in the market and affect unemployment and consumption. The interest rate level in Norway has been low and stable during the last decade (Norges Bank 2011). A high income level in conjunction with low interest rate over time results in increased funding for households. This might stand as a buffer against unexpected interest rate increases and therefore dampen volatility in the housing market. Interest rate is thus an important leading indicator for how the housing market develops over time. Strict and robust interest rate setting during the last financial crisis explains why Norway's economy made it so well during the crisis.

3.2.5 Gross Domestic Product (GDP)

GDP is the value of a country's total produced domestic goods and services in a given year or quarter, valued at market prices (Steigum 2010). We collected quarterly data on GDP from SSB and converted to monthly data using EViews[12]. A high GDP is a result of stable economic growth with increased production and prices which we have seen in Norway the last decade. New dwellings built and year over year increase in house prices are also included in computation of GDP (Rahman 2010).

3.2.6 Consumption

In the second research question, we used data on households' consumption for each neighbourhood and region. Consumption is calculated using the following budget constraint for households:

$$Net\ wealth_1 = Income_0 - Tax_0 + Net\ wealth_0(1 + r) - Consumption_0$$

Annual average gross income and annual average taxable gross wealth for each neighbourhood and region are described earlier in the data description. Average annual tax for each neighbourhood and region is collected from SSB. The interest rate r is calculated by the annual non-labour income for Norway divided by the annual average taxable gross wealth for Norway collected from SSB. The interest

[12] We used the frequency conversion method Linear-match last which performs linear interpolation on the missing values.

rate is comprised of both the riskless rate and the market rate since we want to capture the overall rate level from net wealth. The annual average NIBOR of daily observations collected from Norges Bank is used as the riskless rate. The annual market rate is calculated from the OBX Total Return Index collected from Oslo Stock Exchange. The weights for the riskless rate and the market rate are calculated using simple weight calculation[13]. The weights indicate how much net wealth that is invested in the risk free rate and in the market rate. The weights are shown in table 3.1.

	NIBOR	OBX
2006	0.97	0.03
2007	0.92	0.08
2008	0.98	0.02
2009	0.99	0.01

Table 3.1 *Weights for the risk free rate and market rate*

We observe a decrease in the percentage invested at the Oslo Stock Exchange after the financial crisis. During the crisis investors were more risk averse.

We converted the annual data on consumption to monthly data using EViews[14]. The time period we use for consumption is from 2007 to 2009[15]. According to Maclennan, Muellbauer and Stephens (2000), changes in the interest rate have direct and indirect effects on households' consumption. The income effect is the direct effect, which means that an interest rate increase will raise the interest rate repayment of outstanding debt. This will result in lower disposable income, and consequently, the consumption level will be reduced. The indirect effect, however, can be divided into the wealth effect and the credit channel effect (Elbourne 2008). An increase in interest rate will dampen the activity in the market and lead to decreased house prices. This will reduce the households' wealth since the collateral value of the house has fallen. As a consequence, households' access to credit will be reduced. This will result in declined consumption (Bernanke and Blinder 1988, Bernanke and Gertler 1989, Case et al. 2005). Changes in house prices will thus have consequent effects on households'

[13] The weights for the riskless rate and the market rate are calculated using the following formula: $R_{\Pi} = \alpha R_{NIBOR} + (1 - \alpha) R_{MARKET}$

[14] We used the frequency conversion method Linear-match last which performs linear interpolation on the missing values.

[15] Non-labour income is only available from 2006. Data on wealth for 2011 is not available before autumn 2012, which is needed to calculate net wealth for 2010. Since we converted the annual data to monthly, data for 2006 was missing.

consumption. This causal relationship will be investigated in research question 2 in the paper.

4. Methodology

Time series is used in testing our first research question *"Will house prices in regions of Akershus and neighbourhoods in East and West of Oslo respond differently to variables such as income, net wealth, unemployment, interest rate and GDP?"*. This is widely used in quantitative analysis of financial issues since it is a repeated set of observations of the same variable over a period of time. Our time series is written as: t=2005, 2006, ... , 2010 for Oslo and t=2002, 2003, ... , 2010 for Akershus.

Before we started the estimation we needed to test for non-stationarity in the data. Since we have time series data, it is important to use stationary data in the estimation to avoid spurious regression. We ran the Augmented Dickey Fuller (ADF) test in all the real percentage change variables and tested the null hypothesis that series contains a unit root. If a series contains a unit root, it will be appropriate to differencing once to evoke stationarity. Our tests gave stationary results at the five percent level and we therefore rejected the null hypothesis of unit roots in the data. Further, we checked for multicollinearity in the data. If variables are highly correlated, unreliable estimates of the individual regression coefficients might occur. We used the variance inflation factor (VIF) in EViews and tested the hypothesis of no multicollinarity. The results showed low VIF values. We can therefore not reject the null hypothesis and draw the conclusion that we do not have a problem with multicollinearity in the data.

We ran the White's test for heteroskedasticity to investigate whether the errors have a constant variance. Using OLS in the presence of heteroskedasticity, will give consequences; the OLS estimators will not be BLUE[16], meaning the coefficient estimates are inefficient and will give incorrect standard error estimates (Brooks 2008, 135). We tested the null hypothesis of no heteroskedasticity and found that homoskedasticity is present in almost all the data at the five percent level of significance (appendix 1). We can therefore not reject the null hypothesis of no heteroskedasticity in the data. Since

[16] BLUE: Best Linear Unbiased Estimators

heteroskedasticity was observed in the data for Western Aker, Northen Romerike and Southern Romerike, we ran the Newey-West procedure for the respective data to correct for autocorrelation and heteroskedasticity. The Newey-West procedure changes the standard errors and not the point estimates. Then we tested for autocorrelation in the data and the Breuch-Godfrey test was conducted. If autocorrelation is present and further ignored, the consequences are similar to those of ignoring heteroskedasticity (Brooks 2008, 149). The null hypothesis of no autocorrelation was not rejected at the five percent level of significance (appendix 2). Based on the estimation output from appendix 2, we can therefore conclude that autocorrelation not seems to be present in the dataset.

Further, we tested for normality. The Jarque-Bera normality test, which tests for normal distribution under the null hypothesis, was conducted. From appendix 3, only Follo, Asker and Ullern are not normality distributed using the five percent level of significance. One explanation might be that it is common to have few extreme residuals in financial modelling, which can result in rejection of the normal distribution. Our dataset involves volatile years, which might be the reason why we have non-normality in the data. According to Brooks (2008; 164), even when non-normality is found it is desirable to stick with OLS if possible. Since our dataset contains reliable data, as mentioned above, it should therefore be justifiable to run OLS estimation on our data.

Linear regression explains movements in one dependent variable given movements in one or more independent variables (Brooks 2008, 27). We used multiple linear regressions for all the explanatory variables on the house prices to investigate which variable that has the most significant impact on house prices in each area in Oslo and Akershus. The standard regression procedure OLS is used to estimate the relationship.

The following equation is used for the Oslo neighbourhoods; Alna, Bjerke, Frogner, Grorud, Northern Aker, Stovner and Ullern:

$$House\ prices_{\ neighbourhood} = \beta_{0\ neighbourhood} + \beta_1 income_{neighbourhood} + \beta_2 net\ wealth_{neighbourhood} + \beta_3 unemployment_{neighbourhood} + \beta_4 interest\ rate + \beta_5 GDP + u_t \quad (1)$$

For the Akershus regions Asker, Bærum, Follo, Northern Romerike and Southern Romerike we used the following equation:

$$House\ prices_{\ region} = \beta_{0\ region} + \beta_1 income_{region} + \beta_2 net\ wealth_{\ region} + \beta_3 unemployment_{region} + \beta_4 interest\ rate + \beta_5 GDP + u_t \quad (2)$$

To ensure that our model is precise, we did a cross-validation test. We divided the dataset into two subgroups to estimate how accurate the predictive model performs relative to the full model. We divided the subgroups for Oslo into the periods 2005 to 2007 and 2008 to 2010 and the subgroups for Akershus into the periods 2002 to 2006 and 2007 to 2010. We ran the same tests for the subgroups as we did for the full model to ensure similar results.

By using Student's t-test, we ran a slope coefficient test for differences between the slope coefficients in two independent areas. We tested the null hypothesis for equality between the slope coefficients between two independent areas. The test statistic is calculated by dividing the difference between the two slopes on the standard error of the difference between the slopes (Wuensch, Jenkins and Poteat 2002).

$$t = \frac{b_i - b_j}{S_{b_i - b_j}}$$

The standard error of the difference between the slopes is calculated using the formula (Wuensch, Jenkins and Poteat 2002):

$$S_{b_i - b_j} = \sqrt{S_{b_i}^2 + S_{b_j}^2}$$

The Granger Causality test is used in order to answer our second research question *"Do house prices in Oslo and Akershus cause households' consumption?"*. At first, we tested for unit root, heteroskedasticity and autocorrelation in the data. In addition, we checked for multicollinearity in both the contemporaneous and lagged variables. We found credible results in all the tests. In the Granger-fundament "*x* is a cause of *y* if it is useful in forecasting y" (Foresti 2006, 3). This means that *x* changes the accuracy of *y* with respect to forecast, considering past values of *y*. A simple Granger causality test between house prices and consumption is used in the estimation. The following equation is used to determine whether there exists a relationship between the percentage changes in house prices and the percentage changes in consumption:

$$\%\ Consumption_t = \alpha + \sum_{i=1}^{m} \beta_i\ \%\ Consumption_{t-i} + \sum_{j=1}^{n} \tau_j\ \%\ House\ prices_{t-j} + \mu_t$$

$$\%\ House\ prices_t = \theta + \sum_{i=1}^{p} \phi_i\ \%\ House\ prices_{t-i} + \sum_{j=1}^{q} \psi_j\ \%\ Consumption_{t-j} + \eta_t$$

In order for a causal relationship to exist, there must already be an existing relationship between the two variables (Comincioli 1995). We investigated if lagged observations of house prices drive the observation of consumption or vice versa. If this is true, then the variables have a causal relationship. Changes in house prices can quickly occur. However, consumption might not change quite as fast due to consumption smoothing.

5. Results

5.1 Research Question 1

In this part we will present the results from the regression analysis of research question 1.

Research question 1: Will house prices in regions of Akershus and neighbourhoods in East and West of Oslo respond differently to financial variables such as income, net wealth, unemployment, interest rate and GDP?

Earlier research (Bjørnland and Jacobsen 2010, Rahman 2010, Helbling and Terrones 2003) and publications (SSB 2008, Norges Bank 2011) made us have certain expectations of how the different areas respond to the independent variables. Our expectations were that there would be inequalities within the areas. Our expectations are shown in the table below.

Independent variables	Expected to be most significant in:	
	OSLO	AKERSHUS
Income	East	Northern Romerike
Interest rate	East	Follo, Northern Romerike, Southern Romerike
Net wealth	West	Asker, Bærum
GDP	East, West	All regions
Unemployment	East	Northern Romerike

Table 5.1 Variables expected to be most significant in Oslo and Akershus

We expected income and interest rate to have most impact on house prices in the East areas of Oslo and in Northern Romerike. The demand for houses in East of Oslo is high, but the house price level is still low compared to the rest of Oslo. This indicates that households living here generally have lower income level. Northern Romerike lies demographically further from Oslo and it might be less attractive for people working in Oslo to live here. The demand for houses is lower, which reflects the low house price level. Further, we expected net wealth to have the most impact in Asker, Bærum and the neighbourhoods in West of Oslo. These are some of the wealthiest areas in Norway with the highest income level, which is reflected in the high house prices. Therefore the households might not be sensitive to changes in the interest rate. Further, it was thus more difficult to expect which variables that affected most in Follo and Southern Romerike. Since income, wealth and house price levels are lower than the West areas but higher than the East areas, we assumed that interest rate might be the most significant variable. We expected GDP to have an impact in all areas since changes in GDP affect the whole country's economy. Economic growth in conjunction with low and stable unemployment in Norway cause positive expectations about the housing market. This leads to rising activity and increases in house prices because households become generally less risk aware. Low unemployment might therefore indicate good activity in the housing market. Hence it might have some impact on house prices.

We ran the regression analysis for the areas in Akershus and Oslo[17]. The table below summarizes the results from the OLS regression.

	Income	Net Wealth	Unemployment	GDP	Interest Rate	R^2
Alna	0.0001*	0.2208	0.9551	0.0058*	0.0006*	0.46
Bjerke	0.0001*	0.3522	0.6370	0.0121*	0.0009*	0.45
Grorud	0.0007*	0.5239	0.6045	0.0198*	0.0023*	0.40
Stovner	0.0131*	0.0684	0.9809	0.0126*	0.0158*	0.40
Frogner	0.4199	0.0006*	0.5629	0.2957	0.1105	0.22
Northern Aker	0.0304*	0.0040*	0.5166	0.0807	0.3864	0.33
Ullern	0.0020*	0.0000*	0.7354	0.1049	0.0001*	0.36
Western Aker	0.0049*	0.0000*	0.3862	0.3596	0.0094*	0.49
Asker	0.5098	0.0022*	0.7815	0.0450*	0.6488	0.15
Bærum	0.5332	0.0000*	0.2982	0.0803	0.2354	0.28
Follo	0.2879	0.0534	0.0386*	0.0110*	0.6594	0.21
Northern Romerike	0.1749	0.1237	0.1378	0.0704	0.0054*	0.21
Southern Romerike	0.7199	0.0222*	0.0399*	0.0486*	0.3852	0.25

Table 5.2 Summarized results from the regression analysis. * indicates significant on the five percent level.

Table 5.2 is divided into Akershus and East and West of Oslo. As we can see from the table, all the neighbourhoods in East of Oslo are significantly affected by the same variables income, GDP and interest rate. Income and interest rate are clearly the most affecting variables on house prices in these neighbourhoods. This is in accordance with our expectations. It reflects that areas with lower income level might be more sensitive to changes in interest rate, which is essential for the housing demand. On the other side, unemployment and net wealth are not significant in all the East neighbourhoods. From the R^2, we observe that the variables explain 40 to 46 percent in the model in the East of Oslo. These are the highest R^2 in the test, but still not very high levels. This indicates that house prices in these areas also are explained by other explanatory variables outside our paper. In the neighbourhoods in West of Oslo, we experience that income and net wealth are most significant. Net wealth is the only significant variable in Frogner, but the R^2 is only 22 percent. This indicates that other factors are influencing the house price level. Since Frogner is located near downtown Oslo and is a very popular place to live, it reflects that net wealth is essential for the housing demand. This might explain why Frogner has one of the highest net wealth levels

[17] See equations (1) and (2)

in Norway per inhabitant, in addition to the highest house price level per square meter in Norway (NEF). House prices in Ullern and Western Aker are significantly affected by the same variables income, net wealth and interest rate, while Northern Aker is significantly affected by income and net wealth. Significant net wealth is in accordance with what we expected for the West of Oslo, even though income and interest rate also are clearly significant, like in the East of Oslo. The West of Oslo experience some of the highest wealth levels in Norway, and households might not be so sensitive to changes in the monetary policy. Further, we observe that unemployment and GDP are not significant in the West neighbourhoods. We expected GDP to be significant since it affects the whole country's economy. But since West of Oslo is one of the wealthiest areas in Norway, changes in GDP may not be essential for households' purchasing power. We observe R^2 between 22 to 49 percent for the neighbourhoods in the West of Oslo, which point out that other factors also are explanatory in this area.

In Akershus, we see that net wealth is the only significant variable in Bærum. This is the same as we observed for Frogner in the West of Oslo. We also observe that net wealth is significant in Asker, in addition to GDP. It is in accordance with our expectations that net wealth is significant in the West region in Akershus, since the income and wealth levels in Asker and Bærum are among the highest in Norway, and the purchasing power for households is therefore strong. Asker and Bærum are also very popular places outside the Oslo border to live; this reflects the high house prices that are present in these areas. Unemployment was neither significant in Asker nor Bærum, and signals less importance for house prices. The fact that GDP is significant in Asker, but not in Bærum is rather surprising, since the two regions are to a large extent similar demographical regions. The R^2 is 28 percent for Bærum and 15 percent for Asker, and indicates that other variables are as well explanatory in these areas.

Northern Romerike and Southern Romerike are geographically located in the North of Akershus. Nevertheless, we observe that house prices in these areas are significantly affected by different variables; Northern Romerike is significantly affected by interest rate, while Southern Romerike is affected by net wealth, unemployment and GDP. This was somewhat in accordance with what we expected. Based on the fact that Northern Romerike is located geographically

further from Oslo than Southern Romerike and exists of more country side areas, we thought that house prices might be differently affected in the two regions. We do neither find the same pattern for Northern and Southern Romerike as we do for the East of Oslo, even though we expected that house prices in these areas should be affected by the same variables. This is because they are located geographical nearby each other. We observe the R^2 levels to be 21 and 25 percent. It is therefore other factors explaining house prices in these areas as well. In Follo we observe that unemployment and GDP have significant impact on house prices, where GDP is the most significant variable. It is rather surprising that unemployment is significant in Follo since many of the municipalities in Follo are located geographically nearby Oslo with easy access to the labour market in Oslo. Hence we thought unemployment may not be a significant factor on house prices in Follo. GDP is significant, and in accordance with our expectations. From the R^2 we find that the variables observe 21 percent of changes in house prices. We can therefore conclude that house prices in Follo also are affected by other explanatory variables.

To sum up the observations from table 5.2, we can say that interest rate and income are the most significant variables on house prices in Oslo and Akershus. Important findings are that in the East of Oslo, income, interest rate and GDP are the dominant variables, while in West of Oslo and Asker and Bærum, net wealth is significant. On the other hand, unemployment is not significant in any areas, except Follo and Southern Romerike. As earlier stated, Oslo and Akershus are the areas with the highest credit creation in Norway. This reflects that these areas in general have good access to find suitable jobs, and thus changes in unemployment are not essential for how house prices evolve over time. In this paper we have focused on the financial aspect of the marked. Since R^2 generally appears to be relatively low in our test, between 15 to 49 percent, it is important to keep in mind that there are as well other factors that explain changes in house prices. Increased immigration, in combination with less building of new houses, has the recent decade resulted in increased demand for houses. In addition do old people live longer in their owner-occupied home and the numbers of persons per households have decreased during recent decade. These numerous signals reduce the chance of capturing all variability in the dataset in one regression model. This supports that the low values of R^2 are not necessarily insufficient.

In order to validate the model, a cross-validation test was conducted. We divided the dataset into two subgroups to estimate how accurately the predictive model performs compared to the full model (appendix 17). This means that if the results in the subgroup are equal to the results in the full model, we have a reliable dataset. We observed for Oslo that income, unemployment, GDP and interest rate gave almost the same results in both the subgroups and in the full model. However, for net wealth we observed some differences in the East neighbourhoods; the results in the first subgroup were not equal to the results from the full model. For Akershus, we observed that income, unemployment and interest rate gave almost equal results in both the subgroups and in the full model. However, we found some differences in GDP and net wealth. For Northern and Southern Romerike, the results from GDP in the second subgroup were not equal with the results from the full model. These regions also differed in net wealth, where they were not equal in the first subgroup compared to the full model. Further, unemployment in the second subgroup in Follo was not equal with the results from the full model. This means that unemployment was not significant in the OLS regression for the second period.

It is important to keep in mind that the first subgroup in the cross-validation test represents a rising period, while the second subgroup represents meltdown and aftermath of the crisis. It should therefore be reason to defend why we found some differences in the results for the subgroups compared to the full model. In addition, the short time period might not give appropriate results. But since most of the results are equal, it might indicate that we have a reliable dataset.

At last, we ran the slope coefficient test to investigate possible significant differences between slope coefficients in two independent areas (appendix 18). We tested the hypothesis: *There is no significant difference between how house prices will be affected in the Akershus regions and East and West of Oslo.*

Table 5.3 summarizes the results from the slope coefficient test.

	Alna	Bjerke	Grorud	Stovner	Frogner	Northern Aker	Ullern	Western Aker	Asker	Bærum	Follo	Northern Romerike	Southern Romerike
Alna					Income Interest Rate	Income Interest Rate	Income	Income Net Wealth Interest Rate	Income Interest Rate	Income Interest Rate	Income Interest Rate		Income Interest Rate
Bjerke					Income	Income Interest Rate	Income	Income Net Wealth	Income Interest Rate	Income Net Wealth Interest Rate	Income Interest Rate		Income Interest Rate
Grorud					Income		Income	Income Net Wealth	Income Interest Rate	Income Net Wealth Interest Rate	Income Interest Rate		Income Interest Rate
Stovner					Income			Income	Income	Income			
Frogner	Income Interest Rate	Income	Income	Income		Income	Income Interest Rate	Income Net Wealth			Unem-ployment		Unem-ployment
Northern Aker	Income Interest Rate	Income Interest Rate			Income		Interest Rate				Interest Rate		Interest Rate
Ullern	Income	Income	Income		Income Interest Rate	Interest Rate		Net Wealth Interest Rate	Interest Rate	Interest Rate			
Western Aker	Income Net Wealth Interest Rate	Income Net Wealth	Income Net Wealth	Income	Income Net Wealth		Net Wealth Interest Rate				Unem-ployment		Unem-ployment
Asker	Income Interest Rate	Income Interest Rate	Income Interest Rate	Income			Interest Rate						
Bærum	Income Interest Rate	Income Net Wealth Interest Rate	Income Net Wealth Interest Rate	Income			Interest Rate						
Follo	Income Interest Rate	Income Interest Rate	Income Interest Rate			Unem-ployment	Interest Rate	Unem-ployment					
Northern Romerike	Income Interest Rate	Income Interest Rate	Income Interest Rate				Unem-ployment						
Southern Romerike	Income Interest Rate	Income Interest Rate	Income Interest Rate				Interest Rate	Unem-ployment					

Table 5.3: Summarized results from the slope coefficient test. The table presents slope coefficients that are significant between two areas. The white empty areas indicate that the slope coefficients of the variables between two areas are not significant.

In table 5.3 we observed that the slope coefficients between the neighbourhoods in East of Oslo are not significant at the five percent level. We can therefore not reject the null hypothesis of equality between the slope coefficients in the East of Oslo. This is in line with what we observe from the regression analysis in table

5.2, where all house prices in East of Oslo are significantly affected by income, interest rate and GDP and not significantly affected by net wealth and unemployment. We can therefore indicate that house prices in East of Oslo are equally affected by changes in the financial variables.

Between the neighbourhoods in West of Oslo, we observe that the slopes on income, net wealth and interest rate are significant among certain neighbourhoods. We can therefore reject the null hypothesis of equality between these slope coefficients and indicate that there are differences between the slope coefficients on income, net wealth and interest rate. In addition, we observe from the regression analysis in table 5.2, that house prices in West of Oslo are significantly affected by income, net wealth and interest rate. In accordance with the slope coefficient test, we can therefore say that house prices in West of Oslo are differently affected by interest rate, net wealth and interest rate. On the other hand, neither the slope coefficients on unemployment nor GDP are significant in slope coefficient test, which means that we cannot reject the null hypothesis of equality between the slope coefficients. The regression analysis in table 5.2, in addition, finds that the house prices in West of Oslo are not significantly affected by unemployment or GDP.

When we compare the slope coefficients between the neighbourhoods in East and West of Oslo, we experienced that the slopes on income, interest rate and net wealth are significant. We can therefore reject the null hypothesis of equality and indicate that the slope coefficients on income, interest rate and net wealth are significantly different between the certain areas. The slope coefficients on income are significantly different in most of the neighbourhoods in East and West. This can be explained by the varying income levels that are present in the neighbourhoods. The slopes coefficient on net wealth are significant different between Western Aker and three of the East neighbourhoods. Net wealth level in Western Aker is one of the highest in Norway compared to the lower wealth levels in the East neighbourhoods. It should therefore be reason to think that the house prices in Western Aker is more likely to be affected by net wealth than house prices in the East Neighbourhoods. Further, we observe that we cannot reject the slope coefficients on GDP and unemployment between the East and the

West of Oslo. This might indicate that East and West respond equal to GDP and unemployment, since for instance GDP is affecting the whole country's economy.

For the regions in Akershus, we find that none variables are significant at the five percent level. We can therefore not reject the null hypothesis of equality between the slope coefficients for the regions in Akershus. This was rather surprising, and not in accordance with our expectations, since we expected that house prices in the West regions and the East and South Regions should respond differently to the financial variables.

At last, we compared the slopes coefficients between the neighbourhoods in Oslo and the regions in Akershus. Between the East of Oslo and the East of Akershus, we observed that the slope coefficients on interest rate and income are the most consistently significant coefficients. We can therefore reject the null hypothesis of equality and indicate that the slope coefficients on interest rate and income are significantly different between the East of Oslo and the East of Akershus. Before we ran the slope coefficient test, we expected that these areas should respond similar to the same variables. Nevertheless, we see from the slope coefficient test that unemployment, GDP and net wealth are not significant, thus we cannot reject the null hypothesis of equality. When we compared the West of Oslo with all regions in Akershus, we experienced that only unemployment and interest rate were significant, and the null hypothesis could be rejected.

To sum up, in general we see that the slope coefficients on income and interest rate are significant between the areas; we therefore reject the null hypothesis of equality between the slope coefficients in Oslo and Akershus. This indicates that the slope coefficients on interest rate and income are significantly different in the neighbourhoods of Oslo and in the regions in Akershus. From the regression analysis in table 5.2 we know that income and interest rate are the financial variables that have the most significant impact on house prices in Oslo and Akershus, even though house price level differs. This is in accordance with our expectations and previous articles, which state that historically low interest rate in combination with rapid increases in income level has increased households liquidity (Norges Bank 2011). Based on the slope coefficient test in 5.3, changes in interest rate and income will thus have different effect on house prices in the

areas in Oslo and Akershus. This is in accordance with what we expected. Interest rate setting is affecting households' access to credit, and for credit-constrained borrowers a change in the interest rate will affect households different in according to their wealth and debt level. Increased income level for Norway during the last decade has increased the value of economic buffers for households. It is also worth mention that households' expectations about the interest rate are an important factor for their behaviour in the housing market. If households expect future low and stable interest rate, in combination with future increases in income, it will generate optimistic expectations about future economic development. The demand for houses might also increase due to the optimistic expectations of rising house prices (Hegnar 2012). There might be other non-financial variables that are essential for the rapid price increase in these areas. Increased immigration in and around Oslo has led to increased demand for houses. Since the building of new houses has not increased in the same proportion, demand and supply frictions have occurred. This further leads to increases in house prices.

5.2 Research Question 2

In this part we will present the results from the Granger causality test in research question 2:

Research Question 2: Do house prices in Oslo and Akershus cause households' consumption?

Earlier research by Case et.al (2011), Paiella (2009) and Oikarinen and Kahra (2002) made us have certain expectations about the relationship between house prices and consumption. Our expectations were that households' consumption increase due to an increase in house prices. As earlier described in part 3.2.6, this can be explained by the direct and indirect effects concerning house prices' effect on consumption. First of all, increases in income leads to positive expectations about future liquidity, and give a positive effect on consumption for households. Second, housing wealth is a substantial part of households' total wealth. Increases in house prices give a positive effect on total wealth for households in addition to a positive credit channel effect (Maclennan et.al 2000). With increased wealth and

reduced credit constraints, households consequently increase their consumption. Our expectations are shown in table 5.5 below.

Expectations
Consumption is a cause of house prices
House prices are not a cause of consumption

Table 5.5 Expectations of the relationship between house prices and consumption

We expected consumption to be caused by changes in house prices since consumption is closely connected to households' income and wealth (Case et.al 2011). We tested the following hypothesis: *House prices do not cause consumption*. We also tested the opposite situation that consumption is not a significant driver on house prices although this is not likely to occur.

Table 5.4 summarizes the results from the Granger Causality test with two lags (see appendix 19 and 20 for four and six lags).

2 lags	House Prices do not Granger cause Consumption		Consumption does not Granger cause House Prices	
	F-statistic	P-value	F-statistic	P-value
Alna	8.13295	0.0016*	0.41571	0.6637
Bjerke	5.14795	0.0122*	0.28596	0.7534
Grorud	8.54048	0.0012*	0.32414	0.7131
Stovner	8.64421	0.0011*	0.19072	0.8274
Frogner	0.64715	0.5309	0.35573	0.7037
Northern Aker	1.91189	0.1660	0.07313	0.9297
Ullern	0.04844	0.9528	0.11478	0.8920
Western Aker	0.04935	0.9519	1.04579	0.3643
Asker	6.98958	0.0033*	0.71643	0.4969
Bærum	3.06636	0.0619	0.17727	0.8385
Follo	5.62948	0.0086*	0.23077	0.7954
Northern Romerike	9.74051	0.0006*	0.38942	0.6809
Southern Romerike	13.1103	0.00009*	0.20858	0.8129

Table 5.4 Results from the Granger Causality test. * indicates significance at the five percent level

We can see from table 5.4 that eight out of thirteen areas are significant at the five percent level when testing the null hypothesis *"House prices do not Granger cause consumption"*. The only insignificant areas are the neighbourhoods in the West of Oslo; Frogner, Northern Aker, Ullern and Western Aker, and Bærum in Akershus. We also found insignificant results in four and six lags in these neighbourhoods. This is not in accordance with our assumptions, since we expected that house prices in wealthy areas should to some extent be affected by changes in house prices. The F-statistics are in addition very low and strengthens the statement that changes in house prices do not affect households' consumption up to six months after the house price change has occurred. We can thus not reject the null hypothesis that house prices do not "Granger cause" consumption in Bærum and the West of Oslo. As we know, wealth and income levels in these neighbourhoods are among the highest in Norway. Households are therefore not so sensitive to changes in house prices. This might explain why consumption is not affected by changes in house prices.

In the neighbourhoods in the East of Oslo and Asker, Follo, Northern Romerike and Southern Romerike, we experience low p-values in addition to high F-statistics when testing the null hypothesis *"House prices do not Granger-cause consumption"* in table 5.4. They are in addition significant on four and six lags, which indicate up to six months significance after the house price change. Increases in house prices raises the activity in the market and lead to increases in wealth since the collateral value of houses has increased. As a consequence, households' credits increase (Bernanke and Blinder 1988, Bernanke and Gertler 1989, Case et al. 2005). Households allocate wealth to smooth consumption over time, thus current consumption is a result of past changes in the house prices. We can therefore reject the null hypothesis and draw the conclusion that households' current consumption in Asker, Follo, Northern Romerike, Southern Romerike and neighbourhoods in the East of Oslo are caused by house price changes that appeared up to six months ago.

We also tested the opposite situation, with the null hypothesis that *"Consumption does not Granger-cause house prices"*. Our expectations were that this is not true since consumption is supposed to be the result of households' income and wealth-being, and not the opposite direction. As we can see from the test results in table

5.4, none of the neighbourhoods are significant on neither two, four or six lags. The F-statistics are in addition very low. We can therefore not reject the null hypothesis that consumption does not cause changes in house prices.

It may also be important to remember that the time series for this test is only three years, since we only had available data for this time period. Our results might therefore not be optimal. But since the test results are in accordance with earlier research (Case et.al 2011, Paiella 2009 and Oikarinen and Kahra 2002) as well as our expectations, it indicates that the results can be reliable.

6. Conclusion

We have now discussed the results from our analysis. In this section we will present some concluding remarks, as well as give suggestions for further research.

6.1 Conclusion

This paper investigates how financial variables affect house prices in neighbourhoods in Oslo and regions in Akershus. Since approximately 80 percent of the Norwegian population own their home, it indicates that the housing market is important for Norway's economy. Previous research by Bjørnland and Jacobsen (2010) has shown that house prices are interdependent of interest rate, inflation and GDP. Thus these variables are important factors for how the house prices develop over time. Changes in the housing market are also important for monetary policy setting to maintain a stable economy. In order to investigate how different areas in Oslo and Akershus respond to interest rate, income, GDP, unemployment and net wealth, we looked at house prices in Oslo from 2005 to 2010 and Akershus from 2002 to 2010.

The main result of this paper is that there exist both differences and similarities between how house prices in Oslo and Akershus respond to financial variables. We experience that house prices in West of Oslo and Bærum in Akershus respond mostly to the same variables income, interest rate and net wealth. This is much in accordance with what we expected and in line with earlier research and publications. House prices in these areas are the highest in Norway, in addition that these areas are the wealthiest areas in Norway (NEF). Income levels are also

highly above average level for Norway. This tells us that high income and wealth levels are the most important factors for house prices in the West.

House prices in the East of Oslo, on the other hand, are mostly affected by interest rate, GDP and income. Income and interest rate were also significant in Northern Romerike and Southern Romerike, in addition to net wealth. This indicates that we might see some of the same patterns in the neighbourhoods in the East of Oslo and in East Akershus. Follo, that represent the southern part of Akershus, are affected by GDP and unemployment. Few studies have been conducted on this topic earlier, but the results are much in line with earlier research by Røed Larsen and Sommervoll (2004), Røed Larsen and Weum (2008), as well as Bjørnland (2010) and earlier publications on the development in prices.

The results from the slope coefficient test showed that the slope coefficients of income and interest rate were mostly significant when we compared all the areas in Oslo and Akershus. We therefore rejected the null hypothesis of equality between the slope coefficients, and indicate that the slope coefficients on interest rate and income significantly are different from each other. This means that the variables are differently affecting house prices in Oslo and Akershus. On the other hand, we observe that unemployment and GDP are consistently not significant when we compared the East and West areas. This means that we cannot reject the null hypothesis of equality between the slopes. Thus, house prices in Oslo and Akershus might respond similar to changes in unemployment and GDP. We observed, in addition, that net wealth was significant different in few areas within the West area in Oslo and Akershus.

In the second research question we investigated the relationship between housing wealth and consumption. Previous research by Case et al. (2011), show that changes in housing wealth affects households' consumption. Since housing wealth is the result of households' assets, the value of their housing assets explain how their housing wealth develops over time.

The main results are that house prices are a significant driver on consumption, thus we can reject the null hypothesis that house prices do not affect consumption in all areas in Oslo, except West of Oslo, and in all areas in Akershus, except

Bærum. This indicates that house prices in these areas cause households' consumption. This is much in line with the contents of the results by Case et al. (2011) that there is a significant relationship between housing wealth and consumption. Households allocate wealth to smooth consumption over time, thus current consumption is a result of past changes in the house prices. We can draw the conclusion that households' current consumption in Asker, Follo, Northern Romerike, Southern Romerike and neighbourhoods in the East of Oslo are caused by house price changes that appeared up to six months ago. In the opposite direction, we could not reject the null hypothesis that consumption does not cause house prices.

From the results, we can conclude that house prices in regions in Akershus and neighbourhoods in East and West of Oslo responds differently to the variables income and interest rate and to some extent net wealth. However, the areas respond in general similarly to the variables such as unemployment and GDP. For the variables income and interest rate, we can therefore reject the H_1 hypothesis and conclude that there is a significant difference between how house prices are affected in the Akershus regions and in East and West of Oslo. For the variables unemployment and GDP, we cannot reject the H_1 hypothesis, that there is no significant difference between how house prices are affected in the the Akershus regions and in East and West of Oslo. We also make the conclusions that house prices in Oslo and Akershus drives households' consumption, thus we can reject the H_2 hypothesis and conclude that house prices in Oslo and Akershus cause consumption.

6.2 Suggestion for further research

We find it particularly interesting for future research to study how house prices in Norway develops and investigate whether it possibly can be a housing market bubble in the near future. The Norwegian housing market is in a distinctive position and did only experience a small depression during the last financial crisis. Today's house prices are rapid increasing and the house price level is higher than for many years. But households' debt levels do increase rapid as well, and the American professor Robert Shiller argues that Norway is approaching a housing bubble in an interview with Aftenposten (Jan. 2012). By looking at earlier data on house prices for Norway, it can be possible to make further estimates on how

house prices will develop and if the increasing house price level should be a warning for a forthcoming bubble.

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8. Appendix

Appendix 1: Heteroskedasticity Test: White

Alna			
F-statistic	0.939035	Prob. F(20,49)	0.5449
Obs*R-squared	19.39562	Prob. Chi-Square (20)	0.4963
Scaled explained SS	26.44812	Prob. Chi-Square (20)	0.1515

Bjerke			
F-statistic	0.806590	Prob. F(20,49)	0.6938
Obs*R-squared	17.33755	Prob. Chi-Square (20)	0.6310
Scaled explained SS	23.43923	Prob. Chi-Square (20)	0.2677

Grorud			
F-statistic	0.768215	Prob. F(20,49)	0.7360
Obs*R-squared	16.70958	Prob. Chi-Square (20)	0.6717
Scaled explained SS	22.60573	Prob. Chi-Square (20)	0.3086

Stovner			
F-statistic	1.000991	Prob. F(20,49)	0.4779
Obs*R-squared	20.30413	Prob. Chi-Square (20)	0.4391
Scaled explained SS	24.82085	Prob. Chi-Square (20)	0.2084

Frogner			
F-statistic	0.546275	Prob. F(20,49)	0.9296
Obs*R-squared	12.76226	Prob. Chi-Square (20)	0.8873
Scaled explained SS	16.58711	Prob. Chi-Square (20)	0.6796

Northern Aker			
F-statistic	0.476897	Prob. F(20,49)	0.9636
Obs*R-squared	11.40553	Prob. Chi-Square (20)	0.9350
Scaled explained SS	15.42623	Prob. Chi-Square (20)	0.7515

Ullern			
F-statistic	1.453903	Prob. F(20,49)	0.1432
Obs*R-squared	26.06960	Prob. Chi-Square (20)	0.1635
Scaled explained SS	36.00007	Prob. Chi-Square (20)	0.0554

Western Aker			
F-statistic	2.182847	Prob. F(20,49)	0.0136
Obs*R-squared	32.98173	Prob. Chi-Square (20)	0.0339
Scaled explained SS	39.63473	Prob. Chi-Square (20)	0.0056

Asker			
F-statistic	1.313851	Prob. F(20,86)	0.1928
Obs*R-squared	25.04200	Prob. Chi-Square (20)	0.1998
Scaled explained SS	32.94354	Prob. Chi-Square (20)	0.0542

Bærum			
F-statistic	1.378380	Prob. F(20,86)	0.1559
Obs*R-squared	25.97337	Prob. Chi-Square (20)	0.1667
Scaled explained SS	33.65845	Prob. Chi-Square (20)	0.0585

Follo			
F-statistic	1.469589	Prob. F(20,86)	0.1139
Obs*R-squared	27.25429	Prob. Chi-Square (20)	0.1283
Scaled explained SS	36.20918	Prob. Chi-Square (20)	0.0608

Northern Romerike			
F-statistic	3.099663	Prob. F(20,86)	0.0001
Obs*R-squared	44.82150	Prob. Chi-Square (20)	0.0012
Scaled explained SS	50.60416	Prob. Chi-Square (20)	0.0002

Southern Romerike			
F-statistic	2.835254	Prob. F(20,86)	0.0004
Obs*R-squared	42.51736	Prob. Chi-Square (20)	0.0024
Scaled explained SS	47.48011	Prob. Chi-Square (20)	0.0005

Appendix 2: Breusch-Godfrey Serial Correlation LM Test

Alna			
F-statistic	1.523292	Prob. F(12,52)	0.1458
Obs*R-squared	18.20681	Prob. Chi-Square (12)	0.1096

Bjerke			
F-statistic	1.243024	Prob. F(12,52)	0.2806
Obs*R-squared	15.60368	Prob. Chi-Square (12)	0.2101

Grorud			
F-statistic	1.373479	Prob. F(12,52)	0.2086
Obs*R-squared	16.84715	Prob. Chi-Square (12)	0.1554

Stovner			
F-statistic	1.578640	Prob. F(12,52)	0.1272
Obs*R-squared	18.69170	Prob. Chi-Square (12)	0.0962

Frogner			
F-statistic	1.262995	Prob. F(12,52)	0.2684
Obs*R-squared	15.79779	Prob. Chi-Square (12)	0.2007

Northern Aker			
F-statistic	1.767541	Prob. F(12,52)	0.0790
Obs*R-squared	20.28035	Prob. Chi-Square (12)	0.0620

Ullern			
F-statistic	0.823361	Prob. F(12,52)	0.6260
Obs*R-squared	11.17679	Prob. Chi-Square (12)	0.5138

Western Aker			
F-statistic	1.046213	Prob. F(12,52)	0.4230
Obs*R-squared	13.61359	Prob. Chi-Square (12)	0.3261

Asker			
F-statistic	0.585521	Prob. F(12,89)	0.8485
Obs*R-squared	7.829200	Prob. Chi-Square (12)	0.7983

Bærum			
F-statistic	1.204969	Prob. F(12,89)	0.2923
Obs*R-squared	14.95443	Prob. Chi-Square(12)	0.2439

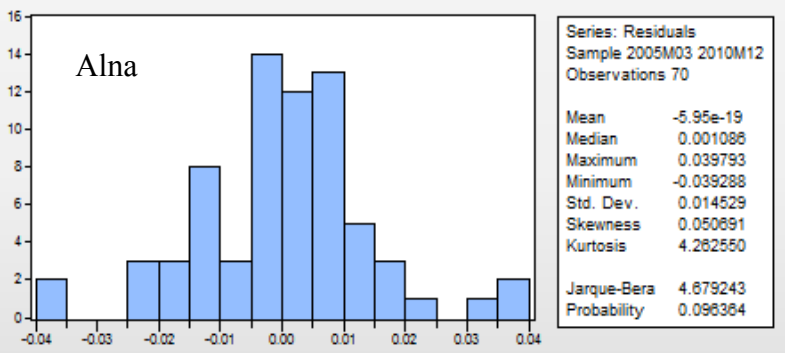
Follo			
F-statistic	1.154236	Prob. F(12,89)	0.3284
Obs*R-squared	14.40959	Prob. Chi-Square(12)	0.2753

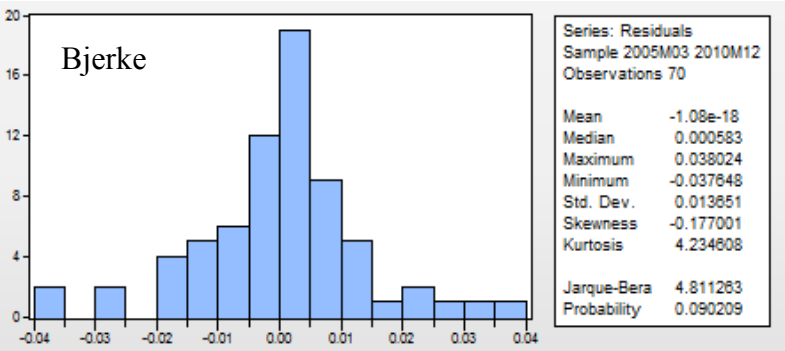
Northern Romerike			
F-statistic	0.657073	Prob. F(12,89)	0.7874
Obs*R-squared	8.708083	Prob. Chi-Square(12)	0.7276

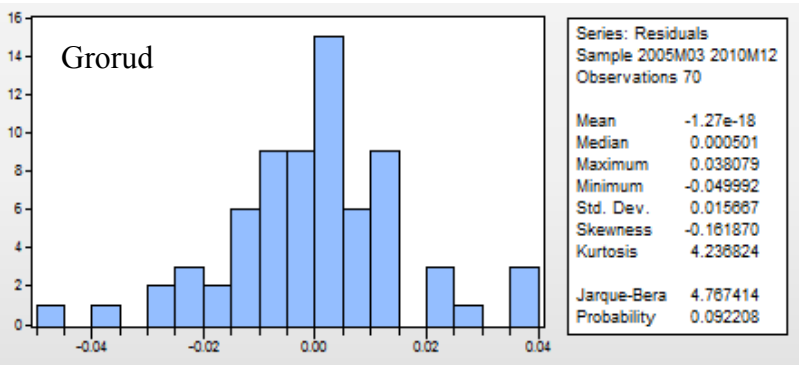
Southern Romerike			
F-statistic	0.778874	Prob. F(12,89)	0.6705
Obs*R-squared	10.16889	Prob. Chi-Square(12)	0.6011

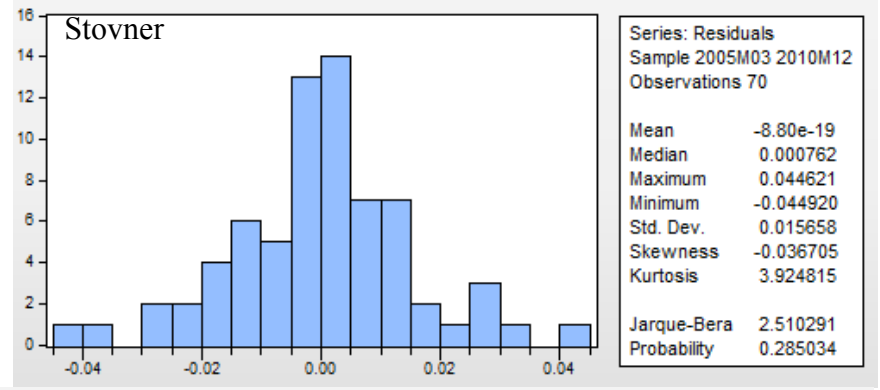
Grorud

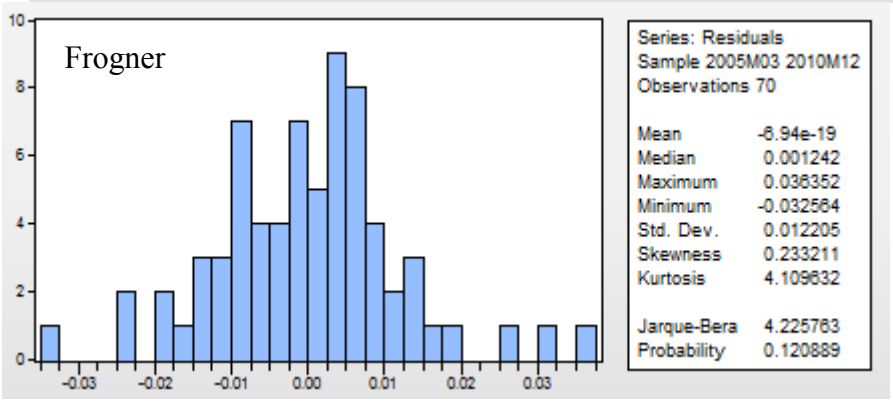
Appendix 3: Test for Normality

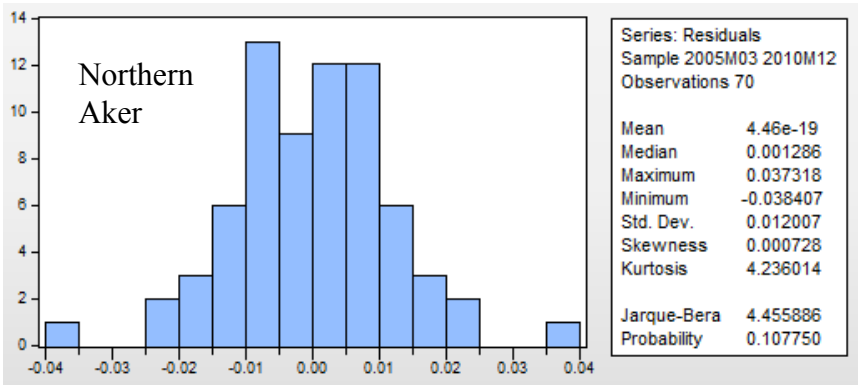


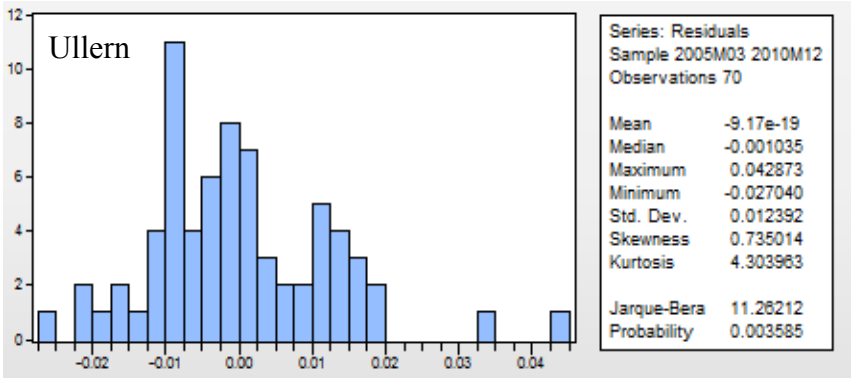


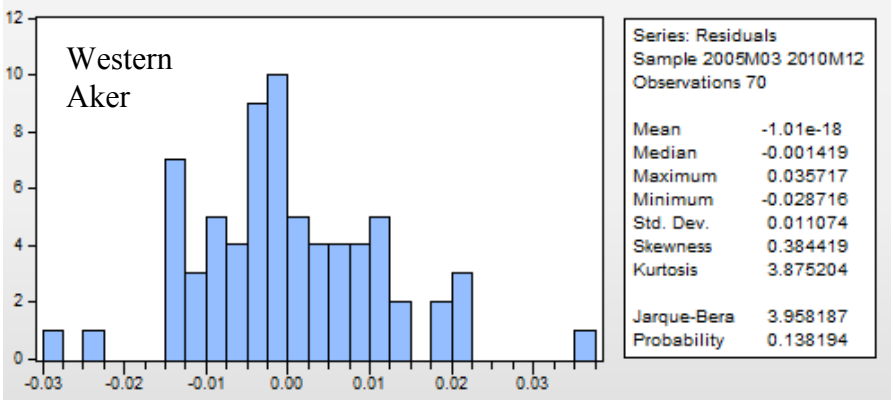


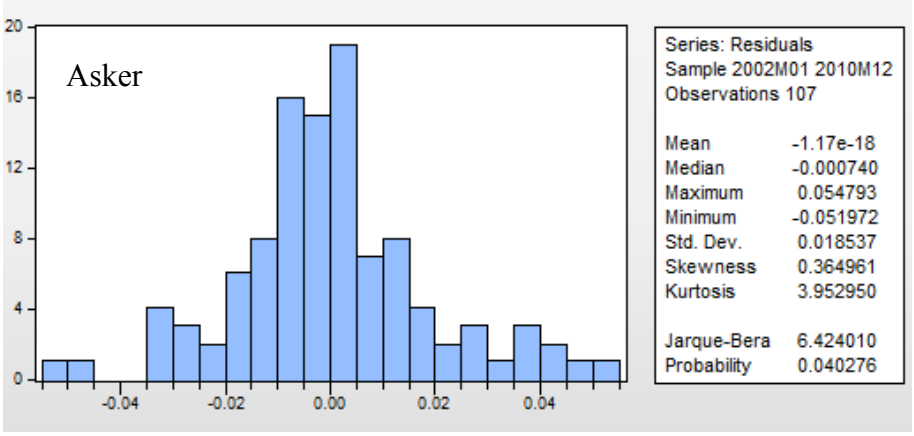

Stovner
Series: Residuals
Sample 2005M03 2010M12
Observations 70
Mean -8.80e-19
Median 0.000762
Maximum 0.044621
Minimum -0.044920
Std. Dev. 0.015658
Skewness -0.036705
Kurtosis 3.924815
Jarque-Bera 2.510291
Probability 0.285034


Frogner
Series: Residuals
Sample 2005M03 2010M12
Observations 70
Mean -6.94e-19
Median 0.001242
Maximum 0.036352
Minimum -0.032564
Std. Dev. 0.012205
Skewness 0.233211
Kurtosis 4.109632
Jarque-Bera 4.225763
Probability 0.120889


Northern
Aker
Series: Residuals
Sample 2005M03 2010M12
Observations 70
Mean 4.46e-19
Median 0.001286
Maximum 0.037318
Minimum -0.038407
Std. Dev. 0.012007
Skewness 0.000728
Kurtosis 4.236014
Jarque-Bera 4.455886
Probability 0.107750


Ullern
Series: Residuals
Sample 2005M03 2010M12
Observations 70
Mean -9.17e-19
Median -0.001035
Maximum 0.042873
Minimum -0.027040
Std. Dev. 0.012392
Skewness 0.735014
Kurtosis 4.303963
Jarque-Bera 11.26212
Probability 0.003585


Western
Aker
Series: Residuals
Sample 2005M03 2010M12
Observations 70
Mean -1.01e-18
Median -0.001419
Maximum 0.035717
Minimum -0.028716
Std. Dev. 0.011074
Skewness 0.384419
Kurtosis 3.875204
Jarque-Bera 3.958187
Probability 0.138194


Asker
Series: Residuals
Sample 2002M01 2010M12
Observations 107
Mean -1.17e-18
Median -0.000740
Maximum 0.054793
Minimum -0.051972
Std. Dev. 0.018537
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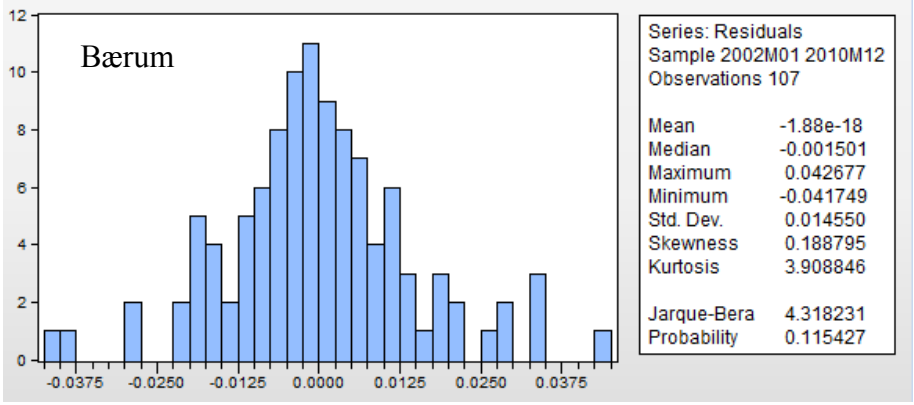
Kurtosis 3.952950
Jarque-Bera 6.424010
Probability 0.040276


Bærum
Series: Residuals
Sample 2002M01 2010M12
Observations 107
Mean -1.88e-18
Median -0.001501
Maximum 0.042677
Minimum -0.041749
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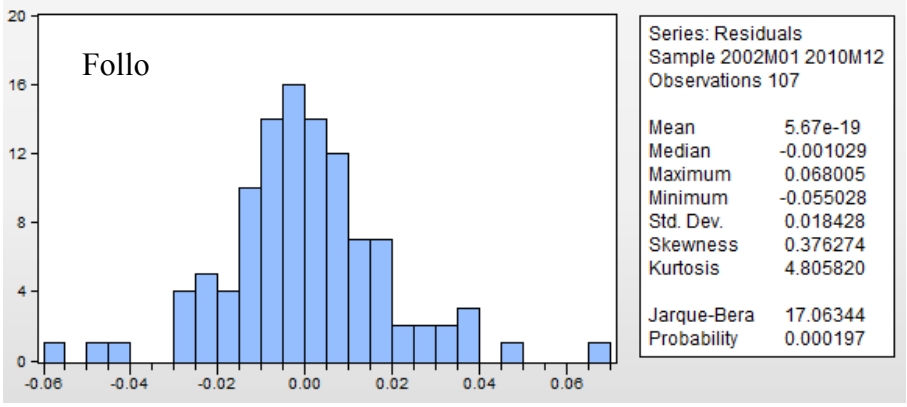
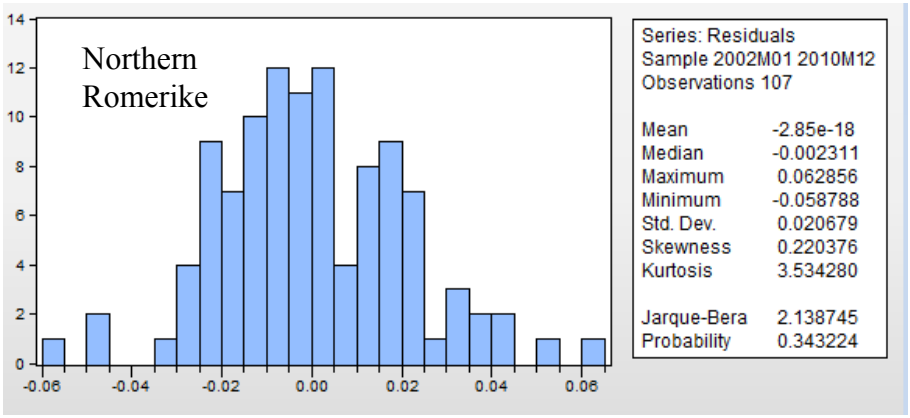
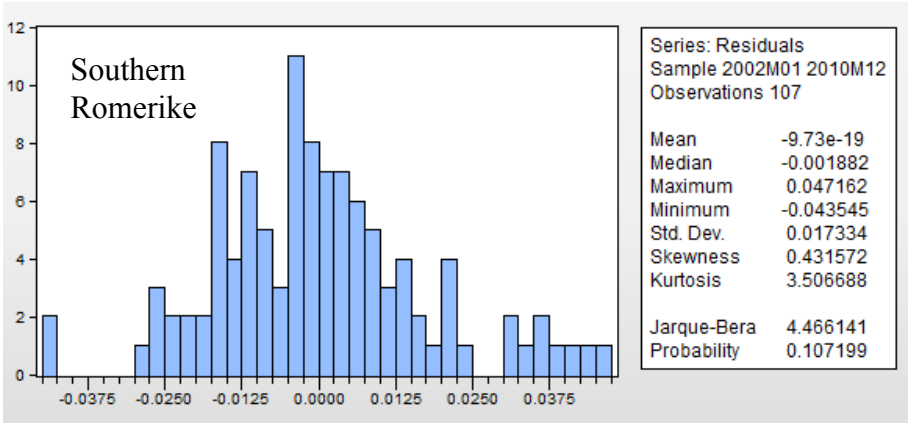
Kurtosis 3.908846
Jarque-Bera 4.318231
Probability 0.115427


Follo
Series: Residuals
Sample 2002M01 2010M12
Observations 107
Mean 5.67e-19
Median -0.001029
Maximum 0.068005
Minimum -0.055028
Std. Dev. 0.018428
Skewness 0.376274
Kurtosis 4.805820
Jarque-Bera 17.06344
Probability 0.000197





Appendix 4: OLS regression with Alna as dependent variable

Dependent variable: Percentage change in real house prices in Alna				
Method: Least Squares				
Sample (adjusted): 2005M03 2010M12				
Included observations: 70 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.005036	0.003438	1.464816	0.1479
% change in real income in Alna	1.974875	0.478440	4.127735	0.0001
% change in real net wealth in Alna	0.353540	0.285948	1.236378	0.2208
% change in unemployment in Alna	-0.001776	0.031402	-0.056568	0.9551
% change in real GDP	-0.313716	0.109816	-2.856746	0.0058
Real interest rate	-0.004970	0.001372	-3.621646	0.0006
R-squared	0.455065	Adjusted R-squared		0.412492

Appendix 5: OLS regression with Bjerke as dependent variable

Dependent variable: Percentage change in real house prices in Bjerke				
Method: Least Squares				
Sample (adjusted): 2005M03 2010M12				
Included observations: 70 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.005460	0.003355	1.627742	0.1085
% change in real income in Bjerke	1.841130	0.441579	4.169427	0.0001
% change in real net wealth in Bjerke	0.233714	0.249404	0.937093	0.3522
% change in unemployment in Bjerke	0.014283	0.030125	0.474126	0.6370
% change in real GDP	-0.278923	0.108042	-2.581603	0.0121
Real interest rate	-0.004696	0.001344	-3.493778	0.0009
R-squared	0.451038	Adjusted R-squared		0.408151

Appendix 6: OLS regression with Grorud as dependent variable

Dependent variable: Percentage change in real house prices in Grorud				
Method: Least Squares				
Sample (adjusted): 2005M03 2010M12				
Included observations: 70 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.005915	0.004049	1.460799	0.1490
% change in real income in Grorud	1.894241	0.532002	3.560589	0.0007
% change in real net wealth in Grorud	0.222067	0.346484	0.640916	0.5239
% change in unemployment in Grorud	0.016304	0.031323	0.520488	0.6045
% change in real GDP	-0.294248	0.123089	-2.390529	0.0198
Real interest rate	-0.004847	0.001524	-3.181396	0.0023
R-squared	0.403389	Adjusted R-squared		0.356779

Appendix 7: OLS regression with Stovner as dependent variable

Dependent variable: Percentage change in real house prices in Stovner				
Method: Least Squares				
Sample (adjusted): 2005M03 2010M12				
Included observations: 70 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.001189	0.004413	0.269398	0.7885
% change in real income in Stovner	1.436370	0.562793	2.552219	0.0131
% change in real net wealth in Stovner	0.744545	0.401597	1.853960	0.0684
% change in unemployment in Stovner	-0.000893	0.037235	-0.023983	0.9809
% change in real GDP	-0.323124	0.125812	-2.568317	0.0126
Real interest rate	-0.003813	0.001537	-2.480658	0.0158
R-squared	0.400222	Adjusted R-squared		0.353364

Appendix 8: OLS regression with Frogner as dependent variable

Dependent variable: Percentage change in real house prices in Frogner				
Method: Least Squares				
Sample (adjusted): 2005M03 2010M12				
Included observations: 70 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.000455	0.002497	-0.182260	0.8560
% change in real income in Frogner	-0.094002	0.115788	-0.811847	0.4199
% change in real net wealth in Frogner	0.628162	0.173858	3.613073	0.0006
% change in unemployment in Frogner	0.012546	0.021574	0.581558	0.5629
% change in real GDP	-0.098326	0.093252	-1.054411	0.2957
Real interest rate	-0.001586	0.000980	-1.618392	0.1105
R-squared	0.215042	Adjusted R-squared		0.153717

Appendix 9: OLS regression with Northern Aker as dependent variable

Dependent variable: Percentage change in real house prices in Northern Aker				
Method: Least Squares				
Sample (adjusted): 2005M03 2010M12				
Included observations: 70 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.001715	0.003322	-0.516284	0.6074
% change in real income in Northern Aker	0.705531	0.318643	2.214178	0.0304
% change in real net wealth in Northern Aker	0.664308	0.222477	2.985962	0.0040
% change in unemployment in Northern Aker	-0.011760	0.018032	-0.652145	0.5166
% change in real GDP	-0.168003	0.094670	-1.774626	0.0807
Real interest rate	-0.001060	0.001215	-0.872157	0.3864
R-squared	0.326784	Adjusted R-squared		0.274189

Appendix 10: OLS regression with Ullern as dependent variable

Dependent variable: Percentage change in real house prices in Ullern				
Method: Least Squares				
Sample (adjusted): 2005M03 2010M12				
Included observations: 70 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.005788	0.002366	2.445934	0.0172
% change in real income in Ullern	0.490563	0.152416	3.218577	0.0020
% change in real net wealth in Ullern	0.635800	0.124690	5.099046	0.0000
% change in unemployment in Ullern	0.006918	0.020384	0.339389	0.7354
% change in real GDP	-0.151562	0.092146	-1.644809	0.1049
Real interest rate	-0.005003	0.001182	-4.232822	0.0001
R-squared	0.362649	Adjusted R-squared		0.312856

Appendix 11: OLS regression with Western Aker as dependent variable

Dependent variable: Percentage change in real house prices in Western Aker				
Method: Least Squares				
Sample (adjusted): 2005M03 2010M12				
Included observations: 70 after adjustments				
HAC standard errors & covariance (Bartlett Kernel, Newey-West fixed bandwidth = 4.0000)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.002263	0.001917	-1.80340	0.2422
% change in real income in Western Aker	0.211505	0.072610	2.912878	0.0049
% change in real net wealth in Western Aker	1.222033	0.203404	6.007905	0.0000
% change in unemployment in Western Aker	-0.015010	0.017205	-0.872420	0.3862
% change in real GDP	-0.069301	0.075101	-0.922760	0.3596
Real interest rate	-0.001770	0.000660	-2.679727	0.0094
R-squared	0.487027	Adjusted R-squared		0.446951

Appendix 12: OLS regression with Asker as dependent variable

Dependent variable: Percentage change in real house prices in Asker				
Method: Least Squares				
Sample (adjusted): 2002M01 2010M12				
Included observations: 107 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.000628	0.003846	-0.163389	0.8705
% change in real income in Asker	0.174578	0.263889	0.661558	0.5098
% change in real net wealth in Asker	1.065403	0.339797	3.135412	0.0022
% change in unemployment in Asker	0.004856	0.017459	0.278144	0.7815
% change in real GDP	-0.236900	0.116732	-2.029444	0.0450
Real interest rate	-0.000538	0.001177	-0.456834	0.6488
R-squared	0.151381	Adjusted R-squared		0.109370

Appendix 13: OLS regression with Bærum as dependent variable

Dependent variable: Percentage change in real house prices in Bærum				
Method: Least Squares				
Sample (adjusted): 2002M01 2010M12				
Included observations: 107 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.000543	0.002846	-0.190698	0.8491
% change in real income in Bærum	0.167807	0.268349	0.625329	0.5332
% change in real net wealth in Bærum	1.099544	0.253358	4.339891	0.0000
% change in unemployment in Bærum	0.018248	0.017449	1.045738	0.2982
% change in real GDP	-0.164327	0.093021	-1.766545	0.0803
Real interest rate	-0.001102	0.000923	-1.193806	0.2354
R-squared	0.277605	Adjusted R-squared		0.241843

Appendix 14: OLS regression with Follo as dependent variable

Dependent variable: Percentage change in real house prices in Follo				
Method: Least Squares				
Sample (adjusted): 2002M01 2010M12				
Included observations: 107 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.001727	0.003627	0.476039	0.6351
% change in real income in Follo	0.472824	0.442543	1.068427	0.2879
% change in real net wealth in Follo	0.757000	0.387246	1.954831	0.0534
% change in unemployment in Follo	0.052977	0.025274	2.096086	0.0386
% change in real GDP	-0.305742	0.117948	-2.592174	0.0110
Real interest rate	-0.000517	0.001170	-0.442052	0.6594
R-squared	0.211413	Adjusted R-squared		0.172374

Appendix 15: OLS regression with Northern Romerike as dependent variable

Dependent variable: Percentage change in real house prices in Northern Romerike				
Method: Least Squares				
Sample (adjusted): 2002M01 2010M12				
Included observations: 107 after adjustments				
HAC standard errors & covariance (Bartlett Kernel, Newey-West fixed bandwidth = 5.0000)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.004372	0.003755	1.164207	0.2471
% change in real income in Northern Romerike	0.832157	0.609114	1.366176	0.1749
% change in real net wealth in Northern Romerike	0.731836	0.471396	1.552487	0.1237
% change in unemployment in Northern Romerike	0.034307	0.022937	1.495714	0.1378
% change in real GDP	-0.265106	0.144993	-1.828402	0.0704
Real interest rate	-0.002862	0.001007	-2.842492	0.0054
R-squared	0.212513	Adjusted R-squared		0.173528

Appendix 16: OLS regression with Southern Romerike as dependent variable

Dependent variable: Percentage change in real house prices in Southern Romerike				
Method: Least Squares				
Sample (adjusted): 2002M01 2010M12				
Included observations: 107 after adjustments				
HAC standard errors & covariance (Bartlett Kernel, Newey-West fixed bandwidth = 5.0000)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.31E-07	0.004382	9.83E-05	0.9999
% change in real income in Southern Romerike	0.200065	0.556436	0.359547	0.7199
% change in real net wealth in Southern Romerike	1.116914	0.480970	2.322210	0.0222
% change in unemployment in Southern Romerike	0.069552	0.033411	2.081723	0.0399
% change in real GDP	-0.179621	0.089977	-1.996293	0.0486
Real interest rate	-0.000945	0.001083	-0.872219	0.3852
R-squared	0.254688	Adjusted R-squared		0.217791

Appendix 17: Results from Cross-validation test

	Income	Net Wealth	Unemployment	GDP	Interest Rate
Alna	Equal	Not Equal / Equal	Equal	Equal	Equal
Bjerke	Equal	Not Equal / Equal	Equal	Equal	Equal
Grorud	Equal	Not Equal / Equal	Equal	Not Equal	Equal
Stovner	Equal	Not Equal / Equal	Equal	Equal	Equal
Frogner	Not Equal	Equal	Equal	Equal	Not Equal
Northern Aker	Equal	Not Equal / Equal	Equal	Equal	Equal
Ullern	Equal	Equal	Equal	Equal	Equal
Western Aker	Equal	Equal	Equal	Equal	Not Equal
Asker	Equal	Equal / Not Equal	Equal	Equal	Equal
Bærum	Equal	Equal	Equal	Equal	Not Equal
Follo	Equal	Equal	Equal / Not Equal	Equal	Equal
Northern Romerike	Equal	Not Equal / Equal	Equal	Equal / Not Equal	Equal
Southern Romerike	Equal	Not Equal / Equal	Equal	Equal / Not Equal	Equal

"Equal" indicates that the results in the two subgroups give the same results as the results in the full model. "Not Equal" indicates that the results are different from the full model in both of the two subgroups. Not Equal/Equal or Equal/Not Equal indicates the results in the first subgroup compared to the full model and the results in the second subgroup compared to the full model.

Appendix 18: Results from the slope coefficients test

	Alna	Bjerke	Δ Alna Bjerke	T-stat	Conclusion
Income	1.974875 (0.478440)	1.841130 (0.441579)	0.133745 (0.651074)	0.205422	Cannot reject
Net Wealth	0.353540 (0.285948)	0.233714 (0.249404)	0.119826 (0.379432)	0.315804	Cannot reject
Unemployment	-0.001776 (0.031402)	0.014283 (0.030125)	0.016059 (0.369041)	0.369041	Cannot reject
GDP	-0.313716 (0.109816)	-0.278923 (0.108042)	-0.034793 (0.154054)	0.225849	Cannot reject
Interest Rate	-0.004970 (0.001372)	-0.004696 (0.001344)	-0.000274 (0.001921)	0.142663	Cannot reject

	Alna	Grorud	Δ Alna Grorud	T-stat	Conclusion
Income	1.974875 (0.478440)	1.894241 (0.532002)	0.080634 (0.715494)	0.112697	Cannot reject
Net Wealth	0.353540 (0.285948)	0.222067 (0.346484)	0.131473 (0.449241)	0.292656	Cannot reject
Unemployment	-0.001776 (0.031402)	0.016304 (0.031323)	-0.01808 (0.044353)	0.407636	Cannot reject
GDP	-0.313716 (0.109816)	-0.294248 (0.123089)	-0.019468 (0.164956)	0.118019	Cannot reject
Interest Rate	-0.004970 (0.001372)	-0.004847 (0.001524)	-0.000123 (0.002051)	0.059982	Cannot reject

	Alna	Stovner	Δ Alna Stovner	T-stat	Conclusion
Income	1.974875 (0.478440)	1.436370 (0.562793)	0.538505 (0.738675)	0.729015	Cannot reject
Net Wealth	0.353540 (0.285948)	0.744545 (0.401597)	-0.391005 (0.492997)	0.793118	Cannot reject
Unemployment	-0.001776 (0.031402)	-0.000893 (0.037235)	-0.000883 (0.048709)	0.018128	Cannot reject
GDP	-0.313716 (0.109816)	-0.323124 (0.125812)	0.009408 (0.166998)	0.056336	Cannot reject
Interest Rate	-0.004970 (0.001372)	-0.003813 (0.001537)	-0.001157 (0.002060)	0.561574	Cannot reject

	Alna	Frogner	Δ Alna Frogner	T-stat	Conclusion
Income	1.974875 (0.478440)	-0.094002 (0.115788)	2.068877 (0.492252)	4.202885	Reject
Net Wealth	0.353540 (0.285948)	0.628162 (0.173858)	-0.274622 (0.334653)	0.820616	Cannot reject
Unemployment	-0.001776 (0.031402)	0.012546 (0.021574)	-0.014322 (0.038099)	0.375917	Cannot reject
GDP	-0.313716 (0.109816)	-0.098326 (0.093252)	-0.21539 (0.144068)	1.495061	Cannot reject
Interest Rate	-0.004970 (0.001372)	-0.001586 (0.000980)	-0.003384 (0.001686)	2.007051	Reject

	Alna	Northern Aker	Δ Alna Northern Aker	T-stat	Conclusion
Income	1.974875 (0.478440)	0.705531 (0.318643)	1.269344 (0.574838)	2.208179	Reject
Net Wealth	0.353540 (0.285948)	0.664308 (0.222477)	-0.310768 (0.362301)	0.857761	Cannot reject
Unemployment	-0.001776 (0.031402)	-0.011760 (0.018032)	0.009984 (0.036211)	0.275717	Cannot reject
GDP	-0.313716 (0.109816)	-0.168003 (0.094670	-0.145713 (0.144990)	1.004990	Cannot reject
Interest Rate	-0.004970 (0.001372)	-0.001060 (0.001215)	-0.00391 (0.001833)	2.133522	Reject

	Alna	Ullern	Δ Alna Ullern	T-stat	Conclusion
Income	1.974875 (0.478440)	0.490563 (0.152416)	1.484312 (0.502131)	2.956026	Reject
Net Wealth	0.353540 (0.285948)	0.635800 (0.124690)	-0.28226 (0.311952)	0.904820	Cannot reject
Unemployment	-0.001776 (0.031402)	0.006918 (0.020384)	-0.008694 (0.037438)	0.232225	Cannot reject
GDP	-0.313716 (0.109816)	-0.151562 (0.092146)	-0.162154 (0.143354)	1.131142	Cannot reject
Interest Rate	-0.004970 (0.001372)	-0.005003 (0.001182)	0.000033 (0.001811)	0.018223	Cannot reject

	Alna	Western Aker	Δ Alna Western Aker	T-stat	Conclusion
Income	1.974875 (0.478440)	0.211505 (0.072610)	1.76337 (0.483918)	3.643941	Reject
Net Wealth	0.353540 (0.285948)	1.222033 (0.203404)	0.868493 (0.350912)	2.474957	Reject
Unemployment	-0.001776 (0.031402)	-0.015010 (0.017205)	0.013234 (0.035806)	0.369599	Cannot reject
GDP	-0.313716 (0.109816)	-0.069301 (0.075101)	-0.244415 (0.133040)	1.837150	Cannot reject
Interest Rate	-0.004970 (0.001372)	-0.001770 (0.000660)	-0.0032 (0.001522)	2.101816	Reject

	Alna	Asker	Δ Alna Asker	T-stat	Conclusion
Income	1.974875 (0.478440)	0.174578 (0.263889)	1.800297 (0.546390)	3.294893	Reject
Net Wealth	0.353540 (0.285948)	1.065403 (0.339797)	-0.711863 (0.444104)	1.602920	Cannot reject
Unemployment	-0.001776 (0.031402)	0.004856 (0.017459)	-0.006632 (0.035929)	0.184586	Cannot reject
GDP	-0.313716 (0.109816)	-0.236900 (0.116732)	-0.076816 (0.160268)	0.479296	Cannot reject
Interest Rate	-0.004970 (0.001372)	-0.000538 (0.001177)	-0.004432 (0.001808)	2.451759	Reject

	Alna	Bærum	Δ Alna Bærum	T-stat	Conclusion
Income	1.974875 (0.478440)	0.167807 (0.268349)	1.807068 (0.548558)	3.294214	Reject
Net Wealth	0.353540 (0.285948)	1.099544 (0.253358)	-0.746004 (0.382043)	1.952672	Cannot reject
Unemployment	-0.001776 (0.031402)	0.018248 (0.017449)	-0.020024 (0.035924)	0.557395	Cannot reject
GDP	-0.313716 (0.109816)	-0.164327 (0.093021)	-0.149389 (0.143918)	1.038013	Cannot reject
Interest Rate	-0.004970 (0.001372)	-0.001102 (0.000923)	-0.003868 (0.001654)	2.339173	Reject

	Alna	Follo	Δ Alna Follo	T-stat	Conclusion
Income	1.974875 (0.478440)	0.472824 (0.442543)	1.502051 (0.651728)	2.304721	Reject
Net Wealth	0.353540 (0.285948)	0.757000 (0.387246)	-0.40346 (0.481379)	0.838134	Cannot reject
Unemployment	-0.001776 (0.031402)	0.052977 (0.025274)	-0.054753 (0.040310)	1.358313	Cannot reject
GDP	-0.313716 (0.109816)	-0.305742 (0.117948)	-0.007974 (0.161156)	0.049480	Cannot reject
Interest Rate	-0.004970 (0.001372)	-0.000517 (0.001170)	-0.004453 (0.001803)	2.469592	Reject

	Alna	Northern Romerike	Δ Alna Northern Romerike	T-stat	Conclusion
Income	1.974875 (0.478440)	0.832157 (0.609114)	1.142718 (0.774548)	1.475335	Cannot reject
Net Wealth	0.353540 (0.285948)	0.731836 (0.471396)	-0.378296 (0.551344)	0.686134	Cannot reject
Unemployment	-0.001776 (0.031402)	0.034307 (0.022937)	-0.036083 (0.038887)	0.927896	Cannot reject
GDP	-0.313716 (0.109816)	-0.265106 (0.144993)	-0.04861 (0.181886)	0.267225	Cannot reject
Interest Rate	-0.004970 (0.001372)	-0.002862 (0.001007)	-0.002108 (0.001702)	1.238622	Cannot reject

	Alna	Southern Romerike	Δ Alna Southern Romerike	T-stat	Conclusion
Income	1.974875 (0.478440)	0.200065 (0.556436)	1.77481 (0.733843)	2.418514	Reject
Net Wealth	0.353540 (0.285948)	1.116914 (0.480970)	-0.763374 (0.559552)	1.364259	Cannot reject
Unemployment	-0.001776 (0.031402)	0.069552 (0.033411)	-0.071328 (0.045852)	1.555623	Cannot reject
GDP	-0.313716 (0.109816)	-0.179621 (0.089977)	-0.134095 (0.141970)	0.944532	Cannot reject
Interest Rate	-0.004970 (0.001372)	-0.000945 (0.001083)	-0.004025 (0.001748)	2.302719	Reject

	Bjerke	Grorud	Δ Bjerke Grorud	T-stat	Conclusion
Income	1.841130 (0.441579)	1.894241 (0.532002)	-0.053111 (0.691389)	0.076818	Cannot reject
Net Wealth	0.233714 (0.249404)	0.222067 (0.346484)	0.011647 (0.426912)	0.027282	Cannot reject
Unemployment	0.014283 (0.030125)	0.016304 (0.031323)	-0.002021 (0.043459)	0.046504	Cannot reject
GDP	-0.278923 (0.108042)	-0.294248 (0.123089)	0.015325 (0.163780)	0.093570	Cannot reject
Interest Rate	-0.004696 (0.001344)	-0.004847 (0.001524)	0.000151 (0.002032)	0.074312	Cannot reject

	Bjerke	Stovner	Δ Bjerke Stovner	T-stat	Conclusion
Income	1.841130 (0.441579)	1.436370 (0.562793)	0.40476 (0.715352)	0.565820	Cannot reject
Net Wealth	0.233714 (0.249404)	0.744545 (0.401597)	-0.510831 (0.472739)	1.080576	Cannot reject
Unemployment	0.014283 (0.030125)	-0.000893 (0.037235)	0.015176 (0.047895)	0.316858	Cannot reject
GDP	-0.278923 (0.108042)	-0.323124 (0.125812)	0.044201 (0.165836)	0.266534	Cannot reject
Interest Rate	-0.004696 (0.001344)	-0.003813 (0.001537)	-0.000883 (0.002042)	0.432474	Cannot reject

	Bjerke	Frogner	Δ Bjerke Frogner	T-stat	Conclusion
Income	1.841130 (0.441579)	-0.094002 (0.115788)	1.935132 (0.456507)	4.238995	Reject
Net Wealth	0.233714 (0.249404)	0.628162 (0.173858)	-0.394448 (0.304021)	1.297435	Cannot reject
Unemployment	0.014283 (0.030125)	0.012546 (0.021574)	0.001737 (0.037053)	0.046878	Cannot reject
GDP	-0.278923 (0.108042)	-0.098326 (0.093252)	-0.180597 (0.142720)	1.265393	Cannot reject
Interest Rate	-0.004696 (0.001344)	-0.001586 (0.000980)	-0.00311 (0.001663)	1.869720	Cannot reject

	Bjerke	Northern Aker	Δ Bjerke Northern Aker	T-stat	Conclusion
Income	1.841130 (0.441579)	0.705531 (0.318643)	1.135599 (0.544541)	2.085423	Reject
Net Wealth	0.233714 (0.249404)	0.664308 (0.222477)	-0.430594 (0.334213)	1.288382	Cannot reject
Unemployment	0.014283 (0.030125)	-0.011760 (0.018032)	0.026043 (0.035109)	0.741768	Cannot reject
GDP	-0.278923 (0.108042)	-0.168003 (0.094670	-0.11092 (0.143651)	0.772152	Cannot reject
Interest Rate	-0.004696 (0.001344)	-0.001060 (0.001215)	-0.003636 (0.001812)	2.006862	Reject

	Bjerke	Ullern	Δ Bjerke Ullern	T-stat	Conclusion
Income	1.841130 (0.441579)	0.490563 (0.152416)	1.350567 (0.467143)	2.891121	Reject
Net Wealth	0.233714 (0.249404)	0.635800 (0.124690)	-0.402086 (0.278837)	1.442012	Cannot reject
Unemployment	0.014283 (0.030125)	0.006918 (0.020384)	0.007365 (0.036373)	0.202483	Cannot reject
GDP	-0.278923 (0.108042)	-0.151562 (0.092146)	-0.127361 (0.142000)	0.896909	Cannot reject
Interest Rate	-0.004696 (0.001344)	-0.005003 (0.001182)	0.000307 (0.001790)	0.171526	Cannot reject

	Bjerke	Western Aker	Δ Bjerke Western Aker	T-stat	Conclusion
Income	1.841130 (0.441579)	0.211505 (0.072610)	1.629625 (0.447509)	3.641548	Reject
Net Wealth	0.233714 (0.249404)	1.222033 (0.203404)	-0.988319 (0.321832)	3.070920	Reject
Unemployment	0.014283 (0.030125)	-0.015010 (0.017205)	0.029293 (0.034692)	0.844376	Cannot reject
GDP	-0.278923 (0.108042)	-0.069301 (0.075101)	-0.209622 (0.131580)	1.593117	Cannot reject
Interest Rate	-0.004696 (0.001344)	-0.001770 (0.000660)	-0.002926 (0.001497)	1.954172	Cannot reject

	Bjerke	Asker	Δ Bjerke Asker	T-stat	Conclusion
Income	1.841130 (0.441579)	0.174578 (0.263889)	1.666552 (0.514421)	3.239663	Reject
Net Wealth	0.233714 (0.249404)	1.065403 (0.339797)	-0.831689 (0.421502)	1.973153	Cannot reject
Unemployment	0.014283 (0.030125)	0.004856 (0.017459)	0.009427 (0.034819)	0.270746	Cannot reject
GDP	-0.278923 (0.108042)	-0.236900 (0.116732)	-0.042023 (0.159058)	0.264199	Cannot reject
Interest Rate	-0.004696 (0.001344)	-0.000538 (0.001177)	-0.004158 (0.001787)	2.327426	Reject

	Bjerke	Bærum	Δ Bjerke Bærum	T-stat	Conclusion
Income	1.841130 (0.441579)	0.167807 (0.268349)	1.673323 (0.516724)	3.238333	Reject
Net Wealth	0.233714 (0.249404)	1.099544 (0.253358)	-0.86583 (0.355517)	2.435408	Reject
Unemployment	0.014283 (0.030125)	0.018248 (0.017449)	-0.003965 (0.034814)	0.113892	Cannot reject
GDP	-0.278923 (0.108042)	-0.164327 (0.093021)	-0.114596 (0.142569)	0.803792	Cannot reject
Interest Rate	-0.004696 (0.001344)	-0.001102 (0.000923)	-0.003594 (0.001630)	2.204342	Reject

	Bjerke	Follo	Δ Bjerke Follo	T-stat	Conclusion
Income	1.841130 (0.441579)	0.472824 (0.442543)	1.368306 (0.625169)	2.188698	Reject
Net Wealth	0.233714 (0.249404)	0.757000 (0.387246)	-0.523286 (0.460610)	1.136071	Cannot reject
Unemployment	0.014283 (0.030125)	0.052977 (0.025274)	-0.038694 (0.039323)	0.984007	Cannot reject
GDP	-0.278923 (0.108042)	-0.305742 (0.117948)	0.026819 (0.159953)	0.167669	Cannot reject
Interest Rate	-0.004696 (0.001344)	-0.000517 (0.001170)	-0.004179 (0.001782)	2.345224	Reject

	Bjerke	Northern Romerike	Δ Bjerke Northern Romerike	T-stat	Conclusion
Income	1.841130 (0.441579)	0.832157 (0.609114)	1.008973 (0.752338)	1.341117	Cannot reject
Net Wealth	0.233714 (0.249404)	0.731836 (0.471396)	-0.498122 (0.533307)	0.934025	Cannot reject
Unemployment	0.014283 (0.030125)	0.034307 (0.022937)	-0.020024 (0.037863)	0.528851	Cannot reject
GDP	-0.278923 (0.108042)	-0.265106 (0.144993)	-0.013817 (0.180820)	0.076413	Cannot reject
Interest Rate	-0.004696 (0.001344)	-0.002862 (0.001007)	-0.001834 (0.001679)	1.092057	Cannot reject

	Bjerke	Southern Romerike	Δ Bjerke Southern Romerike	T-stat	Conclusion
Income	1.841130 (0.441579)	0.200065 (0.556436)	1.641065 (0.710361)	2.310184	Reject
Net Wealth	0.233714 (0.249404)	1.116914 (0.480970)	-0.8832 (0.541788)	1.630157	Cannot reject
Unemployment	0.014283 (0.030125)	0.069552 (0.033411)	-0.055269 (0.044987)	1.228561	Cannot reject
GDP	-0.278923 (0.108042)	-0.179621 (0.089977)	-0.099302 (0.140602)	0.706263	Cannot reject
Interest Rate	-0.004696 (0.001344)	-0.000945 (0.001083)	-0.003751 (0.001726)	2.173179	Reject

	Grorud	Stovner	Δ Grorud Stovner	T-stat	Conclusion
Income	1.894241 (0.532002)	1.436370 (0.562793)	0.457871 (0.774443)	0.591226	Cannot reject
Net Wealth	0.222067 (0.346484)	0.744545 (0.401597)	-0.522478 (0.530407)	0.985052	Cannot reject
Unemployment	0.016304 (0.031323)	-0.000893 (0.037235)	0.017197 (0.048658)	0.353428	Cannot reject
GDP	-0.294248 (0.123089)	-0.323124 (0.125812)	0.028876 (0.176010)	0.164059	Cannot reject
Interest Rate	-0.004847 (0.001524)	-0.003813 (0.001537)	-0.001034 (0.002164)	0.477714	Cannot reject

	Grorud	Frogner	Δ Grorud Frogner	T-stat	Conclusion
Income	1.894241 (0.532002)	-0.094002 (0.115788)	1.988243 (0.544457)	3.651793	Reject
Net Wealth	0.222067 (0.346484)	0.628162 (0.173858)	-0.406095 (0.387657)	1.047563	Cannot reject
Unemployment	0.016304 (0.031323)	0.012546 (0.021574)	0.003758 (0.038034)	0.098807	Cannot reject
GDP	-0.294248 (0.123089)	-0.098326 (0.093252)	-0.195922 (0.154424)	1.268726	Cannot reject
Interest Rate	-0.004847 (0.001524)	-0.001586 (0.000980)	-0.003261 (0.001812)	1.799770	Cannot reject

	Grorud	Northern Aker	Δ Grorud Northern Aker	T-stat	Conclusion
Income	1.894241 (0.532002)	0.705531 (0.318643)	1.18871 (0.620129)	1.916877	Cannot reject
Net Wealth	0.222067 (0.346484)	0.664308 (0.222477)	-0.442241 (0.411761)	1.074023	Cannot reject
Unemployment	0.016304 (0.031323)	-0.011760 (0.018032)	0.028064 (0.036143)	0.776481	Cannot reject
GDP	-0.294248 (0.123089)	-0.168003 (0.094670	-0.126245 (0.155285)	0.812991	Cannot reject
Interest Rate	-0.004847 (0.001524)	-0.001060 (0.001215)	-0.003787 (0.001949)	1.942997	Cannot reject

	Grorud	Ullern	Δ Grorud Ullern	T-stat	Conclusion
Income	1.894241 (0.532002)	0.490563 (0.152416)	1.403678 (0.553405)	2.536440	Reject
Net Wealth	0.222067 (0.346484)	0.635800 (0.124690)	-0.413733 (0.368237)	1.123550	Cannot reject
Unemployment	0.016304 (0.031323)	0.006918 (0.020384)	0.009386 (0.037372)	0.251153	Cannot reject
GDP	-0.294248 (0.123089)	-0.151562 (0.092146)	-0.142686 (0.153759)	0.927986	Cannot reject
Interest Rate	-0.004847 (0.001524)	-0.005003 (0.001182)	0.000156 (0.001929)	0.080885	Cannot reject

	Grorud	Western Aker	Δ Grorud Western Aker	T-stat	Conclusion
Income	1.894241 (0.532002)	0.211505 (0.072610)	1.682736 (0.536934)	3.133971	Reject
Net Wealth	0.222067 (0.346484)	1.222033 (0.203404)	-0.999966 (0.401776)	2.488861	Reject
Unemployment	0.016304 (0.031323)	-0.015010 (0.017205)	0.031314 (0.035737)	0.876232	Cannot reject
GDP	-0.294248 (0.123089)	-0.069301 (0.075101)	-0.224947 (0.144191)	1.560062	Cannot reject
Interest Rate	-0.004847 (0.001524)	-0.001770 (0.000660)	-0.003077 (0.001661)	1.852749	Cannot reject

	Grorud	Asker	Δ Grorud Asker	T-stat	Conclusion
Income	1.894241 (0.532002)	0.174578 (0.263889)	1.719663 (0.593855)	2.895763	Reject
Net Wealth	0.222067 (0.346484)	1.065403 (0.339797)	-0.843336 (0.485297)	1.737773	Cannot reject
Unemployment	0.016304 (0.031323)	0.004856 (0.017459)	0.011448 (0.035860)	0.319241	Cannot reject
GDP	-0.294248 (0.123089)	-0.236900 (0.116732)	-0.057348 (0.169639)	0.338060	Cannot reject
Interest Rate	-0.004847 (0.001524)	-0.000538 (0.001177)	-0.004309 (0.001926)	2.237753	Reject

	Grorud	Bærum	Δ Grorud Bærum	T-stat	Conclusion
Income	1.894241 (0.532002)	0.167807 (0.268349)	1.726434 (0.595850)	2.897430	Reject
Net Wealth	0.222067 (0.346484)	1.099544 (0.253358)	-0.877477 (0.429234)	2.044288	Reject
Unemployment	0.016304 (0.031323)	0.018248 (0.017449)	-0.001944 (0.035855)	0.054218	Cannot reject
GDP	-0.294248 (0.123089)	-0.164327 (0.093021)	-0.129921 (0.154285)	0.842085	Cannot reject
Interest Rate	-0.004847 (0.001524)	-0.001102 (0.000923)	-0.003745 (0.001782)	2.101909	Reject

	Grorud	Follo	Δ Grorud Follo	T-stat	Conclusion
Income	1.894241 (0.532002)	0.472824 (0.442543)	1.421417 (0.692005)	2.054057	Reject
Net Wealth	0.222067 (0.346484)	0.757000 (0.387246)	-0.534933 (0.519625)	1.029459	Cannot reject
Unemployment	0.016304 (0.031323)	0.052977 (0.025274)	-0.036673 (0.040248)	0.911175	Cannot reject
GDP	-0.294248 (0.123089)	-0.305742 (0.117948)	0.011494 (0.170478)	0.067422	Cannot reject
Interest Rate	-0.004847 (0.001524)	-0.000517 (0.001170)	-0.00433 (0.001921)	2.253657	Reject

	Grorud	Northern Romerike	Δ Grorud Northern Romerike	T-stat	Conclusion
Income	1.894241 (0.532002)	0.832157 (0.609114)	1.062084 (0.808731)	1.313272	Cannot reject
Net Wealth	0.222067 (0.346484)	0.731836 (0.471396)	-0.509769 (0.585034)	0.871349	Cannot reject
Unemployment	0.016304 (0.031323)	0.034307 (0.022937)	-0.018003 (0.038823)	0.463718	Cannot reject
GDP	-0.294248 (0.123089)	-0.265106 (0.144993)	-0.029142 (0.190194)	0.153222	Cannot reject
Interest Rate	-0.004847 (0.001524)	-0.002862 (0.001007)	-0.001985 (0.001827)	1.086693	Cannot reject

	Grorud	Southern Romerike	Δ Grorud Southern Romerike	T-stat	Conclusion
Income	1.894241 (0.532002)	0.200065 (0.556436)	1.694176 (0.769836)	2.200698	Reject
Net Wealth	0.222067 (0.346484)	1.116914 (0.480970)	-0.894847 (0.592776)	1.509587	Cannot reject
Unemployment	0.016304 (0.031323)	0.069552 (0.033411)	-0.053248 (0.045798)	1.162680	Cannot reject
GDP	-0.294248 (0.123089)	-0.179621 (0.089977)	-0.114627 (0.152469)	0.751806	Cannot reject
Interest Rate	-0.004847 (0.001524)	-0.000945 (0.001083)	-0.003902 (0.001870)	2.087059	Reject

	Stovner	Frogner	Δ Stovner Frogner	T-stat	Conclusion
Income	1.436370 (0.562793)	-0.094002 (0.115788)	1.530372 (0.574581)	2.663459	Reject
Net Wealth	0.744545 (0.401597)	0.628162 (0.173858)	0.116383 (0.437615)	0.265948	Cannot reject
Unemployment	-0.000893 (0.037235)	0.012546 (0.021574)	-0.013439 (0.043034)	0.312292	Cannot reject
GDP	-0.323124 (0.125812)	-0.098326 (0.093252)	-0.224798 (0.156603)	1.435461	Cannot reject
Interest Rate	-0.003813 (0.001537)	-0.001586 (0.000980)	-0.002227 (0.001823)	1.221716	Cannot reject

	Stovner	Northern Aker	Δ Stovner Northern Aker	T-stat	Conclusion
Income	1.436370 (0.562793)	0.705531 (0.318643)	0.730839 (0.646737)	1.30040	Cannot reject
Net Wealth	0.744545 (0.401597)	0.664308 (0.222477)	0.080237 (0.459104)	0.174769	Cannot reject
Unemployment	-0.000893 (0.037235)	-0.011760 (0.018032)	0.010867 (0.041371)	0.262669	Cannot reject
GDP	-0.323124 (0.125812)	-0.168003 (0.094670	-0.155121 (0.157452)	0.985197	Cannot reject
Interest Rate	-0.003813 (0.001537)	-0.001060 (0.001215)	-0.002753 (0.001959)	1.405142	Cannot reject

	Stovner	Ullern	Δ Stovner Ullern	T-stat	Conclusion
Income	1.436370 (0.562793)	0.490563 (0.152416)	0.945807 (0.583067)	1.622125	Cannot reject
Net Wealth	0.744545 (0.401597)	0.635800 (0.124690)	0.108745 (0.420509)	0.258603	Cannot reject
Unemployment	-0.000893 (0.037235)	0.006918 (0.020384)	-0.007811 (0.042449)	0.184007	Cannot reject
GDP	-0.323124 (0.125812)	-0.151562 (0.092146)	-0.171562 (0.155947)	1.100128	Cannot reject
Interest Rate	-0.003813 (0.001537)	-0.005003 (0.001182)	0.00119 (0.001939)	0.613737	Cannot reject

	Stovner	Western Aker	Δ Stovner Western Aker	T-stat	Conclusion
Income	1.436370 (0.562793)	0.211505 (0.072610)	1.224865 (0.567458)	2.158514	Reject
Net Wealth	0.744545 (0.401597)	1.222033 (0.203404)	-0.477488 (0.450170)	1.060683	Cannot reject
Unemployment	-0.000893 (0.037235)	-0.015010 (0.017205)	0.014117 (0.041018)	0.344168	Cannot reject
GDP	-0.323124 (0.125812)	-0.069301 (0.075101)	-0.253823 (0.146522)	1.732315	Cannot reject
Interest Rate	-0.003813 (0.001537)	-0.001770 (0.000660)	-0.002043 (0.001673)	1.221369	Cannot reject

	Stovner	Asker	Δ Stovner Asker	T-stat	Conclusion
Income	1.436370 (0.562793)	0.174578 (0.263889)	1.261792 (0.621589)	2.029945	Reject
Net Wealth	0.744545 (0.401597)	1.065403 (0.339797)	-0.320858 (0.526063)	0.609923	Cannot reject
Unemployment	-0.000893 (0.037235)	0.004856 (0.017459)	-0.005749 (0.041125)	0.139793	Cannot reject
GDP	-0.323124 (0.125812)	-0.236900 (0.116732)	-0.086224 (0.171625)	0.502399	Cannot reject
Interest Rate	-0.003813 (0.001537)	-0.000538 (0.001177)	-0.003275 (0.001936)	1.691722	Cannot reject

	Stovner	Bærum	Δ Stovner Bærum	T-stat	Conclusion
Income	1.436370 (0.562793)	0.167807 (0.268349)	1.265863 (0.623496)	2.034597	Reject
Net Wealth	0.744545 (0.401597)	1.099544 (0.253358)	-0.354999 (0.474837)	0.747622	Cannot reject
Unemployment	-0.000893 (0.037235)	0.018248 (0.017449)	-0.019141 (0.041121)	0.465483	Cannot reject
GDP	-0.323124 (0.125812)	-0.164327 (0.093021)	-0.158797 (0.156466)	1.014899	Cannot reject
Interest Rate	-0.003813 (0.001537)	-0.001102 (0.000923)	-0.002711 (0.001793)	1.512121	Cannot reject

	Stovner	Follo	Δ Stovner Follo	T-stat	Conclusion
Income	1.436370 (0.562793)	0.472824 (0.442543)	0.963546 (0.715947)	1.345834	Cannot reject
Net Wealth	0.744545 (0.401597)	0.757000 (0.387246)	-0.012455 (0.557889)	0.022325	Cannot reject
Unemployment	-0.000893 (0.037235)	0.052977 (0.025274)	-0.05387 (0.045002)	1.197046	Cannot reject
GDP	-0.323124 (0.125812)	-0.305742 (0.117948)	-0.017382 (0.172454)	0.100792	Cannot reject
Interest Rate	-0.003813 (0.001537)	-0.000517 (0.001170)	-0.003296 (0.001932)	1.760314	Cannot reject

	Stovner	Northern Romerike	Δ Stovner Northern Romerike	T-stat	Conclusion
Income	1.436370 (0.562793)	0.832157 (0.609114)	0.604213 (0.829310)	0.728573	Cannot reject
Net Wealth	0.744545 (0.401597)	0.731836 (0.471396)	0.012709 (0.619269)	0.020523	Cannot reject
Unemployment	-0.000893 (0.037235)	0.034307 (0.022937)	-0.0352 (0.043733)	0.804889	Cannot reject
GDP	-0.323124 (0.125812)	-0.265106 (0.144993)	-0.058018 (0.191968)	0.302228	Cannot reject
Interest Rate	-0.003813 (0.001537)	-0.002862 (0.001007)	-0.000951 (0.001838)	0.517550	Cannot reject

	Stovner	Southern Romerike	Δ Stovner Southern Romerike	T-stat	Conclusion
Income	1.436370 (0.562793)	0.200065 (0.556436)	1.236305 (0.791427)	1.562121	Cannot reject
Net Wealth	0.744545 (0.401597)	1.116914 (0.480970)	-0.372369 (0.626588)	0.594281	Cannot reject
Unemployment	-0.000893 (0.037235)	0.069552 (0.033411)	-0.070445 (0.050027)	1.408129	Cannot reject
GDP	-0.323124 (0.125812)	-0.179621 (0.089977)	-0.143503 (0.154676)	0.927768	Cannot reject
Interest Rate	-0.003813 (0.001537)	-0.000945 (0.001083)	-0.002868 (0.001880)	1.525347	Cannot reject

	Frogner	Northern Aker	Δ Frogner Northern Aker	T-stat	Conclusion
Income	-0.094002 (0.115788)	0.705531 (0.318643)	-0.799533 (0.339028)	2.358307	Reject
Net Wealth	0.628162 (0.173858)	0.664308 (0.222477)	-0.036146 (0.282352)	0.128018	Cannot reject
Unemployment	0.012546 (0.021574)	-0.011760 (0.018032)	0.024306 (0.028117)	0.864446	Cannot reject
GDP	-0.098326 (0.093252)	-0.168003 (0.094670	0.069677 (0.132885)	0.524342	Cannot reject
Interest Rate	-0.001586 (0.000980)	-0.001060 (0.001215)	-0.000526 (0.001561)	0.336970	Cannot reject

	Frogner	Ullern	Δ Frogner Ullern	T-stat	Conclusion
Income	-0.094002 (0.115788)	0.490563 (0.152416)	-0.584565 (0.191409)	3.054006	Reject
Net Wealth	0.628162 (0.173858)	0.635800 (0.124690)	-0.007638 (0.213949)	0.035700	Cannot reject
Unemployment	0.012546 (0.021574)	0.006918 (0.020384)	0.005628 (0.029681)	0.189618	Cannot reject
GDP	-0.098326 (0.093252)	-0.151562 (0.092146)	0.053236 (0.131099)	0.406076	Cannot reject
Interest Rate	-0.001586 (0.000980)	-0.005003 (0.001182)	0.003417 (0.001535)	2.225445	Reject

	Frogner	Western Aker	Δ Frogner Western Aker	T-stat	Conclusion
Income	-0.094002 (0.115788)	0.211505 (0.072610)	-0.305507 (0.136671)	2.235340	Reject
Net Wealth	0.628162 (0.173858)	1.222033 (0.203404)	-0.593871 (0.267581)	2.219403	Reject
Unemployment	0.012546 (0.021574)	-0.015010 (0.017205)	0.027556 (0.027594)	0.998609	Cannot reject
GDP	-0.098326 (0.093252)	-0.069301 (0.075101)	-0.029025 (0.119733)	0.242413	Cannot reject
Interest Rate	-0.001586 (0.000980)	-0.001770 (0.000660)	0.000184 (0.001182)	0.155731	Cannot reject

	Frogner	Asker	Δ Frogner Asker	T-stat	Conclusion
Income	-0.094002 (0.115788)	0.174578 (0.263889)	-0.26858 (0.288174)	0.932006	Cannot reject
Net Wealth	0.628162 (0.173858)	1.065403 (0.339797)	-0.437241 (0.381692)	1.145534	Cannot reject
Unemployment	0.012546 (0.021574)	0.004856 (0.017459)	0.00769 (0.027753)	0.277083	Cannot reject
GDP	-0.098326 (0.093252)	-0.236900 (0.116732)	0.138574 (0.149406)	0.927497	Cannot reject
Interest Rate	-0.001586 (0.000980)	-0.000538 (0.001177)	-0.001048 (0.001532)	0.684262	Cannot reject

	Frogner	Bærum	Δ Frogner Bærum	T-stat	Conclusion
Income	-0.094002 (0.115788)	0.167807 (0.268349)	-0.261809 (0.292264)	0.895797	Cannot reject
Net Wealth	0.628162 (0.173858)	1.099544 (0.253358)	-0.471382 (0.307273)	1.534081	Cannot reject
Unemployment	0.012546 (0.021574)	0.018248 (0.017449)	-0.005702 (0.027747)	0.205498	Cannot reject
GDP	-0.098326 (0.093252)	-0.164327 (0.093021)	0.066001 (0.131715)	0.501089	Cannot reject
Interest Rate	-0.001586 (0.000980)	-0.001102 (0.000923)	-0.000484 (0.001346)	0.359523	Cannot reject

	Frogner	Follo	Δ Frogner Follo	T-stat	Conclusion
Income	-0.094002 (0.115788)	0.472824 (0.442543)	-0.566826 (0.457440)	1.239127	Cannot reject
Net Wealth	0.628162 (0.173858)	0.757000 (0.387246)	-0.128838 (0.424483)	0.303517	Cannot reject
Unemployment	0.012546 (0.021574)	0.052977 (0.025274)	-0.040431 (0.033230)	1.216713	Cannot reject
GDP	-0.098326 (0.093252)	-0.305742 (0.117948)	0.207416 (0.150358)	1.379477	Cannot reject
Interest Rate	-0.001586 (0.000980)	-0.000517 (0.001170)	-0.001069 (0.001526)	0.700430	Cannot reject

	Frogner	Northern Romerike	Δ Frogner Northern Romerike	T-stat	Conclusion
Income	-0.094002 (0.115788)	0.832157 (0.609114)	-0.926159 (0.620022)	1.493753	Cannot reject
Net Wealth	0.628162 (0.173858)	0.731836 (0.471396)	-0.103674 (0.502435)	0.206343	Cannot reject
Unemployment	0.012546 (0.021574)	0.034307 (0.022937)	-0.021761 (0.031489)	0.691071	Cannot reject
GDP	-0.098326 (0.093252)	-0.265106 (0.144993)	0.16678 (0.172392)	0.967448	Cannot reject
Interest Rate	-0.001586 (0.000980)	-0.002862 (0.001007)	0.001276 (0.001405)	0.908088	Cannot reject

	Frogner	Southern Romerike	Δ Frogner Southern Romerike	T-stat	Conclusion
Income	-0.094002 (0.115788)	0.200065 (0.556436)	-0.294067 (0.568355)	0.517400	Cannot reject
Net Wealth	0.628162 (0.173858)	1.116914 (0.480970)	-0.488752 (0.511428)	0.955661	Cannot reject
Unemployment	0.012546 (0.021574)	0.069552 (0.033411)	-0.057006 (0.039771)	1.433356	Cannot reject
GDP	-0.098326 (0.093252)	-0.179621 (0.089977)	0.081295 (0.129583)	0.627358	Cannot reject
Interest Rate	-0.001586 (0.000980)	-0.000945 (0.001083)	-0.000641 (0.001461)	0.438867	Cannot reject

	Northern Aker	Ullern	Δ Northern Aker Ullern	T-stat	Conclusion
Income	0.705531 (0.318643)	0.490563 (0.152416)	0.214968 (0.353219)	0.608596	Cannot reject
Net Wealth	0.664308 (0.222477)	0.635800 (0.124690)	0.028508 (0.255036)	0.111780	Cannot reject
Unemployment	-0.011760 (0.018032)	0.006918 (0.020384)	-0.018678 (0.027215)	0.686311	Cannot reject
GDP	-0.168003 (0.094670	-0.151562 (0.092146)	-0.016441 (0.132111)	0.124448	Cannot reject
Interest Rate	-0.001060 (0.001215)	-0.005003 (0.001182)	0.003943 (0.001695)	2.326123	Reject

	Northern Aker	Western Aker	Δ Northern Aker Western Aker	T-stat	Conclusion
Income	0.705531 (0.318643)	0.211505 (0.072610)	0.494026 (0.326811)	1.511656	Cannot reject
Net Wealth	0.664308 (0.222477)	1.222033 (0.203404)	-0.557725 (0.301445)	1.850171	Cannot reject
Unemployment	-0.011760 (0.018032)	-0.015010 (0.017205)	0.00325 (0.024923)	0.130401	Cannot reject
GDP	-0.168003 (0.094670	-0.069301 (0.075101)	-0.098702 (0.120841)	0.816792	Cannot reject
Interest Rate	-0.001060 (0.001215)	-0.001770 (0.000660)	0.00071 (0.001383)	0.513493	Cannot reject

	Northern Aker	Asker	Δ Northern Aker Asker	T-stat	Conclusion
Income	0.705531 (0.318643)	0.174578 (0.263889)	0.530953 (0.413728)	1.283339	Cannot reject
Net Wealth	0.664308 (0.222477)	1.065403 (0.339797)	-0.401095 (0.406150)	0.987553	Cannot reject
Unemployment	-0.011760 (0.018032)	0.004856 (0.017459)	-0.016616 (0.025099)	0.662013	Cannot reject
GDP	-0.168003 (0.094670	-0.236900 (0.116732)	0.068897 (0.150296)	0.458410	Cannot reject
Interest Rate	-0.001060 (0.001215)	-0.000538 (0.001177)	-0.000522 (0.001692)	0.308581	Cannot reject

	Northern Aker	Bærum	Δ Northern Aker Bærum	T-stat	Conclusion
Income	0.705531 (0.318643)	0.167807 (0.268349)	0.537724 (0.416587)	1.290785	Cannot reject
Net Wealth	0.664308 (0.222477)	1.099544 (0.253358)	-0.435236 (0.337174)	1.290835	Cannot reject
Unemployment	-0.011760 (0.018032)	0.018248 (0.017449)	-0.030008 (0.025092)	1.195907	Cannot reject
GDP	-0.168003 (0.094670	-0.164327 (0.093021)	-0.003676 (0.132723)	0.027697	Cannot reject
Interest Rate	-0.001060 (0.001215)	-0.001102 (0.000923)	0.000042 (0.001526)	0.027526	Cannot reject

	Northern Aker	Follo	Δ Northern Aker Follo	T-stat	Conclusion
Income	0.705531 (0.318643)	0.472824 (0.442543)	0.232707 (0.54323)	0.426732	Cannot reject
Net Wealth	0.664308 (0.222477)	0.757000 (0.387246)	-0.092692 (0.446604)	0.207548	Cannot reject
Unemployment	-0.011760 (0.018032)	0.052977 (0.025274)	-0.064737 (0.031047)	2.085116	Reject
GDP	-0.168003 (0.094670	-0.305742 (0.117948)	0.137739 (0.151242)	0.910719	Cannot reject
Interest Rate	-0.001060 (0.001215)	-0.000517 (0.001170)	-0.000543 (0.001687)	0.321921	Cannot reject

	Northern Aker	Northern Romerike	Δ Northern Aker Northern Romerike	T-stat	Conclusion
Income	0.705531 (0.318643)	0.832157 (0.609114)	-0.126626 (0.687425)	0.184203	Cannot reject
Net Wealth	0.664308 (0.222477)	0.731836 (0.471396)	-0.067528 (0.521258)	0.129548	Cannot reject
Unemployment	-0.011760 (0.018032)	0.034307 (0.022937)	-0.046067 (0.029176)	1.578916	Cannot reject
GDP	-0.168003 (0.094670	-0.265106 (0.144993)	0.097103 (0.172750)	0.562102	Cannot reject
Interest Rate	-0.001060 (0.001215)	-0.002862 (0.001007)	0.001802 (0.001578)	1.141908	Cannot reject

	Northern Aker	Southern Romerike	Δ Northern Aker Southern Romerike	T-stat	Conclusion
Income	0.705531 (0.318643)	0.200065 (0.556436)	0.505466 (0.641213)	0.788296	Cannot reject
Net Wealth	0.664308 (0.222477)	1.116914 (0.480970)	-0.452606 (0.529932)	0.854083	Cannot reject
Unemployment	-0.011760 (0.018032)	0.069552 (0.033411)	-0.081312 (0.037966)	2.141683	Reject
GDP	-0.168003 (0.094670	-0.179621 (0.089977)	0.011618 (0.130607)	0.088954	Cannot reject
Interest Rate	-0.001060 (0.001215)	-0.000945 (0.001083)	-0.000115 (0.001628)	0.070656	Cannot reject

	Ullern	Western Aker	Δ Ullern Western Aker	T-stat	Conclusion
Income	0.490563 (0.152416)	0.211505 (0.072610)	0.279058 (0.168828)	1.652914	Cannot reject
Net wealth	0.635800 (0.124690)	1.222033 (0.203404)	-0.586233 (0.238581)	2.457168	Reject
Unemployment	0.006918 (0.020384)	-0.015010 (0.017205)	0.021928 (0.026674)	0.822064	Cannot reject
GDP	-0.151562 (0.092146)	-0.069301 (0.075101)	-0.082261 (0.118874)	0.692001	Cannot reject
Interest Rate	-0.005003 (0.001182)	-0.001770 (0.000660)	-0.003233 (0.001354)	2.388126	Reject

	Ullern	Asker	Δ Ullern Asker	T-stat	Conclusion
Income	0.490563 (0.152416)	0.174578 (0.263889)	0.315985 (0.304743)	1.036892	Cannot reject
Net Wealth	0.635800 (0.124690)	1.065403 (0.339797)	-0.429603 (0.361952)	1.186904	Cannot reject
Unemployment	0.006918 (0.020384)	0.004856 (0.017459)	0.002062 (0.026839)	0.076829	Cannot reject
GDP	-0.151562 (0.092146)	-0.236900 (0.116732)	0.085338 (0.148719)	0.573822	Cannot reject
Interest Rate	-0.005003 (0.001182)	-0.000538 (0.001177)	-0.004465 (0.001668)	2.676748	Reject

	Ullern	Bærum	Δ Ullern Bærum	T-stat	Conclusion
Income	0.490563 (0.152416)	0.167807 (0.268349)	0.322756 (0.308613)	1.045829	Cannot reject
Net wealth	0.635800 (0.124690)	1.099544 (0.253358)	-0.463744 (0.282379)	1.642275	Cannot reject
Unemployment	0.006918 (0.020384)	0.018248 (0.017449)	-0.01133 (0.026832)	0.422251	Cannot reject
GDP	-0.151562 (0.092146)	-0.164327 (0.093021)	0.012765 (0.130934)	0.097492	Cannot reject
Interest Rate	-0.005003 (0.001182)	-0.001102 (0.000923)	-0.003901 (0.001500)	2.601214	Reject

	Ullern	Follo	Δ Ullern Follo	T-stat	Conclusion
Income	0.490563 (0.152416)	0.472824 (0.442543)	0.017739 (0.468054)	0.037899	Cannot reject
Net Wealth	0.635800 (0.124690)	0.757000 (0.387246)	-0.1212 (0.406826)	0.297916	Cannot reject
Unemployment	0.006918 (0.020384)	0.052977 (0.025274)	-0.046059 (0.032470)	1.418522	Cannot reject
GDP	-0.151562 (0.092146)	-0.305742 (0.117948)	0.15418 (0.149675)	1.030098	Cannot reject
Interest Rate	-0.005003 (0.001182)	-0.000517 (0.001170)	-0.004486 (0.001663)	2.697313	Reject

	Ullern	Northern Romerike	Δ Ullern Northern Romerike	T-stat	Conclusion
Income	0.490563 (0.152416)	0.832157 (0.609114)	-0.341594 (0.627894)	0.544032	Cannot reject
Net wealth	0.635800 (0.124690)	0.731836 (0.471396)	-0.096036 (0.487608)	0.196953	Cannot reject
Unemployment	0.006918 (0.020384)	0.034307 (0.022937)	-0.027389 (0.030686)	0.892565	Cannot reject
GDP	-0.151562 (0.092146)	-0.265106 (0.144993)	0.113544 (0.171379)	0.662530	Cannot reject
Interest Rate	-0.005003 (0.001182)	-0.002862 (0.001007)	-0.002141 (0.001553)	1.378804	Cannot reject

	Ullern	Southern Romerike	Δ Ullern Southern Romerike	T-stat	Conclusion
Income	0.490563 (0.152416)	0.200065 (0.556436)	0.290498 (0.576933)	0.503521	Cannot reject
Net wealth	0.635800 (0.124690)	1.116914 (0.480970)	-0.481114 (0.496870)	0.968290	Cannot reject
Unemployment	0.006918 (0.020384)	0.069552 (0.033411)	-0.062634 (0.039138)	1.600327	Cannot reject
GDP	-0.151562 (0.092146)	-0.179621 (0.089977)	0.028059 (0.128790)	0.217867	Cannot reject
Interest Rate	-0.005003 (0.001182)	-0.000945 (0.001083)	-0.004058 (0.001603)	2.531304	Reject

	Western Aker	Asker	Δ Western Aker Asker	T-stat	Conclusion
Income	0.211505 (0.072610)	0.174578 (0.263889)	0.036927 (0.273696)	0.134920	Cannot reject
Net Wealth	1.222033 (0.203404)	1.065403 (0.339797)	0.15663 (0.396024)	0.395506	Cannot reject
Unemployment	-0.015010 (0.017205)	0.004856 (0.017459)	-0.019866 (0.024512)	0.810467	Cannot reject
GDP	-0.069301 (0.075101)	-0.236900 (0.116732)	0.167599 (0.138804)	1.207452	Cannot reject
Interest Rate	-0.001770 (0.000660)	-0.000538 (0.001177)	-0.001232 (0.001349)	0.912986	Cannot reject

	Western Aker	Bærum	Δ Western Aker Bærum	T-stat	Conclusion
Income	0.211505 (0.072610)	0.167807 (0.268349)	0.043698 (0.277999)	0.157188	Cannot reject
Net wealth	1.222033 (0.203404)	1.099544 (0.253358)	0.122489 (0.324905)	0.376999	Cannot reject
Unemployment	-0.015010 (0.017205)	0.018248 (0.017449)	-0.033258 (0.024505)	1.357210	Cannot reject
GDP	-0.069301 (0.075101)	-0.164327 (0.093021)	0.095026 (0.119554)	0.794840	Cannot reject
Interest Rate	-0.001770 (0.000660)	-0.001102 (0.000923)	-0.000668 (0.001135)	0.588705	Cannot reject

	Western Aker	Follo	Δ Western Aker Follo	T-stat	Conclusion
Income	0.211505 (0.072610)	0.472824 (0.442543)	-0.261319 (0.448460)	0.582703	Cannot reject
Net Wealth	1.222033 (0.203404)	0.757000 (0.387246)	0.465033 (0.437416)	1.063137	Cannot reject
Unemployment	-0.015010 (0.017205)	0.052977 (0.025274)	-0.067987 (0.030574)	2.223666	Reject
GDP	-0.069301 (0.075101)	-0.305742 (0.117948)	0.236441 (0.139828)	1.690941	Cannot reject
Interest Rate	-0.001770 (0.000660)	-0.000517 (0.001170)	-0.001253 (0.001343)	0.932766	Cannot reject

	Western Aker	Northern Romerike	Δ Western Aker Northern Romerike	T-stat	Conclusion
Income	0.211505 (0.072610)	0.832157 (0.609114)	-0.620652 (0.613427)	1.011779	Cannot reject
Net wealth	1.222033 (0.203404)	0.731836 (0.471396)	0.490197 (0.513408)	0.954791	Cannot reject
Unemployment	-0.015010 (0.017205)	0.034307 (0.022937)	-0.049317 (0.028673)	1.720004	Cannot reject
GDP	-0.069301 (0.075101)	-0.265106 (0.144993)	0.195805 (0.162850)	1.202362	Cannot reject
Interest Rate	-0.001770 (0.000660)	-0.002862 (0.001007)	0.001092 (0.001204)	0.906966	Cannot reject

	Western Aker	Southern Romerike	Δ Western Aker Southern Romerike	T-stat	Conclusion
Income	0.211505 (0.072610)	0.200065 (0.556436)	0.01144 (0.561153)	0.020387	Cannot reject
Net wealth	1.222033 (0.203404)	1.116914 (0.480970)	0.105119 (0.522212)	0.201296	Cannot reject
Unemployment	-0.015010 (0.017205)	0.069552 (0.033411)	-0.084562 (0.037581)	2.250146	Reject
GDP	-0.069301 (0.075101)	-0.179621 (0.089977)	0.11032 (0.117201)	0.941291	Cannot reject
Interest Rate	-0.001770 (0.000660)	-0.000945 (0.001083)	-0.000825 (0.001268)	0.650496	Cannot reject

	Asker	Bærum	Δ Asker Bærum	T-stat	Conclusion
Income	0.174578 (0.263889)	0.167807 (0.268349)	0.006771 (0.376362)	0.017991	Cannot reject
Net Wealth	1.065403 (0.339797)	1.099544 (0.253358)	-0.034141 (0.423854)	0.080549	Cannot reject
Unemployment	0.004856 (0.017459)	0.018248 (0.017449)	-0.013392 (0.024684)	0.542545	Cannot reject
GDP	-0.236900 (0.116732)	-0.164327 (0.093021)	-0.072573 (0.149262)	0.486211	Cannot reject
Interest Rate	-0.000538 (0.001177)	-0.001102 (0.000923)	0.000564 (0.001496)	0.377069	Cannot reject

	Asker	Follo	Δ Asker Follo	T-stat	Conclusion
Income	0.174578 (0.263889)	0.472824 (0.442543)	-0.298246 (0.515249)	0.578838	Cannot reject
Net Wealth	1.065403 (0.339797)	0.757000 (0.387246)	0.308403 (0.515191)	0.598619	Cannot reject
Unemployment	0.004856 (0.017459)	0.052977 (0.025274)	-0.048121 (0.030718)	1.566544	Cannot reject
GDP	-0.236900 (0.116732)	-0.305742 (0.117948)	0.068842 (0.165946)	0.414846	Cannot reject
Interest Rate	-0.000538 (0.001177)	-0.000517 (0.001170)	-0.000021 (0.001660)	0.012654	Cannot reject

	Asker	Northern Romerike	Δ Asker Northern Romerike	T-stat	Conclusion
Income	0.174578 (0.263889)	0.832157 (0.609114)	-0.657579 (0.663820)	0.990598	Cannot reject
Net Wealth	1.065403 (0.339797)	0.731836 (0.471396)	0.333543 (0.581099)	0.573986	Cannot reject
Unemployment	0.004856 (0.017459)	0.034307 (0.022937)	-0.029451 (0.028826)	1.021691	Cannot reject
GDP	-0.236900 (0.116732)	-0.265106 (0.144993)	0.028206 (0.186143)	0.151528	Cannot reject
Interest Rate	-0.000538 (0.001177)	-0.002862 (0.001007)	0.002324 (0.001549)	1.500330	Cannot reject

	Asker	Southern Romerike	Δ Asker Southern Romerike	T-stat	Conclusion
Income	0.174578 (0.263889)	0.200065 (0.556436)	-0.025487 (0.615840)	0.041386	Cannot reject
Net Wealth	1.065403 (0.339797)	1.116914 (0.480970)	-0.051511 (0.588892)	0.087471	Cannot reject
Unemployment	0.004856 (0.017459)	0.069552 (0.033411)	-0.064696 (0.037698)	1.716182	Cannot reject
GDP	-0.236900 (0.116732)	-0.179621 (0.089977)	-0.057279 (0.147385)	0.388636	Cannot reject
Interest Rate	-0.000538 (0.001177)	-0.000945 (0.001083)	0.000407 (0.001599)	0.254464	Cannot reject

	Bærum	Follo	Δ Bærum Follo	T-stat	Conclusion
Income	0.167807 (0.268349)	0.472824 (0.442543)	-0.305017 (0.517548)	0.589351	Cannot reject
Net Wealth	1.099544 (0.253358)	0.757000 (0.387246)	0.342544 (0.462763)	0.740215	Cannot reject
Unemployment	0.018248 (0.017449)	0.052977 (0.025274)	-0.034729 (0.030712)	1.130786	Cannot reject
GDP	-0.164327 (0.093021)	-0.305742 (0.117948)	0.141415 (0.150215)	0.941415	Cannot reject
Interest Rate	-0.001102 (0.000923)	-0.000517 (0.001170)	-0.000585 (0.001490)	0.392553	Cannot reject

	Bærum	Northern Romerike	Δ Bærum Northern Romerike	T-stat	Conclusion
Income	0.167807 (0.268349)	0.832157 (0.609114)	-0.66435 (0.665606)	0.998113	Cannot reject
Net Wealth	1.099544 (0.253358)	0.731836 (0.471396)	0.367708 (0.535168)	0.687089	Cannot reject
Unemployment	0.018248 (0.017449)	0.034307 (0.022937)	-0.016059 (0.028820)	0.557224	Cannot reject
GDP	-0.164327 (0.093021)	-0.265106 (0.144993)	0.100779 (0.172267)	0.585017	Cannot reject
Interest Rate	-0.001102 (0.000923)	-0.002862 (0.001007)	0.00176 (0.001366)	1.288426	Cannot reject

	Bærum	Southern Romerike	Δ Bærum Southern Romerike	T-stat	Conclusion
Income	0.167807 (0.268349)	0.200065 (0.556436)	-0.032258 (0.617764)	0.052217	Cannot reject
Net wealth	1.099544 (0.253358)	1.116914 (0.480970)	-0.01737 (0.543620)	0.031952	Cannot reject
Unemployment	0.018248 (0.017449)	0.069552 (0.033411)	-0.051304 (0.037693)	1.361101	Cannot reject
GDP	-0.164327 (0.093021)	-0.179621 (0.089977)	0.015294 (0.129417)	0.118176	Cannot reject
Interest Rate	-0.001102 (0.000923)	-0.000945 (0.001083)	-0.000157 (0.001423)	0.110333	Cannot reject

	Follo	Northern Romerike	Δ Follo Northern Romerike	T-stat	Conclusion
Income	0.472824 (0.442543)	0.832157 (0.609114)	-0.3539333 (0.752904)	0.477263	Cannot reject
Net Wealth	0.757000 (0.387246)	0.731836 (0.471396)	0.025164 (0.610060)	0.041248	Cannot reject
Unemployment	0.052977 (0.025274)	0.034307 (0.022937)	0.01867 (0.034130)	0.547020	Cannot reject
GDP	-0.305742 (0.117948)	-0.265106 (0.144993)	-0.040636 (0.186908)	0.217411	Cannot reject
Interest Rate	-0.000517 (0.001170)	-0.002862 (0.001007)	0.002345 (0.001544)	1.519097	Cannot reject

	Follo	Southern Romerike	Δ Follo Southern Romerike	T-stat	Conclusion
Income	0.472824 (0.442543)	0.200065 (0.556436)	0.272759 (0.710961)	0.383648	Cannot reject
Net Wealth	0.757000 (0.387246)	1.116914 (0.480970)	-0.359914 (0.617488)	0.582868	Cannot reject
Unemployment	0.052977 (0.025274)	0.069552 (0.033411)	-0.016575 (0.041894)	0.395646	Cannot reject
GDP	-0.305742 (0.117948)	-0.179621 (0.089977)	-0.126121 (0.148350)	0.850161	Cannot reject
Interest Rate	-0.000517 (0.001170)	-0.000945 (0.001083)	0.000428 (0.001594)	0.268457	Cannot reject

	Northern Romerike	Southern Romerike	Δ Northern Romerike Southern Romerike	T-stat	Conclusion
Income	0.832157 (0.609114)	0.200065 (0.556436)	0.632092 (0.825010)	0.766163	Cannot reject
Net wealth	0.731836 (0.471396)	1.116914 (0.480970)	-0.385078 (0.673458)	0.571792	Cannot reject
Unemployment	0.034307 (0.022937)	0.069552 (0.033411)	-0.035245 (0.040527)	0.869677	Cannot reject
GDP	-0.265106 (0.144993)	-0.179621 (0.089977)	-0.085485 (0.170642)	0.500960	Cannot reject
Interest Rate	-0.002862 (0.001007)	-0.000945 (0.001083)	-0.001917 (0.001479)	1.296295	Cannot reject

Appendix 19: Results from Granger Causality test with four lags

4 lags	House Prices do not Granger cause Consumption		Consumption does not Granger cause House Prices	
	F-statistic	P-value	F-statistic	P-value
Alna	4.44221	0.0083*	0.82282	0.5240
Bjerke	3.13744	0.0338*	0.71607	0.5895
Grorud	4.30187	0.0096*	0.54936	0.7013
Stovner	4.10852	0.0118*	0.93738	0.4599
Frogner	1.31425	0.2943	0.46221	0.7627
Northern Aker	1.77917	0.1674	0.34298	0.8461
Ullern	2.22642	0.0976	0.17106	0.9510
Western Aker	0.06751	0.9911	0.98396	0.4358
Asker	4.57998	0.0072*	2.10072	0.1135
Bærum	1.83981	0.1556	0.35811	0.8357
Follo	3.43966	0.0241*	0.82683	0.5217
Northern Romerike	5.01801	0.0047*	1.51249	0.2315
Southern Romerike	6.92382	0.0008*	1.17125	0.3494

Appendix 20: Results from Granger Causality test with six lags

6 lags	House Prices do not Granger cause Consumption		Consumption does not Granger cause House Prices	
	F-statistic	P-value	F-statistic	P-value
Alna	5.97786	0.0016*	0.62185	0.7105
Bjerke	3.83533	0.0133*	0.71245	0.6446
Grorud	4.97456	0.0041*	0.45324	0.8329
Stovner	5.14753	0.0035*	0.65696	0.6848
Frogner	0.73086	0.6314	0.62845	0.7057
Northern Aker	2.46998	0.0665	0.38059	0.8813
Ullern	0.54279	0.7687	0.37241	0.8864
Western Aker	0.97547	0.4711	1.01994	0.4454
Asker	5.54629	0.0024*	0.90280	0.5155
Bærum	1.75417	0.1689	0.13171	0.9904
Follo	4.03203	0.0108*	0.60626	0.7220
Northern Romerike	5.27215	0.0031*	0.55579	0.7592
Southern Romerike	6.90673	0.0008*	0.67983	0.6681

9. Preliminary Thesis

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BI NORWEGIAN BUSINESS SCHOOL

GRA 19002 – Preliminary Thesis Report

The Norwegian Housing Market:

Will Households in East and West of Oslo respond differently to Financial and Economic changes?

Supervisor:
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BI Oslo

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Master of Science in Business and Economics/Siviløkonom

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Table of Contents

1. Introduction

We have reason to believe that the Norwegian housing market is affected by several financial variables, due to the close relationship with Norway's economy. By using the Consumption Capital Asset Pricing Model (CCAPM) and financial variables as GDP, inflation, interest rate, unemployment and wealth, we investigate whether these factors have an impact on the Norwegian housing market. One of the major advances in finance and macroeconomics is the development of consumption-based asset pricing theory (Oikarinen and Kahra 2002). The wealth effect of housing property is discussed by Case, Quigley and Shiller (2001) that found that there is a generally positive relationship between wealth and consumption. Thus, we have reason to believe that changes in housing wealth have effects on household's behavior.

Wealth may take many forms, and there is reason to think that the tendency to consume out of housing wealth is different from the tendency to consume out of stock market. Previous literature (Case, Quigley and Shiller 2001) shows that housing market is earmarked for long term investments because people are general less aware of the short-run changes in real estate wealth since they do not receive regular updates on its value. Oikarinen and Kahra (2002) state that the housing market is less volatile than the stock market and thus more addressed to long-term investments. The peaks and troughs are less fluctuating; thus the risk is lower and it is safer to invest.

The fact that 80% (2011)[18] of the Norwegian population own their home indicates that housing plays an important role for the population and the country's economy. The Norwegian housing market is in a strong and stable position[19] .We therefore find the housing market very interesting, and find it very exciting to see what really affect the housing prices, and how the variation in house wealth affects people's behavior. Having a place to live is seen as a necessary need, and people will be affected by the housing market sometime during their lifetime. Other interested observers of house prices are financial authorities and central bankers. According to Larsen and Sommervoll (2004, 77); "*housing loans make up a large proportion of credit creation in an economy*". The security of

[18] http://www.dinside.no/870855/8-av-10-nordmenn-eier-egen-bolig
[19] http://em.dnbeiendom.no/boligaret-2012-sto-kurs-%e2%80%93-tross-turbulens

mortgages will be affected by changes in real estate value, which further will affect the macroeconomic performance.

Moderate research has been conducted on this area earlier; Larsen and Sommervoll (2004) argue that the challenge of identify each dwelling uniquely is one of the main reasons. We want to test how geographical areas in Oslo respond differently to the same critical variables. We think it is both important and interesting to investigate the impact of these variables on the Norwegian housing market. We will test the east and the west neighborhoods of Oslo to make it easier to find any differences. Due to our thoughts, it is more common to settle down for a longer period in these areas than in the city center.

Using quarterly data from the Norwegian housing market for the period 1992-2010 we want to test the following research question: *Will households in the east and west areas of Oslo respond differently to the CCAPM and the financial variables?*

i. Will households in the east and west areas of Oslo respond differently to critical variables as interest rate, inflation, GDP, unemployment and wealth?

ii. Will the consumption behavior be affected differently in the east and west areas of Oslo by changes in housing wealth?

We want to test the following hypothesis:

H_0 = There is no difference between how the households respond in east and west

H_1 = There is a difference between how the households respond in east and west

2. Literature review

There is some literature on the role of housing when it comes to investments, housing wealth and consumption. An article that includes parts of our research is the work of Case, Quigley and Shiller (2001). The article investigates the linkage between stock market wealth, housing wealth and household consumption using data from different U.S. states and other developed countries, one of them Norway. Case, Quigley and Shiller (2001) argue that in according to the life cycle savings hypothesis consumers will distribute increases in anticipated wealth over time, thus a proportional effect between wealth and consumption must exist in the long run. Paiella (2009) also has the same findings and says that householder's

consumption might increase due to an increase in house prices. This might lead to tightening credit constraints which allow householders to borrow more and smooth consumption over time.

Case, Quigley and Shiller (2001) point out that there are many reasons why consumption may be differently affected by the stock market and the house market. Since people do not receive regular updates on their housing values, they may be less affected by short-run changes. Thus the long-run effects of real estate wealth on consumption seem more important. Their results strongly support that consumption is affected by variations in housing market wealth. Rahman (2010) argues that with rising prices people feel wealthier and more confident. This leads to increased consumption, and is called the 'wealth effect'. Aggregate demand increases which leads to economic growth and a raise in house prices through a self-reinforcing cycle.

The same findings are in accordance with Oikarinen and Kahra (2002). Housing prices experience bull and bear markets like stock market, but prices may be less volatile for house properties because of more moderate fluctuations. Permanent gain in wealth is therefore common with increased house prices, thus households can borrow against their increased housing equity. Income obtained from housing in this way will thus have directly impact on consumption (Oikarinen and Kahra 2002). This means that for a rational forward looking householder there is a close link between housing prices and consumption, thus CCAPM gives a good explanation to housing returns (Oikarinen and Kahra 2002). CCAPM is defined as the declining marginal utility of wealth as consumption increases. The individual's consumption plays an important role since individual utility is based directly on consumption. The same authors also found that location affects the housing investments. Since householders do not buy new houses every time there is a rising opportunity, the holding periods are long, and the housing market is characterized as illiquid.

The Norwegian housing market has increased the recent twenty years. Before the last financial crisis house prices increased drastically and people wanted to buy and invest in houses. But equity reductions and capital losses that appear outside of consumer control can be crucial when the market burst (Larsen and Weum,

2008). In that way house price bubbles tend to emerge when there is market inefficiency. Therefore one may benefit from considering the optimal entry point to find the pattern of house prices cycles. The same article compares the Norwegian housing market with other countries in the article by Case and Shiller (1989). They found that the Norwegian housing market is more stable.

According to Larsen and Sommervoll (2004) it was a tremendous price increase in the house market in Oslo during the booming in 1990s. Larsen and Sommervoll (2008) point out that house prices are of interest because they affect the security of mortgages. Since the aggregate of mortgages influence macroeconomic performance, financial authorities and central bankers also have interest of house prices. Moreover, since housing costs are a large part of households' budget, the distribution of wealth is affected by both changes in and among relative housing prices. Another important issue is that time-sensitive households with lower standards of living, that own or rent smaller apartments, experience an accelerated increase in cost-of-living compared to households with higher standards of living which tend to purchase larger houses. Most of the house mortgages in Norway are floating loans which is equivalent to rapid and potentially drastic prices increases (Larsen and Sommervoll 2008).

Past research (Rahman 2010) indicates that there are different factors that influence housing prices. Increased housing prices tend to have a positive impact on households wealth, employment, aggregate demand and GDP. House prices are also mainly determined by demand and supply factors. According to standard economic theory (Rahman 2010), house prices increase when demand exceeds supply. The critical variables that affect the housing prices are both short-term and long-term factors. Among the short-term factors we have the interest rate. With lower interest rate, the mortgage repayments will be lower, thus consumers can borrow more at the given repayment-to-income ratio. This will increase the demand for housing and hence increase the housing prices, other things being equal. Tax benefits lead to increased investment demand for housing since investment in property is preferable in terms of risk and return. In the last decades, the inflation in Norway has been stable and the unemployment rate has decreased. In addition, the average income of people has been improved. This in turn motivates investors, which increase the housing demand. Several authors (Berry

and Dalton 2004, Chouwdhury and Mallik 2004) have also found relationship between decreased unemployment and increased house prices.

In the long-run is house prices affected by demographic factors. When the population increases, the demand for houses will be even higher, and this will increase the house prices (Rahman 2010). In Oslo the demand for houses has exploded during the last decades, due to immigration, and this is one of the reasons why the price per square meter is so high. Permanent house price inflation is thus caused by this population concentration. Empirical study from Helbling and Terrones (2003) notes that GDP is also positively affected by increased house prices in many countries. Another issue concerning rising housing prices is the distributional aspect (Rahman 2010). Owners of rental property tend to be better off through a price increase than renters which will be worse off. In addition will generational differences matters; older owner-occupiers may benefit from a price increase but the younger generation will reduce their chances to purchase their own house because of the high price. This actually leads to a drop in their consumption when house prices increase.

The article by Case, Quigley and Shiller (2001) conducts the method ordinary least squares (OLS) for estimating wealth effects on consumption. The dataset consists of time series cross-sectional data from 1982-1999 to see whether housing wealth or financial wealth has the most significant effect on consumer's wealth in both U.S. and developed countries. As Case, Quigley and Shiller (2001), we will also apply OLS, and we will use time-series because we want to test each critical variable's influencing on the house prices over the period 1992-2010.

Baccaro and Rei (2005) use a time-series approach for 18 countries between 1960 an 1998 where they test institutional and macroeconomic measures. By using OLS they test the full static model. Further through cross-validation, they test the cross-sectional homogeneity. Different from our paper, they estimate the model leaving out one country to see how well a country fits the data. In the same way as Baccaro and Rei, we will apply OLS. To see if the data is appropriate we will also use the cross-validation method where we will divide the data into different time periods for each area.

3. Data description

Our data will consist of the real estate price statistics for the east and west areas of Oslo from 1992 to 2010. We want to use data from Norges Eiendomsmeglerforbund (NEF) where the data is available and can be downloaded from their respective web pages. Data from Statistics Norway (SSB) will also be used, but we have not received those data yet. In our study we will use data that includes the entire housing market, including both rental and owned houses.

To get the best impression of the differences in house prices in Oslo we will divide Oslo into the west and the east areas. The house prices in the west of Oslo are expected to be higher than in the east area (appendix 1). Since the west area of Oslo is an attractive place to live, the willingness to pay is high, and thus the house prices are higher. On the other hand, in the east neighborhood of Oslo, the demand is still high, but the prices are relatively lower (Larsen and Sommervoll 2004). As Larsen and Sommervoll (2004,78) states in their article; "*Households with lower standards of living, which purchase smaller apartments not only for investment purposes but also to extract shelter services, experience an accelerated increase in costs-of-living relative to households with higher standards of living, which tend to purchase larger dwellings*". By comparing these two areas we will find out if households in the west and east respond differently to the critical factors and to the CCAPM.

We will define the west area of Oslo as the neighborhoods Frogner, Ullern, Vestre Aker and Nordre Aker, while we define the east area of Oslo as the neighborhoods Alna, Stovner, Grorud and Bjerke. Our dataset involves data from 1992 to 2010. Data from this period include the two last financial crises. We think that quarterly data is the most appropriate because it gives the best picture of the changes during the year. People's expectations of the housing market have an impact of how the market develops due to demand and supply. Since consumers expectations do not change that often as monthly we will prefer quarterly data.

Further, we want to look at the financial variables interest rates, inflation, GDP, wealth, unemployment and the model CCAPM to see whether and how they might impact in the west and east areas of Oslo. They are crucial for the housing

market and will help us to explain the differences in the markets in the most appropriate way.

3.1 Interest rate

Norges Bank determines the interest rate to ensure a stable and low inflation[20]. The interest rate will have an impact on the consumers' willingness to pay. A high interest rate indicates more expensive loans and thus the demand will decrease. On the other hand, if the interest rate decreases the activity in the market will increase. With a low interest rate the consumers' willingness to take more loans in the bank will increase, and this will stimulate the market. As Ebrahim and Mathur (2003, 1) states in their article; "*Changes in interest rates will cause inverse changes in housing prices*".

3.2 Inflation

According to Steigum (2010) the inflation is based on rapidly increased prices on goods and services that have an impact of macroeconomic factors, as interest rates, developments in wages and exchange rates. When Norges Bank sets the interest rate they have a goal to maintain a stable and low inflation which contribute to economic growth, higher wealth and income, in addition to low unemployment. The inflation rate is forecasted every year with a target of 2.5%[21].

As Titman (1982) states in his article will a decrease in interest rate lead to an increase in inflation, which further will make the demand higher, as well as house prices will increase.

3.3 Wealth

Wealth can be difficult to define and quantify, thus the most common measure is income[22]. We have decided to use net fortune as a measure of wealth since it includes consumers' revenue and assets subtracted debt. As Case, Quigley and Shiller (2001) indicate is there a relation between wealth and consumption. As wealth increases, consumption follows the same proportional effect, thus the willingness to pay becomes higher. This indicates that the purchasing power increases and people might demand more goods and services, such as a more attractive house.

[20] http://www.norges-bank.no/en/about/published/articles-and-chronicles/art-2001-05-29-enhtml/
[21] http://www.norges-bank.no/en/about/published/articles-and-chronicles/art-2001-05-29-enhtml/
[22] http://www.regjeringen.no/nb/dep/fin/dok/regpubl/stprp/2008-2009/stprp-nr-1-2008-2009--2/5.html?id=530454

3.4 GDP

GDP is the value of a country's total produced domestic goods and services in a given year or quarter, valued at market prices (Steigum 2010). Previous produced capital formation, as dwellings, is not included in GDP. When a house is sold, only the ownership shifts hand without new value added. Thus, only new dwellings are included in a country's GDP. According to Rahman (2010) will an increase in the house prices from one period to another increase the GDP since increased GDP is related to both increased production and prices.

3.5 Unemployment

Unemployment is a huge economic and social problem. During recessions, high unemployment leads to low activity in the market, and thus lower standards of living. In addition will it result in bigger differences among the population, since the unemployed become the biggest loser. Even though unemployment leads to more leisure, most of the unemployed will consider their situation as unsatisfied, especially if they are unemployed during a long-term period. We can thus consider low unemployment as booming activity in the market, where both the demand for housing and the house prices increase.

3.6 CCAPM

Consumption Capital Asset Pricing Model (CCAPM) is a multi-period model based on current and future consumption (Bodie, Kane and Marcus, 2009). This model is one of the major advances in financial and macro economics. A consumer with a specific amount of income can either decide to consume today or save for future investments, to smooth consumption over time. This is called the portfolio selection problem (Oikarinen and Kahra 2002). Through portfolio selection, the consumer can transfer wealth between different time periods, and thus affect his or her consumption path. Increased wealth will thus have the same positive proportional effect on consumption and living behavior (Oikarinen and Kahra 2002).

3.7 Frequency

Unemployment, consumption and wealth will be collected from SSB with a frequency of quarterly data. Since these variables differ from neighborhood to neighborhood, we want to measure the variables on the east and west areas of

Oslo, respectively. The interest rate will be collected from Norges Bank[23] and it is public available to download at their respective homepage. Inflation, Consumer price index (CPI) and GDP will be collected using Datastream. Since interest rate, inflation, CPI and GDP are variables that measure the entire country's economic condition, will we use quarterly frequency for Norway. In order to calculate the CCAPM we need the risk-free rate and the return from the house market. This will be collected using Datastream.

4. Methodology

In finance and macroeconomics most of the data can be described as time-series, as repeated set of observations of the same variable (Favero, 2001) .Time-series is widely used in quantitative analysis of financial issues. Selecting an appropriate frequency to use for the observation for the same time period is important. Our data is collected on different variables over a period of time. With quarterly frequency on the financial variables we will estimate how the quantitative data impacts the dependent variable, house prices, over time. Time-series take into account that the data over time may have an internal structure as seasonal variation which may occur on house prices during Christmas and summer holiday.

Time-series is a sample of observations indexed by the date of each period with starting time t=1 and ending time t=T. Our finite time series can be written as:
t = 1992, 1993,…, 2010.

A linear regression model will be used to estimate[24] all the financial variables over the entire period from 1992-2010 on the house prices. By testing how the house prices will be affected, we see which variables that are most significance in the different neighborhoods using the following equations:

$$House\ prices_{east} = \beta_0 + \beta_1 interest\ rate + \beta_2 inflation + \beta_3 unemployment + \beta_4 GDP + \beta_5 wealth + \beta_6 consumption + u_t \quad (1)$$

[23] http://www.norges-bank.no/no/prisstabilitet/rentestatistikk/styringsgrente-manedlig/
[24] We will use EViews for all estimation.

$$House\ prices_{west} = \beta_0 + \beta_1 interest\ rate + \beta_2 inflatio + \beta_3 unemployment + \beta_4 GDP + \beta_5 wealth + \beta_6 consumption + u_t \quad (2)$$

Since this estimation only will give us an overall picture of the differences, more estimation of the individual variables is needed. Ordinary Least Squares (OLS) is a standard regression procedure which will estimate the true relationship between two variables using sample data. We will estimate the influence of each independent variable on the house prices. A linear relationship between two variables will be as the following:

$$y_t = \alpha + \beta X_t + e_t \quad (3)$$

House prices will be the dependent variable y_t, while the individual financial variables will be the independent variable X_t. β is a vector of parameters to be estimated. α is the constant term and is the error term that makes the equation equal with a mean zero. When estimating the individual factors separately on the house prices, we will test which variable that is most significance on the house prices. This will be an appropriate estimate to answer our first research question.

We will use the statistical method called cross-validation (CV) to validate the model. Cross-Validation divides the data into two segments to compare and evaluate algorithms (Refaeilzadeh, Tang and Liu 2008). This model will help us estimate how the model will perform and how accurately it will be in practice.
By using cross-validation we partitioning a sample of the house prices into subgroups in both east and west, and perform an analysis of them separately. We will divide the data into 1992-2000 and 2001-2010 in both east and west areas separately. Further we will compare the results under cross-validation with the result for the same variable under OLS regression to see if our research is appropriate.

In order to estimate the CCAPM we use the quarterly house price data received from SSB. In addition we apply the gross private consumption and the consumer price index to estimate the average and standard deviation.

The illustration of the CCAPM model is:

$$r = r_f + \beta_0(r_m - r_f) \quad (4)$$

r = expected return

r_f = risk-free rate

β_0= consumption beta

r_m = return from the market

By using equation (4) we can calculate the expected return from housing property, and thus see if the consumption growth and the price level have changed during the sample period. From previous research (Oikarinen and Kahra 2002) we know that price changes in the sample period dominates the effect of the total return on housing property. In recessions the average consumption rate can be negative.

By estimating the expected return on house prices with consumption through OLS, we find the change in consumption with changes in housing wealth. As Oikarinen and Kahra (2002) find; there is a strong positive relationship between changes in housing wealth and consumption. If the expected return from house prices increases, the housing wealth increases, and people will thus increase their consumption. This will be appropriate for answering our last research question.

5. Progress plan

We will try to follow our progress plan as much as possible:

January: We have collected research articles, financial books and other sources to write the preliminary thesis report. We are still waiting for the data collection from SSB.

February: We want to collect even more sources and start writing on the introduction part and the literature review. We hope to get this finished by the end of the month. Since we are still waiting for the data, we will try to join coaching courses in Datastream and EViews.

March: We are expecting to get the data collection this month, so we will start writing the data description. When this is finished, we will write the methodology part and then start to estimate the data collection. As we know, this will take much time, so we assume to use some parts of April too.

April: We will continue working with the estimation of the data, and try to find results to our research questions. Since the exam period is approaching, we suppose to use some time to study and prepare for the exams in May.

May: This is the exam month, so we will give priority to prepare for the exams. If we have time, we will continue with the data estimation.

June: We will try to finish the research and write the results. As we know from earlier assignments, this will take much time, in addition to control that we have done everything correct.

July: We hope that we have come to a conclusion this month so we can finish the thesis. At last we will write appendix and references.

1st September: Deadline!

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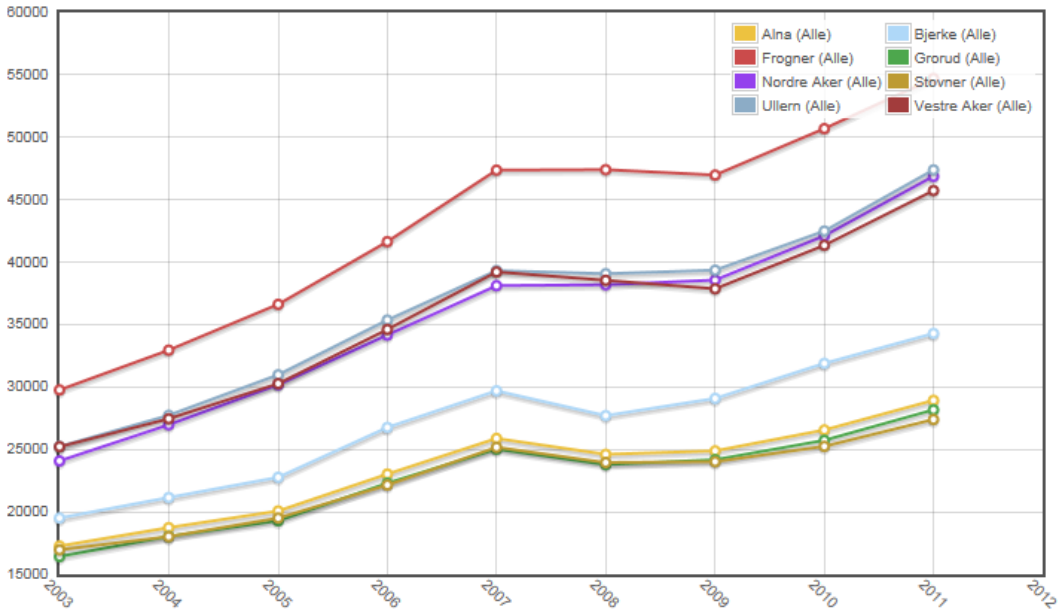
7. Appendix

Appendix 1: Growth in house prices in east and west areas in Oslo



Source: http://www.nef.no/xp/pub/topp/boligprisstatistikk