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The Cash-out Refinancing in the Norwegian Housing Market

Master's Thesis
For the Degree of MSc Financial Economics

Trondheim, June 2014

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Abstract

The housing prices in Norway and the ratio of Norwegian household debt to disposable income have reached unprecedentedly high levels in recent years, raising concerns about whether we are in a serious housing bubble. This attracts much attention and initiates debates among politicians, researchers as well as the entire society. Contributing to the debates, the present thesis studies "cash-out" refinancing in the Norwegian housing market and has two main findings. First, along with the soaring housing prices in the past ten years, mortgage borrowers significantly extended their debt levels through home equity-based refinancing. This "cash-out" effect substantially contributed to the high ratio of Norwegian household debt to disposable income. Second, borrowers with larger "cash-out" refinancing are more likely to face payment difficulties with unexpected expenditures, indicating a potential coming danger in the Norwegian housing market. As "cash-out" refinancing is blamed to be one of the key drivers of the subprime crisis in the United States (Atif Mian and Amir Sufi, 2011 AER), our findings call for more regulations in the Norwegian mortgage market.

Preface

This thesis is submitted in partial fulfillment of the requirements for the degree MSc. at the Norwegian University of Science and Technology. The master thesis is carried out as a cooperation between Synne Schanke Almaas and Line Synnøve Bystrøm. The data applied in the present thesis are retrieved from Statistics Norway's (SSB) survey of living conditions 2001, 2004, 2007 and 2012. Anonymized data sets have been made available by the Norwegian Social Science Data Services (NSD). SSB was responsible for sampling and interviewing. Neither NSD nor SSB are responsible for the analyzes/interpretation of the data presented. Thanks and appreciation to Christopher Tønnessen (NSD), John Epland and Tor Morten Normann (SSB).

Further, we would like to thank Vegard Johansen and Per Kristian Alnes (Østlandsforskning) for helpful guidance. Moreover, a deep sense of gratitude to Håvard Håkon, Øystein and Frederik for proofreading and support.
Finally, a special thank to our supervisor Postdoctoral Fellow Xunhua Su who trusted us to take on this project. He has given us helpful guidance and valuable comments, with great enthusiasm.

Trondheim, June, 2014

Synne Schanke Almaas Line Synnøve Bystrøm

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Chapter 1

Introduction

The debt of Norwegian households has reached a unprecedentedly high level, and has increased more than the income in the latest years. By the end of 2013, Norwegian households had a debt to income ratio[1] of 210 percent (The Financial Supervisory Authority of Norway, 2013). In the US, the debt to income ratio has never exceeded 130 percent, even at its peak in 2007, which was followed by the financial crisis.

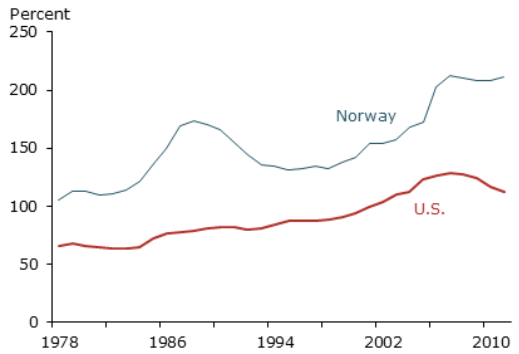


Figure 1.1: Ratio of Household Debt to Disposable Income
Sources: Norges Bank and FRB St. Louis

Prior to the crisis, mortgage credit became more easily available for

[1]Debt as proportion of disposable income

new home buyers, which contributed to the rapid increase in US-household leverage between 2002-2006 (Mian and Sufi, 2009). In Norway, regulations and capital requirements by the authorities are set to prevent the banks to undertake a lot of risky mortgages. New home buyers need at least 15 percent equity to get mortgage credit (Norges Bank, 2013).

Recent research by Mian and Sufi (2011) finds that a significant part of the US leverage crisis, was driven by existing home-owners borrowing heavily against rising home value. This finding provides motivation to apply this line of research in the Norwegian housing market.

Our main goal in this study is to estimate how Norwegian home-owners "cash-out" home-equity as a response to increased home value. Using cross sectional survey data consisting of anonymous households housing and credit conditions, we examine this home-equity based borrowing channel, also referred to as the "cash-out" effect. The survey of living conditions is conducted annually by Statistics Norway, with a rotating module. The module of housing conditions were carried out in 2001, 2004, 2007 and 2012. The survey data includes a total of 10 433 owner households.

First, we present a model in order to measure if home-owners extract home-equity based on their self-predicted home value. Controlling for household characteristics, we find that a one percent increase in predicted selling price is associated with 0.55 percent "cash-out" of home-equity, or borrowing of 55 NOK for every 100 NOK gain in home equity.

Next, we seek to answer whether the the rapid growth in the housing market amplify the "cash-out" effect for Norwegian home-owners. By including time dummies and interaction terms, we examine whether the "cash-out" effect differs across time. Our findings suggest that home-owners respond more aggressively to a change in predicted selling price in 2012, compared to 2001. Furthermore, we identify which home-owners that "cash-out" most aggressively. By studying the cross sectional heterogeneity among home-owners, we find that the extraction of home-equity is not uniform across household characteristics.

Economists Paul Krugman, Vernon Smith and Robert Shiller, have all warned about a Norwegian housing bubble. Krugman's warnings are based on the strong and continuous growth in Norwegian house prices in addition to the high debt to income ratio. Smith points out the rapid growth in house prices, compared to the growth in inflation and income as a sign of a bubble. Shiller's concerns are based on possible psychological factors among Norwegians, and argues that the oil industry and low unemployment rate may be a feeling of national success. In other words, we have three Nobel Prize winners pointing out the same; the Norwegian housing market looks like a bubble (Dagens Næringsliv, 2014, 8th of January; Langberg, 2013; Ellyatt, 2012).

Paul Krugman's concerns about the Norwegian housing market got some unexpected attention from the prime minister of Norway, Erna Solberg. In January 2014, she rejected a housing bubble in Norway and stated:

> *"Often I find foreign economists, with an American view, have a different frame of reference when analyzing the Norwegian economy"*
> *Source: Dagens Næringsliv, 8th of January, 2014*

Krugman, however, interpreted this as an even stronger sign of a bubble, and provocative enough replied:

> *"When politicians says that everything is OK, its a sign of a bubble"*
> *Source: Dagens Næringsliv, 8th of January, 2014*

The credit default rate on Norwegian households fell after the banking crisis in the 1990s, and has been low and stable since 2000 (Solheim and Vatne, 2013). At the same time, the debt to income ratio has never been higher (Vrålstad, Wiggen, and Thorsen, 2013). The relatively small share of credit defaults could be explained by certain credit regulations. In Norway, there is full recourse borrowing, meaning the credit do not follow the house but the individual. As for the lenders, securitization of mortgages are strictly regulated (NOU, 2011).

Despite the existence of "cash-out" in the Norwegian housing market, the authorities reject the existence of a bubble. In our final analysis we use a logistic model to identify how the probability of facing payment difficulties is related to the "cash-out" refinancing. Our model suggest a 50 percent higher odds of having payment difficulties for households with a mortgage that exceeds the initial house price.

We do not attempt to confirm bubble speculations, nor predict a financial crisis. Our contribution to the ongoing debate concerning the Norwegian housing market is to explore the "cash-out" effect, and to determine whether or not the "cash-out" effect is sustainable for the household economy.

To achieve the goals mentioned, first a brief look into theoretical background and literature will be covered in chapter 2. Research question and hypotheses will be presented in chapter 3. Chapter 4 features descriptive statistics and describes the underlying methodology. Subsequently, chapter 5 covers the empirical analysis and the test results. Having carried out the results, chapter 6 then features a discussion of the most interesting findings and results. Finally, chapter 7 concludes the thesis with a brief summary.

Chapter 2

Background and the Literature

2.1 Regulatory Differences Between Housing Markets in Norway and the US

The last thirty years the financial system has undergone a revolutionary change. The technical change has reduced transaction costs while commercial and academic development has led to a widely use of portfolio optimization, securitization and credit scores. The deregulation has removed barriers which prevents entries and competition between institutions, markets and products. Last, the institutional change has provided new entities within the financial system, such as private equity firms and hedge funds. As a result the financial markets have expanded and become deeper, and hence allowed the risk to be more widely spread throughout the economy (Rajan, 2005).

The purpose of securitization is converting illiquid assets into liquid securities. This process allows the lenders to structure financial products like collateralized debt obligation (CDO) and mortgage-backed securi-

ties (MBS) (Benmelech and Dlugosz, 2010). As pointed out by Keys et al. (2010), the securitization practices did affect screening incentives of US lenders prior to the subprime crisis. CDOs and MBSs offered high return, due to higher interest rates on mortgages. The risk level was considered low as the credit agencies provided the lenders with high credit scores (Benmelech and Dlugosz, 2010).

Prior to the US subprime crisis in 2007, the US leverage sharply increased. From 2002 to 2007, US households doubled their debt balance. Debelle (2004) points out that much of the increase in household leverage can be attributed to two factors, which is the deregulation in the early 1980s and the reduction of interest rates. Combined, these factors commonly reduce the credit constraints on households. It seems to be widely agreed that introducing easy available mortgage credit to risky new home buyers, was unsustainable (Mian and Sufi, 2009; Anundsen and Jansen, 2011). Other countries, including Norway, with more stable credit conditions have been relatively shielded from the current crisis. The main effect was through international financial leakages, as Norwegian banks had a small exposure to US subprime loans. Norwegian manufacturers produced consumer durables to a very small extent, which were the products exposed to the greatest decline in demand internationally. Furthermore, the demand from the oil sector remained high. The financial solidity of Norway gave the authorities high flexibility in economic policy compared with many other countries. The losses on loans for the financial sector were modest, hence the financial crisis was not a solvency crisis for Norwegian banks (NOU, 2011). Norwegian households have a high leverage rate compared with other countries. 80 percent of Norwegians own their home, a share that

has been stable for the last decades (Vrålstad, Wiggen, and Thorsen, 2013). Furthermore, the majority of households hold floating interest rate mortgages. When the financial crisis reached Norway, the expansionary monetary policy had a fast and powerful impact on households income and thus their demand (NOU, 2011).

Norwegian fiscal institutions are subject to regulations which in certain areas are stricter than the requirements in the European Union. A low percentage of mortgage defaults may be contributed to some of these regulations. The process of mortgage securitization is strictly regulated. Mortgages are full recourse, hence home-owners have a strong incentive to avoid default (NOU, 2011). In 1992 the Debt Settlement Act (DSA) was introduced in Norway. The arrangement involves setting up a plan for the debtor's income and expenses for the next five years. If the person lives simply and follows the determined plan, the debt is partially, or completely, cleared by the end of the five-year period. The intention of the DSA is to ensure that the borrower fulfils its obligations as far as possible, and that there is an organized distribution of the debtor's assets among creditors (Kommunal- og regionaldepartementet, 2004). A full recourse mortgage exposes the lenders for less risk, since the mortgage follows the borrower and not the real estate (International Monetary Fund, 2012). This is contrary to some states in the US, where the borrower has limited liability. Hence, a decrease in house prices would affect the lender to a greater extent in the United States as home-owners simply could choose to walk away from their homes to cover their mortgages (NOU, 2011).

2.2 Aggregate House Prices and Aggregate Consumption

There is a strong correlation between aggregate house prices and aggregate consumption (Case, Quigley, and Shiller, 2003). Defining wealth as the sum of liquid financial assets and property minus outstanding debt, implies that an increase in house prices leads to an increase in households financial wealth. The underlying model of consumer behaviour depends on whether or not this contribution can affect the housing wealth. Standard economic theory suggests utility maximizing households with rational and forward looking behaviour. Households decide how much to consume in this period, and how much to invest/save for future consumption (Varian, 1992). As pointed out by Sinai and Souleles (2005), an increase in home value compensates for an implicit higher rental cost. In other words, home-owners are hedged against fluctuations in spot housing costs. Houses pay out dividends equal to the ex post spot rent, and therefore a hedge against rent risk is provided. With increasing house prices, renters would experience an increase in their future rent "liabilities". On the other hand, home-owners would experience a corresponding increase in home value, and therefore an implicit dividend increase. These factors reduce the overall wealth effect from increased house prices, and should not affect consumption choices. In other words, the propensity to "cash-out" home equity is zero.

Young home-owners are expected to increase the size of their home

later in life, and can be thought of as "short" in the housing market. Older home-owners are on the other hand expected to move to smaller homes, hence they are "long" in the housing market. Without financial instruments to hedge these positions, house price growth is expected to affect the consumption of these two groups differently. Young households are expected to cut their consumption with rising house prices, while older households are expected to increase their consumption (Campbell and Cocco, 2007).

A second explanation of the correlation between consumption and house prices is credit constrained home-owners. Homes are used as collateral in a mortgage. An increase in home value allows borrowing constrained households to smooth their consumption path over time, by "cashing-out" home equity (Lustig and Nieuwerburgh, 2006).

Another consumption model is based on short-lived home-owners. This is households that do not value housing bequests high, and that prefer to spend their capital before they pass. These home-owners would "cash-out" home equity with increasing home value to finance consumption. The propensity to borrow would then be stronger for home-owners with a shorter life-horizon (Mian and Sufi, 2011).

From 2005 to 2010, TNS Gallup, on Finanstilsynet's behalf, conducted a survey of a random sample of borrowers that have taken out a mortgage secured on a dwelling over the past year. The results of the survey are presented in figure 2.1. In 2010, only a modest proportion of new

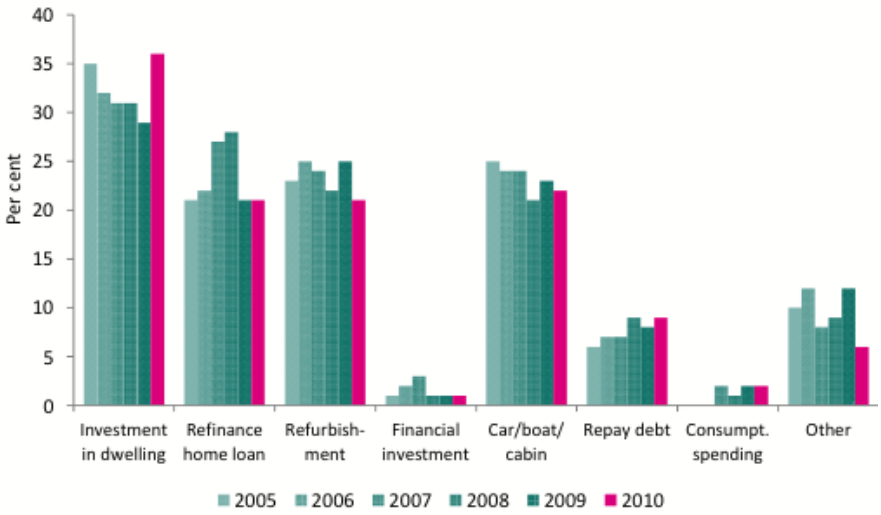


Figure 2.1: Purpose of Loan, ordinary repayment loans secured on dwellings
Source: The financial supervisory authority of Norway/Finanstilsynet

issued loans were used to housing investments[1]. About 50 percent of new issued loans were used for home improvement, purchase of a car, boat or cabin, consumption and repayment of other debt (The Financial Supervisory Authority of Norway, 2011).

2.3 Expectations and Housing Prices

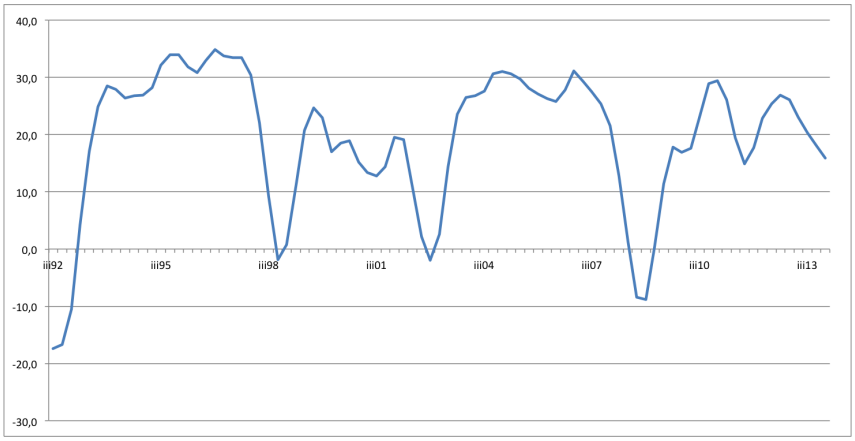
Behavioural economics and psychology are important to understand and predict households economic behaviour. In theory there are two types of investors, rational and irrational. Rational investors trade on

[1]Participants where able to report more than one purpose per loan

fundamental values, while irrational investors operate independently on fundamental values and might value an asset on the basis of historical returns or technical analysis. An argument supporting the efficient market hypothesis, is that irrational investors trade randomly, and hence cancel each other out. Psychological research suggests that noise traders do not trade randomly, but deviate in the same direction. In other words, irrational investors buy the same securities and sell the same securities roughly at the same time (Shleifer, 2000).

Case, Quigley, and Shiller (2003) finds that home-buyer's expectations are significantly affected by previous experience. Using US survey data, they find that home buyers who previous have experienced a rapid growth in house prices, typically expect an annual growth of double-digit numbers. This implies a tripling or quadrupling of home value for the next decade. At the same time, these home-buyers expect a low risk level. Previous work of Case and Shiller (1988) also suggests that home-buyers in cities where house prices have risen rapidly in the past, expect much higher future growth compared to home buyers in cities where house prices have been stagnant or declining.

Anundsen and Jansen (2011) finds that household's future expectations about their private economy and the Norwegian macro economy lead to an immediate increase in the house price growth. If the consumer confidence index, illustrated in figure 2.2, rises by one index point, the immediate effect on house price growth would be 0.1 percentage points. The cumulative increase in house prices would be 0.25 percentage points.



Source: Finans Norge

Figure 2.2: Survey of Expectations, 1992-2014. Norwegian households expectations concerning future development in their private economy and the macro economy, quarterly 1992-2014. The index is developed by TNS Gallup and Finans Norge. The indicator measures the difference between the percentage proportion of optimistic and pessimistic answers for each question, divided by 5. The survey questions are listed in appendix A

2.4 Self-reinforcing Effects Between Housing Prices and Debt

Falling house prices have preceded financial crises in the past[2] (Hilbers, Lei, and Lisbeth, 2001). Koetter and Poghosyan (2010) argues that deviations from the long run equilibrium occur more frequently in the real estate market compared to the financial market. This is thought to be because of the rigid supply and market imperfections. Increased house prices lead to higher demand for credit in order to finance a house purchase. As most mortgages have the property itself as collateral, and with rising house prices the value of the collateral also increases. More collateral leads to higher borrowing capacity for the home-owner. Property prices affect the value of the bank, since the probability of default reduces with higher value of the collateral on existing mortgages. This may stimulate the lending capacity for the banks, since the willingness to extend loans increases with the risk capacity of the bank. Since most property purchases are financed with credit, changes in household mortgages are expected to affect housing prices. The findings of Koetter and Poghosyan (2010) suggest that deviation of house prices from their fundamental value contributes to bank distress.

Anundsen and Jansen (2011) identifies the self-reinforcing effects between housing prices and debt. They find that real housing prices are affected by real debt, disposable income and home credit. Furthermore,

[2]For example, Netherlands (early 1980's) and Scandinavia (late 1980's), Japan (early 1990's)

the real debt depends on the real value of their property, real interest rate after tax and housing turnover. Their model shows that debt gives a direct effect on house prices in the short run, but the house prices only affect debt through the error-correction term. Further, they provide clear evidence of a financial accelerator in Norway. An exogenous shock in the credit aggregate changes the house price growth, which in turn changes the credit growth due to collateral effects. This, in turn, drives the house price growth further, and so on.

Chapter 3

Research Question

3.1 Motivation

The findings of Mian and Sufi (2009) suggest that the sharp increase in US household leverage from 2002 to 2006, was a primary trigger of the recent financial crisis. They point out that the rapid leverage growth can be contributed to the weakening of the US credit standards. As the standards were weakened, mortgage credit became more easily available for new home buyers. Furthermore, in Mian and Sufi (2011) they provide evidence that the credit availability also had an important feedback through existing home-owners. Using individual credit files they follow a panel of 74 000 US home-owners at an annual frequency from 1997 to 2008. By using two types of instrument variables for the house price growth, they find a strong link between house prices and household borrowing. In addition, they suggest that the extraction of home-equity concentrates largely among young home-owners with high credit card utilization or low credit score. Their findings also indicate that the extraction of home-equity is primarily used for consumption or home-improvement.

However, the most interesting finding in their paper is the relation between home-equity extraction and the default rate. By estimating the default rate implications of home-equity extraction, they found that 39 percent of US defaults can be attributed to existing home-owners. This implicates that the US-default crisis was not entirely driven by new home-buyers, but also through the "cash-out" refinancing of exciting home-owners.

As of the current Norwegian credit standards, subprime lending is not an issue for the Norwegian banks. However, the evidence provided by Mian and Sufi (2011) gives strong motivation for researching whether or not it is possible to find a "cash-out" tendency among Norwegian households.

3.2 The Norwegian Housing and Credit Market

In the 1970s the Norwegian credit market was strict, and the authorities had a wide range of instruments to keep the credit growth under control (Krogh, 2010).

The strict regulations in the 1970s were followed by a gradual deregulation in the 1980s. In 1980 the interest rate norms set by the government were given less strict formulation, before it was abandoned in 1985 and interest rates were allowed to float freely. The liberalization process in

the 1980s lead to a sharp increase in household leverage and boomed the real estate market, illustrated in figure 3.1. The stock market collapse in October 1987 and an increase in credit defaults, were the first signs of weaknesses in the banking sector. In the following years, losses on loans increased. In the beginning of the 1990s, the Norwegian economy experienced a national banking crisis, and a sharp drop in house prices (Krogh, 2010). This was a development fulfilling the characteristics of a boom-bust economy (Eitrheim and Erlandsen, 2004).

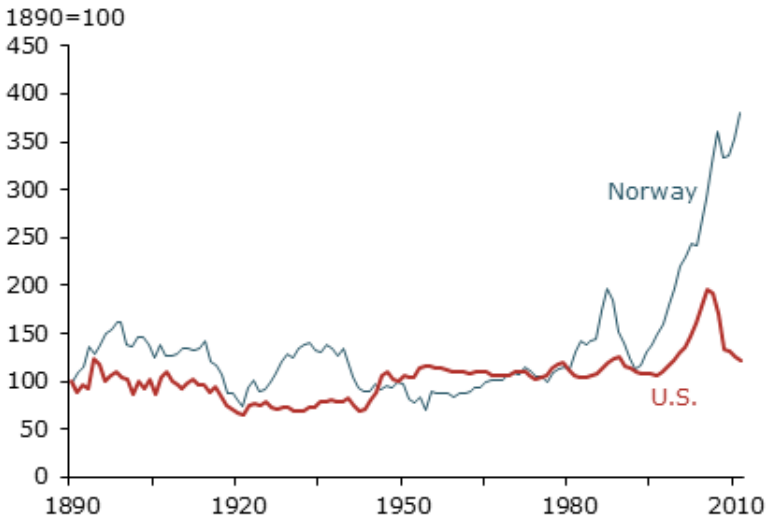


Figure 3.1: Real House Price Index
Sources: Shiller (2005) and Eitrheim and Erlandsen (2004, 2005)

In 1992 the unemployment rate peaked at 6 % accompanied by a lending rate of 13 %. Despite this, only 1033 houses were enforced sold (Astrup and Aarland, 2013). In 1992-1993 the house price index started to increase and the banks started to improve. In 1996 new requirements were introduced to limit the market risk. The housing market

continued to increase and so did the demand for credit. In 1998 regulations by the authorities were implemented to increase the risk weight [1] for mortgages with a high loan to value (LTV) [2]. As a result, the demand for credit was somewhat damped (Krogh, 2010; Jansen and Krogh, 2011).

In 2001 the regulation in 1998 was reversed, as this change in the risk weights of the banks were meant to be temporary. Mid 2000s "flexible mortgages" became more available and popular. Compared to a traditional mortgage, these loans provide a flexible credit line, where the home-owners are free to choose how much they want to use of a given mortgage constraint. As these loans became more available, housing wealth became much more liquid. In 2007 Basel II[3] were implemented (Krogh, 2010). In this context, the most important change was that the risk weight on mortgages was reduced [4]. Throughout 2007, 41 percent of existing home-owners increased their mortgage (Vatne, 2009). As the US subprime crisis became global, the Norwegian housing market fell in the first half of 2008. The international setback and uncertainty contributed to a reinforcing decrease. The housing market stabilized in 2009, and the boom continued. This was contrary to many OECD-countries which experienced a reversal after the previous appreciation. The increase in industrial activity and the low unemployment rate may have contributed to the growth in the Norwegian housing market af-

[1] An increase from 50% to 100%

[2] Mortgages with LTV between 60% and 80%

[3] A set of international banking regulations put forth by the Basel Committee on Bank Supervision

[4] LTV below 80% were given risk weight of 35 %, LTV above 80% were given a risk weight of 75%

ter the crisis (Finansdepartementet, 2013). In 2010 requirements of 10 percent equity to obtain a mortgage secured on dwelling, were implemented. The Financial Supervisory Authority of Norway's, concerns about the financial stability, lead to a further increase in the equity requirements in 2012. 15 percent equity was implemented to ensure a prudent lending practise, in order to reduce the risk in the household sector as well as the solidity of the banks (Norges Bank, 2013).

Excluding 2009, the debt to disposable income ratio has increased over the last 15 years (The Financial Supervisory Authority of Norway, 2013). However, the increased household leverage has not affected the credit default rate. After the crisis in 1990, the credit default rate decreased, and has been low and stable since 2000 (NOU, 2011). In February 2014, The Norwegian Minister of Finance, Siv Jensen, argued in her speech on the Eff-day[5] that the credit regulations and increasing house prices have made it more difficult for "ordinary" people to get mortgage approval. Jensen has repeatedly given the impression that she wants more flexible practise of the 15 percent equity requirement.

3.3 Hypothesis

The objective of the analysis conducted in the present thesis is to determine if existing home-owners in Norway extract home-equity based on self-predicted home value.

[5]Eiendomsmeglerforetakenes forening

The findings of Mian and Sufi, 2011 showed that the weakening of the US credit standards also had an important feedback through existing home-owners. The credit standards in Norway are supposed to ensure sustainability for the household economy as well as the banking sector (Norges Bank, 2013). Our focus will be whether or not the findings of Mian and Sufi, 2011 can be related to the Norwegian economy. Further, we consider whether these findings call for more regulation in the Norwegian mortgage market.

Hypothesis I: *The "cash-out" effect is positive and significant for Norwegian households.*

In Norway, increased house prices have been accompanied with increased household debt. This motivates for the second hypothesis.

Hypothesis II: *The "cash-out" effect is increasing and changes significantly over time in Norway.*

Further, to investigate which home-owners that respond most aggressively to increased predicted selling price, we formulate the following hypothesis:

Hypothesis III: *"The cash-out" effect is heterogeneous across Norwegian home-owners.*

Finally, the leverage growth in Norway is assumed to be sustainable due to credit regulations. This motivates for the fourth hypothesis.

Hypothesis IV: *The Norwegian household economy is sustainable despite the existence of the "cash-out" effect.*

Chapter 4

Data and Methodology

4.1 Data Material

In the present analysis, we use household level data from the Survey of Living Conditions. SSB, Division for Social Welfare Statistics is responsible for the surveys. The survey is carried out annually with a set of rotating topics. Housing conditions were the topic in 1997, 2001, 2004, 2007 and 2012. SSB collects the data mainly through telephone interviews, and in some cases personal interviews. The sample of the survey contains a rotating panel. This means that the same individuals are interviewed several years, in addition to new participants. Additional assessment data is connected to the surveys after the interview process. NSD anonymize the data files and make them available for researchers and students. Due to national regulations about privacy and anonymity the panel can not be connected. In the survey of 1997 one of the key variables chosen for this thesis was omitted, hence the surveys used in the present analysis is from 2001, 2004, 2007 and 2012 (Vrålstad, Wiggen, and Thorsen, 2013).

In 2011 the survey was coordinated with Eurostats Survey on In-

come and Living Conditions, EU-SILC. This implementation makes it possible to compare the living conditions across European countries (Vrålstad, Wiggen, and Thorsen, 2013). As a result, the sample size has increased, and is twice as large as the previous years. However, the response rate of the survey has decreased (Sandlie and Grødem, 2012).

The samples in the survey of living conditions are drawn according to SSB's procedures for random selection. The sample is randomly chosen from BeReg[1]. A representative sample of persons above the age of 16 is chosen to participate in the survey. The gross sample in the survey is supposed to represent the total population. Selection criteria are based on gender, age, education and family size (Vrålstad, Wiggen, and Thorsen, 2013).

From the randomly chosen sample some individuals were prevented to participate due to living abroad or in an institution, or they have past (Vrålstad, Wiggen, and Thorsen, 2013). The sample will no longer be fully representative if the participants that do not answer the survey is not random. To correct the potential bias, SSB has calculated frequency weights based on the selection criteria. Individuals with properties that are more frequently represented in the population are assigned a higher weight. Individuals with the same characteristics are placed in the same group, also called a stratum. Within the same stratum, the number of individuals who participated is divided by the gross sample. This number is the frequency weight. Finally, the weights are

[1]The population statistics system at Statistics Norway

corrected so that the sum equals the number of individuals in the gross sample (Vrålstad, Wiggen, and Thorsen, 2013).

Furthermore, this analysis examines "cash-out" refinancing on a household level. Every person above the age of 16 in the register has the same probability of being selected in the sample. For households, this implies that the probability increases with the number of persons older than 16 years currently living in the household. To correct this probability skewness of being selected, household weights are generated by dividing 1 by the number of adults in each household (Sandlie and Grødem, 2012).

$$\text{Household weight} = \frac{1}{\text{Number of adults in the household}}$$

Combining these two types of weights captures the effect of not random drop-outs and the heterogeneous drawing probability of the households, and yields the following.

$$\text{Replicate weight} = \text{Frequency weight} * \text{Household weight} \tag{4.1}$$

Our analysis focus on home-owners, hence renters are not of interest and will not be included in the analysis. Individuals under the age of 25 living home with their parents, are also not included. In the survey, participants report the household's time at which the house was purchased, remaining mortgage and predicted selling price. This causes a potential mismatch between the participant's age and these variables. The final sample consists of 12 010 individuals, which when using replicate weights amounts to 10 444 households.

4.1.1 Descriptive Statistics

Table 4.1 lists relevant statistics from the household data, including household mortgage[2], purchase price of home, predicted selling price of home, mortgage as a proportion of purchase price, and number of participating households. The reported average mortgage does not include households without debt. Over the studied period, outstanding mortgage grew by 372%, and the predicted selling price grew by 226%.

Table 4.1: Summary Statistics of Key Variables

	2001	2004	2007	2012
Total mortgage (in NOK)	358.849	714.984	973.087	1,335,416
	(10,682.)	(15,841.)	(20,471.)	(21,480.)
Purchase price (in NOK)	627.599	806.033	975.807	1,384,661
	(13,503.)	(17,467.)	(21,177.)	(24,946.)
Predicted selling price (in NOK)	1,349,258	1,752,865	2,284,624	3,051,363
	(21,471.)	(41,286.)	(37,710.)	(43,809.)
Mortgage to house price ratio	0.635	0.905	0.933	1.021
	(0.010)	(0.017)	(0.015)	(0.013)
Observations	2062	1380	2071	4920

Standard errors in parentheses. The numbers are listed in current values. Survey weights are used in the calculation of the population means.

In order to examine a household's tendency of borrowing against increased home value, we use the household's remaining mortgage and their predicted selling price of their home. These values are calculated

[2]The mortgage is secured on a household's current dwelling.

as a ratio of the initial purchase price. This normalization produces variables that give information about the mortgage as a proportion of initial value, in addition to information of predicted growth in house price for each home-owner. Logarithmic functional form is applied to the explained variable and the main explanatory variable to satisfy the assumptions for the regression more accurately. The explained variable chosen in the regression is mortgage, and is determined as:

$$\text{Mortgage as proportion of initial price} = \log\left(\frac{\text{Mortgage of household}}{\text{Purchase price}}\right)$$

The explanatory variable of main interest in the present analysis is the prediction of the selling price, which is given by:

$$\text{Predicted house price growth} = \log\left(\frac{\text{Predicted selling price}}{\text{Purchase price}}\right)$$

Table 4.2 lists the mean of the main variables and the household characteristics. The mean of mortgage as a proportion of the initial house price is negative for each year, and also for the pooled cross section. As expected, the average household has a lower mortgage than the purchase price of their home. Considering the development in the Norwegian housing market it is to expect that the mean of the ratio of predicted selling price is positive for each year. However the ratio is not increasing during the sampled period. Household characteristics, such as age of participant, duration of ownership, household size, children and number of working in household are more or less constant through the whole period. The income variable is divided into quartiles for each year. The reference group for income are households within the lowest 25 percent for each year.

Table 4.2: Summary Statistics: Mean of Main Variables

Variables	2001	2004	2007	2012	Full set
Mortgage as a proportion of initial price	-0.515 (0,021)	-0.263 (0,027)	-0.208 (0,023)	-0.146 (0,017)	-0.228 (-0,011)
Predicted house price growth	1.047 (0,028)	1.007 (0,023)	1.089 (0,026)	1.028 (0,019)	1.041 (0,012)
Duration of ownership	15.954 (0,363)	14.978 (0,305)	15.487 (0,369)	15.978 (0,264)	15.744 (0,166)
Age of household head	51.294 (0,439	50.314 (0,359)	51.477 (0,431)	52.708 (0,330)	51.867 (0,204)
Household size	2.300 (0,029)	2.438 (0,028)	2.245 (0,028)	2.209 (0,021)	2.265 (0,013)
Nr. of children in the household	0.568 (0,020)	0.635 (0,020)	0.521 (0,020)	0.496 (0,013)	0.534 (0,009)
Nr. of working in household	1.081 (0,020)	1.171 (0,018)	1.107 (0,020)	1.154 (0,015)	1.133 (0,009)
Income 1. quartile	224 133 (30919)	265 267 (3351)	299 343 (3931)	347 019 (3060)	302 657 (2100)
Income 2. quartile	422 432 (2100)	479 702 (2313)	547 371 (2600)	637 402 (2417)	556 295 (2206)
Income 3. quartile	579 394 (1918)	651 683 (2011)	761 176 (2951)	905 023 (2509)	777 414 (2954)
Income 4. quartile	876 607 (8021)	1 000 200 (11278)	1 119 047 (7897)	1 318 332 (6430)	1 156 571 (5205)

Standard errors are listed in parentheses. Duration of ownership is the number of years since the purchase of the property. Age is determined by the participant in the survey. Household size is the number of persons living in the household. Children are household members below the age of 16. Household members with paid employment are defined as working in the household. Income is divided into quartiles for each year, and listed in current prices.

The survey contains information about the household's ability to manage an unforeseen expenditure[3]. In order to examine how the "cash-out" tendency affects the household's economy we define two binary variables:

$$\text{Payment difficulties} = \begin{cases} 1 & \text{if the household can not} \\ & \text{manage an unforeseen expenditure} \\ 0 & \text{otherwise} \end{cases} \tag{4.2}$$

The "cash-out" variable takes the value of 1 if the household has a mortgage that exceeds the purchase price of their home.

$$\text{"Cash-out"} = \begin{cases} 1 & \text{if} \quad \text{mortgage} > \text{purchase price of home} \\ 0 & \text{if} \quad \text{mortgage} \leq \text{purchase price of home} \end{cases} \tag{4.3}$$

In table 4.3 we present households with and without payment difficulties for each year together with the pooled total. The variable, payment difficulties, captures household's subjective risk, concerning their economic situation. The percentage share of households with payment difficulties is decreasing over the period.

Table 4.4 lists the number of households with a mortgage that exceeds the purchase price of the house for each year. We see that the "cash-out" tendency increases rapidly from 2001 to the other years. In 2012 almost every third household has definitely extracted home-equity.

[3]The amount of the unforeseen expenditure was 3000 NOK in 2001, 5000 NOK in 2004 and 2007, and 10000 NOK in 2012

Table 4.3: Payment Difficulties by Year

Year	Payment difficulties=0	Payment difficulties=1	Total	Percentage share
2001	1607	447	2054	21,8 %
2004	1104	266	1370	19,4 %
2007	1740	306	2046	15,0 %
2012	4175	718	4893	14,7 %
Total	8626	1737	10363	16,8 %

The table lists units of households that have responded on the question concerning payment difficulties.

Table 4.4: "Cash-out" by Year

	"Cash-out"=0	"Cash-out"=1	Total	Percentage share
2001	801	20	821	2,4 %
2004	471	189	660	28,6 %
2007	812	313	1125	27,8 %
2012	1932	875	2807	31,2 %
Total	4016	1397	5413	25,8 %

The table lists units of households. Participants that have a non-response on either outstanding mortgage or purchase price are not included.

4.1.2 Drawbacks with the Data

In addition to the self-reported variables, assessment data is connected to the dataset. Due to anonymity SSB truncates and rounds the assessment data, and as a consequence the mean might be affected. However, the distribution of the full sample is not affected to a large extent (Vrålstad, Wiggen, and Thorsen, 2013). Until the assessment data for year n is completed, data for year $n-1$ is connected. Accordingly we have information about income for year 2011 in the dataset for 2012, since the assessment data for 2012 is not yet available. This implies a potential mismatch, especially for households where the living situation has changed (Sandlie and Grødem, 2012). A potential error can also be expected with self-reported variables.

4.2 Regression Analysis

Regression analysis is a statistical method which can be used to study the relationship between two or more variables. A regression model predicts the value of the explained variable based on the explanatory variables. Ordinary least squares, OLS, seeks to minimize the sum of the squared error terms. That is, every vertical distance from an observation to the regression line is squared. Finally, the sum of these squares is minimized (Brooks, 2008).

By combining the surveys, using random samples from each year, an independently pooled cross section is obtained. Pooled cross section observations are not likely to be identically distributed, since it is reasonable to believe that the explained variable, and some of the explanatory variables have changed over time. This can be dealt with by simply allowing the intercept in the model to change over time. Pooling random samples increases the sample size, which can lead to more precise and reliable estimates (Wooldridge, 2009).

4.3 Modelling "Cash-out"

To determine if there is a tendency of a "cash-out" effect in the Norwegian housing market, we first examine how predicted house price growth affects mortgage for the pooled cross section. The first model we estimate is a multiple regression model and is given by:

$$log\left(\frac{\text{Mortgage}}{\text{House price}}\right)_{it} = \beta_0 + \beta_1 log\left(\frac{\text{Predicted selling price}}{\text{House price}}\right)_{it} + \gamma_j x_{ijt} + u_{it}, \tag{4.4}$$

where

- $log\left(\frac{\text{Mortgage}}{\text{House price}}\right)_{it}$ is the logarithm of the mortgage as a proportion of the purchase price for household i in year t.

- The intercept β_0 in equation 4.4 measures the logarithmic mortgage ratio when all other explanatory variables equals zero.

- β_1 is the elasticity of $\frac{\text{mortgage}}{\text{house price}}$ with respect to $\frac{\text{predicted selling price}}{\text{house price}}$ This coefficient measures the percentage change in mortgage ratio when the ratio of predicted house price increases with one percent. This is the "cash-out" effect.

- γ_j measures the ceteris paribus effect of household characteristics on the explained variable. The household characteristic for household i in year t is denoted by x_{ijt}, $j = 1, 2, ..., 6$ and denotes the characteristic , given by
  x_{i1t} = Duration of ownership for household i in year t
  x_{i2t} = Age of the household i's participant in year t
  x_{i3t} = Household size for household i in year t
  x_{i4t} = Number of children in household i in year t
  x_{i5t} = Nr. of working in the household for household i in year t
  x_{i6t} = Income quartile for household i in year t

- u_{it} is the error term for household i in year t, also known as the disturbance. u_{it} represents factors other than the explanatory variables that affects the mortgage ratio.

We find it reasonable to believe that home-owners who have owned their house for a longer period is likely to predicate a higher growth than the home-owners that have owned their house for shorter periods. To control for this, an interaction term of the ratio of predicted selling price and duration of ownership is added in the model. Adding an interaction term change the interpretation of all of the coefficients. β_1 is no longer the unique "cash-out" effect as the interaction term measures the effect of predicted house price growth for different durations of ownership. A positive value for the estimated coefficient of

the interaction term would imply that the longer duration, the greater “cash-out” effect.

To test whether or not the “cash-out” effect is significant, we preform a t-test to test our hypothesis about the parameter β_1. We know that the estimator for β_1 derived by OLS is unbiased, but we do not know the actual β_1 in the population. By using a t-test we can test our hypothesis about “cash-out” estimated by β_1 using statistic interference. The following hypotheses are formulated:

$$H_0 : \beta_1 = 0 \text{ No “cash-out” effect}$$

$$H_1 : \beta_1 > 0 \text{ “Cash-out” effect}$$

We calculate the t-statistic by the formula:

$$t_{\hat{\beta}_1} = \frac{\hat{\beta}_1}{se(\hat{\beta}_1)},$$

where $se(\hat{\beta}_1)$ is the standard error of $\hat{\beta}_1$ (Wooldridge, 2009).

The rejection rule depends on the significance level. On a 5% level there is 5% chance of rejecting H_0 and accepting the alternative hypothesis when H_0 is true. The critical value based in the t distribution is denoted by c. We reject H_0 if:

$$t_{\hat{\beta}_j} > c$$

Next, we seek to answer whether the "cash-out" effect changes over time. Since the intercept in a regression model often changes over time, we allow for changes in the intercept by adding a dummy variable for each year. By interacting the main explanatory variable with the year dummies, it is possible to test whether or not the slope coefficients change over time. Hence, we test whether or not the "cash-out" effect differs between 2001, 2004, 2007 and 2012. With an adjusted Wald test it is possible to test whether there is joint significance for the slope coefficients (Wooldridge, 2009).

$$\begin{aligned} log\left(\frac{\text{Mortgage}}{\text{House price}}\right)_{it} = \beta_0 + \beta_1 log\left(\frac{\text{Predicted selling price}}{\text{House price}}\right)_{it} + \gamma_j x_{ijt} \\ +\delta_1\ \text{d04}_t + \delta_2\ \text{d07}_t + \delta_3\ \text{d12}_t \\ +\left(\delta_4\ \text{d04}_t + \delta_5\ \text{d07}_t + \delta_6\ \text{d12}_t\right) log\left(\frac{\text{Predicted selling price}}{\text{House price}}\right)_{it} + u_{it}, \end{aligned} \tag{4.5}$$

where d04, d07 and d12 are dummy variables equal to one if the observation comes from the corresponding year, and zero otherwise.

Table 4.5: Interpretation of the Coefficients in Model 4.5

Year	Intercept	Estimate of the "cash-out" effect
2001	β_0	β_1
2004	$\beta_0 + \delta_1$	$\beta_1 + \delta_4$
2007	$\beta_0 + \delta_2$	$\beta_1 + \delta_5$
2012	$\beta_0 + \delta_3$	$\beta_1 + \delta_6$

We test Hypothesis II, whether the "cash-out" effect has changed over the period, by formulating the following hypothesis for the adjusted

Wald test:

$$H_0 : \delta_4 = \delta_5 = \delta_6 = 0$$

$$H_1 : \text{No } H_0$$

A rejection of this hypothesis implies a slope difference between the years. To determine if the "cash-out" effect is increasing over the period, we test the following hypothesis:

$$H_0 : \delta_4 = \delta_5 = \delta_6$$

$$H_1 : \text{No } H_0$$

A simple transformation of the Wald statistic gives the F-statistic. The p-value of the test can be interpreted as the probability of observing a value of the F-statistic at least as large as we did, given that the null hypothesis is true. Small p-values will hence suggest evidence against H_0 (Wooldridge, 2009).

We examine hypothesis III by interacting $log\left(\frac{\text{Predicted selling price}}{\text{House price}}\right)$ with the variables of household characteristics. In order to determine whether the "cash-out" effect vary by household characteristics we again use a t-tests to test whether the interaction term is statistically significant.

Furthermore, we compare the "cash-out" effect between the income quartiles, the age cohorts and the groups of duration of ownership. We again use an adjusted Wald test to examine whether the slope coefficients differs across the groups. When using replicate weights and analyzing sub-populations, only the sub-population is needed in the calculation of the mean and the regression estimate, but all cases are

needed to correctly calculate the standard errors and the variance.

In the final part of the analysis we focus on the effect of "cash-out" refinancing on the household economy. The explained variable in this final part is the binary variable for payment difficulties. Logistic regression are added to the analysis. This is done due to weaknesses of the OLS method when the explained variable is binary. The error terms in an OLS regression with a binary explained variable are heteroskedastic. In addition, the error terms will not be normally distributed. Furthermore, the predicted probabilities can be greater than 1 or less than 1, which does not make much sense. The heteroskedasticity does not affect the estimators of the parameters. However, it will affect the standard error and hence, the t-tests will not be correctly computed (Tufte, 2000).

The logistic regression model is a non-linear transformation of the linear regression. The logistic regression model can be constructed by an iterative maximum likelihood procedure. When there is a positive relationship between the variables, it offers an S-shaped distribution function where the estimated probabilities lie between 0 and 1. The change in the explained variable as a result of a unit change in the explanatory variables is smallest at the "tails" of the curve, and increases towards the center of the curve (Tufte, 2000).

We formulate the following model:

$$ln\left(\frac{P(\text{Payment difficulties = 1})}{1 - P(\text{Payment difficulties = 1})}\right)_{it} = b_0 + b_1\text{Cash-out}_{it}$$
$$+\gamma_j x_{ijt} + \gamma_l z_{lkt} + \delta_1\ \text{d04}_t + \delta_2\ \text{d07}_t + \delta_3\ \text{d12}_t + e_{it}, \tag{4.6}$$

- $ln\left(\frac{P(\text{Payment difficulties=1})}{1-P(\text{Payment difficulties=1})}\right)$ in equation (4.6) is the logarithm of the odds, called the logit, and the variables are defined by equation 4.2 and 4.3.
- b_1 measures the change in the logit of having payment difficulties, when the household is in the "cash-out" group.
- γ_l is the parameter for a macro control variable, given by z_{lkt}, where t denotes the four years, $k = 1, 2, ..., 7$ denotes the region and $l = 1, 2, 3, 4$ represents
  z_{1kt} = Unemployment rate for region k in year t
  z_{2t} = Δ Consumption
  z_{3t} = Δ GDP
  z_{4t} = Lending interest in year t
- e_{it} is the error term for household i in year t

Unemployment rate is defined as the percentage of the labour force and coded to the k counties defined by SSB in the survey of living conditions. The counties are listed in appendix B. The data for unemployment rate is retrieved from the Norwegian Labour and Welfare Service (NAV). ΔC is the volume change in household consumption from first quarter in year *t-1* to first quarter in year *t*. ΔGDP is the

volume change in GDP in mainland economy from first quarter year *t-1* to first quarter year *t*. The floating lending interest rate is connected to each household's year of home purchase. The lending interest rate is computed as a yearly mean. Data for lending interest rate, volume change in consumption and GDP is retrieved from SSB's statbank.

The estimates of the coefficients in the logistic regression can be reported as odds ratios. The odds ratio of our main explanatory variable is calculated by:

$$\text{Odds ratio} = \frac{\frac{p_1}{1-p_1}}{\frac{p_0}{1-p_0}},$$

where p_0 and p_1 are the probabilities of facing payment difficulties given the two values of the "cash-out" variable. The odds ratios express the change in odds when the explanatory variable increases with one unit. If the odds ratio is greater than one, there is a positive relation between the dependant and the independent variable, and the odds for having the property of the explained variable increases. If the odds ratio is less than one, the odds decreases. Multiplying the odds ratio with 100 gives the percentage change in odds ratio. This number implies how much the new odds represents as a percentage of the original when the independent variable increases by one unit (Tufte, 2000).

4.4 Assumptions for the Regression Analysis

The assumptions for OLS is listed in Appendix C. The OLS method requires homoskedasticity. When the variance of the unobservable error, u, varies across different segments of the population, this assumption is not fulfilled and the errors contain hetereoskedasticity. Homoskedasticity is required in order to conclude that the estimators of the variances are unbiased. Since the error terms are based directly on these variances, presence of heteroskedasticity makes the errors invalid for constructing t-statistics and F-statistics. In other words, homoskedasticity is required in order to preform valid t-tests and F-tests for the OLS estimation (Wooldridge, 2009).

Heteroskedasticity-robust procedures can be used whether or not the errors have constant variance. By using replicate weights, in the regression analysis, standard errors that are robust to heteroskedasticity are computed. Using logarithmic functional form for models where $y > 0$, often satisfy the full set of assumptions more closely than using levels of y. Conditional distributions that are heteroskedastic or skewed are often the case for strictly positive variables. Using the log of these variables may reduce or eliminate both of these problems. The logarithmic transformation also makes the estimates less sensitive to outliers (Wooldridge, 2009).

Especially for small datasets, outliers and extreme observations can

greatly affect the OLS estimates. Trimming makes the distribution less sensitive to outliers. Trimming means to discard the lowest and highest $k\%$ of the observations. In order to deal with outliers, trimming of the variables mortgage, predicted selling price, house price is performed (Hellerstein, 2008).

Multicollinearity implies that there is high, but not perfect, correlation between two or more of the explanatory variables. High multicollinarity is not a violation of the OLS assumptions, but everything else being equal, less correlation between the explanatory variables is more reliable in the estimation of the parameters (Wooldridge, 2009). To examine the degree of multicollinearity when using survey weights, we run one regressions with each of the explanatory variables as explained variable. This makes it possible to evaluate each variable against all of the other predictors at the same time. We test whether the multicollinearity is a problem in the model specification in appendix E. Based on the test results, multicollinearity is not an issue for the regression analysis.

Chapter 5

Empirical Analysis

5.1 The "Cash-out" Effect in the Norwegian Housing Market

Table 5.1 contains the pooled regression results for the model given by equation 4.4. We study how the "cash-out" effect changes, as we add household control variables. The estimated "cash-out" effect is significant in all specifications. The estimated value of the "cash-out" effect increases from 0,5 to 0,7 from model (1) to model (2), due to controlling for duration of ownership. The coefficient for duration of ownership is found to be negative, implying down-payment of mortgages as the duration increases.

The estimator of the interaction term $log\left(\frac{\text{Predicted selling price}}{\text{House price}}\right)$ * (duration of ownership) in model (3) is positive and significant, implying 0,01 additional increase in the "cash-out" effect of one year longer ownership of the property.

Table 5.1: The "Cash-out" Effect in the Norwegian Housing Market

	(1)	(2)	(3)	(4)	(5)
Left-hand side variable	log(mortgage/house price)				
log(predicted selling price /houseprice)	**0.500*** ** (0.015)	**0.698*** ** (0.026)	**0.519*** ** (0.033)	**0.552*** ** (0.031)	**0.553*** ** (0.032)
Duration of ownership		-0.020*** (0.002)	-0.033*** (0.002)	-0.017*** (0.002)	-0.018*** (0.002)
log(predicted selling price /houseprice)* Duration of ownership			0.010*** (0.001)	0.009*** (0.001)	0.010*** (0.001)
Age				-0.018*** (0.001)	-0.017*** (0.001)
Household size				-0.018 (0.016)	0.008 (0.017)
Children				0.039** (0.018)	0.019 (0.019)
Nr. of working in household				0.040*** (0.015)	0.071*** (0.017)
Income 2. quartile					-0.030 (0.030)
Income 3. quartile					-0.087*** (0.033)
Income 4. quartile					-0.144*** (0.036)
Constant	-0.622*** (0.013)	-0.571*** (0.014)	-0.445*** (0.017)	0.135*** (0.047)	0.084* (0.050)
Observations	6.608	6.602	6.602	6.582	6.524
R-squared	0.224	0.247	0.264	0.328	0.331

Standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$
The table presents estimates of the "cash-out" effect for households. Replicate weights are used in the estimation. The reference group for income is households within the lowest 25 percentile. Age is determined by the age of the participant in the survey. Duration of ownership is the number of years since the purchase of the property.

In model (4), we add additional control variables for household characteristics. The coefficients for age, children and number of working in household is found to be statistically significant.

It is conceivable that the "cash-out" effect differs by income, and thus the finding in models (1)-(4) could be driven by an unobservable income effect. To examine this possibility, we control for income fixed effects in model (5). As predicted selling price increases by 1 percent, the propensity to "cash-out" home-equity is found to be 0.55 percent, similar to the findings in model (4). The income fixed effects are statistically significant, at a 1 % confidence level, for the two upper quartiles. These results implies that down-payment of mortgages increases for households in the higher income quartiles. We set model (5) as the baseline regression for the other analyzes.

Overall, these results indicate that households "cash-out" home-equity as their self-predicted selling price increases. These findings are consistent with Hypothesis I.

5.2 The "Cash-out" Effect over Time

It is conceivable that the effect of "cash-out" differs over time. The findings in table 5.1 could be driven by omitted time-varying factors that drive both house prices and mortgages. Recall that the explained variable and the explanatory variable of interest are adjusted by the

purchase price of the house. Hence, a large part of the year effects has been accounted for by this adjustment. Including year fixed effects controls for the remaining time effects.

The coefficients for the year dummies in model (1) are statistically significant on a 1 percent confidence level. The year dummies represent an increase in log $\left(\frac{\text{Mortgage of household}}{\text{Purchase price}}\right)$ that are not captured by the explanatory variables, and include aggregate factors that affect the explained variable over time. This result also highlight the importance of including year-dummies, which are brought on to the next analyzes.

In Model (2) we interact the predicted change in home value with the time dummies, in order to examine how the partial effects change over time. Since log $\left(\frac{\text{Predicted selling price}}{\text{Purchase price}}\right)$ is the main variable of interest, we assume the other factors have the same effect on log $\left(\frac{\text{Mortgage of household}}{\text{Purchase price}}\right)$ in all four time periods. Hence, a 1 percent increase in predicted selling price is associated with a “cash-out” of 0,11 percent in 2001. In 2012 the additional “cash-out” effect are estimated to 0,52 percent. In other words, a 1 percent increase in predicted selling price is associated with a “cash-out” effect of $0,11 + 0,52 = 0,63$ percent in 2012.

The interaction terms are significantly different from zero in all the time periods. Adding these interaction terms allow the “cash-out” effect to be different in each year.

Table 5.2: The "Cash-out" Effect over Time

	(1)	(2)
Left-hand-side variable	log(mortgage/house price)	
log(predicted selling price/house price)	**0.552*** ** (0.032)	**0.111*** (0.057)
Y2004	0.141*** (0.031)	-0.095** (0.042)
Y2007	0.211*** (0.028)	-0.069* (0.039)
Y2012	0.299*** (0.025)	0.008 (0.035)
Y2004*log(predicted selling price/house price)		**0.452*** ** (0.060)
Y2007*log(predicted selling price/house price)		**0.504*** ** (0.059)
Y2012*log(predicted selling price/house price)		**0.518*** ** (0.056)
Duration of ownership	-0.018*** (0.002)	-0.017*** (0.002)
log(predicted selling price /houseprice)* Duration of ownership	0.009*** (0.001)	0.008*** (0.001)
Age	-0.018*** (0.001)	-0.018*** (0.001)
Household size	0.014 (0.017)	0.015 (0.016)
Children	0.016 (0.018)	0.015 (0.018)
Nr. of working in household	0.058*** (0.017)	0.056*** (0.017)
Income 2. quartile	-0.021 (0.030)	-0.023 (0.030)
Income 3. quartile	-0.075** (0.033)	-0.076** (0.033)
Income 4. quartile	-0.136*** (0.036)	-0.140*** (0.036)
Constant	-0.084 (0.053)	0.152*** (0.056)
Observations	6.524	6.524
R-squared	0.347	0.360

Standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$ The table presents estimates of the "cash-out" effect for households when controlling for years. Replicate weights are used in the estimation.

Using an adjusted Wald test listed in the first row in table 5.3, we find that the interaction terms are jointly significantly different from zero. This indicates that the "cash-out" effect has increased from 2001 to 2004, 2007 and 2012. The result implies that inclusion of interaction terms create a statistically significant improvement in the fit of the model. Furthermore, based on the adjusted Wald tests for equality between the coefficients of the interaction terms for 2004, 2007 and 2012, we find no statistical significant evidence of an increasing "cash-out" effect in this period. However, we reject that the "cash-out" effect is equal in 2004 and 2012, on a 10 percent confidence level. Summarized, we cannot accept Hypothesis II based on these findings.

Table 5.3: Adjusted Wald Test of Difference in "Cash-out" Across Years

H_0	F(df_1, df_2)	P-value	Rejection of H_0
$\delta_4 = \delta_5 = \delta_6 = 0$	F(3,6521)=29,58	0.00	Yes***
$\delta_4 = \delta_5 = \delta_6$	F(2,6522)=1,66	0.19	No
$\delta_5 = \delta_6$	F(1,6523)=0,16	0.69	No
$\delta_4 = \delta_6$	F(1,6523)=3,29	0.07	Yes*
$\delta_4 = \delta_5$	F(1,6523)=1,56	0.21	No

5.3 The "Cash-out" Effect by Household Characteristics

Exploring the cross-sectional heterogeneity of the "cash-out" effect provides important information into the underlying model of consumer behaviour. In table 5.4 we examine how the propensity to extract home-equity vary by household characteristics such as income quartile, age, household size, number of children and number of working in the household.

In Model (1) the estimated coefficient of the interaction term between income quartile and $\log\left(\frac{\text{Predicted selling price}}{\text{Purchase price}}\right)$ is positive, which implies that the propensity to extract home-equity is higher for households at the upper end of the income distribution. The income dummies indicate a lower intercept for households with high income. This suggest lower mortgage ratio for high income households. In short, households at the fourth quartile of the income distribution have a lower mortgage to house price ratio, given that everything else is equal.

In model (2) we interact $\log\left(\frac{\text{Predicted selling price}}{\text{Purchase price}}\right)$ with age of household head. The coefficient estimate on the age interaction term suggests that the borrowing of older households is less responsive to predicted house price growth. However, the result is not statistically significant on a reasonable confidence level.

Table 5.4: Variation of the "Cash-out" Effect by Household Characteristics

	(1)	(2)	(3)	(4)	(5)
Left-hand-side variable	log(mortgage/house price)				
Household characteristic	Income quartile	Age	Household size	Children	Nr. of working in household
Household characteristic* log(predicted selling price/house price)	**0.039** (0.014)	**-0.001** (0.002)	**0.037***** (0.014)	**0.056***** (0.018)	**0.021** (0.018)
log(predicted selling price/house price)	**0.489***** (0.043)	**0.592***** (0.070)	**0.451***** (0.058)	**0.500***** (0.040)	**0.518***** (0.050)
Duration of ownership	-0.019*** (0.002)	-0.019*** (0.002)	-0.019*** (0.002)	-0.019*** (0.002)	-0.019*** (0.002)
log(predicted selling price /houseprice)* Duration of ownership	0.010*** (0.001)	0.010*** (0.002)	0.010*** (0.001)	0.011*** (0.001)	0.010*** (0.001)
Age	-0.018*** (0.001)	-0.017*** (0.002)	-0.018*** (0.001)	-0.018*** (0.001)	-0.018*** (0.001)
Household size	0.011 (0.017)	0.013 (0.016)	-0.018 (0.020)	0.015 (0.016)	0.014 (0.017)
Children	0.024 (0.019)	0.016 (0.018)	0.028 (0.019)	-0.020 (0.021)	0.018 (0.019)
Nr. of working in household	0.054*** (0.017)	0.056*** (0.017)	0.058*** (0.017)	0.058*** (0.017)	0.037* (0.022)
Income 2. quartile	-0.048 (0.031)	-0.021 (0.030)	-0.019 (0.030)	-0.019 (0.030)	-0.021 (0.030)
Income 3. quartile	-0.131*** (0.036)	-0.075** (0.033)	-0.071** (0.034)	-0.072** (0.033)	-0.074** (0.034)
Income 4. quartile	-0.224*** (0.043)	-0.137*** (0.036)	-0.135*** (0.036)	-0.135*** (0.036)	-0.136*** (0.036)
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Constant	-0.047 (0.055)	-0.104* (0.063)	-0.031 (0.056)	-0.072 (0.053)	-0.057 (0.057)
Observations	6.524	6.524	6.524	6.524	6.524
R-squared	0.348	0.347	0.348	0.348	0.347

Standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$ The table presents estimates of the "cash-out" effect for households. In each column, predicted house price growth is interacted with a household characteristic, listed at the top of the table. Duration of ownership is the number of years since the purchase of the property. Age is determined by the age of the participant in the survey. The reference group for income is households within the lowest 25 percentile. The base year is 2001. Replicate weights are used in the estimation.

The positive estimate on the household size interaction term in model (3) and the children interaction term in model (4) suggest that there is an additional "cash-out" effect for larger households. Both of these results are statistically significant on a 1 percent confidence level.

In model (5) the coefficient estimate on the working in household interaction term is positive, implying additional "cash-out" for households with more contributors to the household economy. The finding is however, not statistically significant on a reasonable confidence level.

When studying the “cash-out” tendency, household characteristics such as age, income and duration of ownership are of particular interest considering life-cycle theory.

The “Cash-out” Effect Across Income Quartiles

Figure 5.1 illustrates the average mortgage as a proportion of home purchase price for the income quartiles. This ratio takes the highest values for the second and third quartile. In table 5.5 we examine the

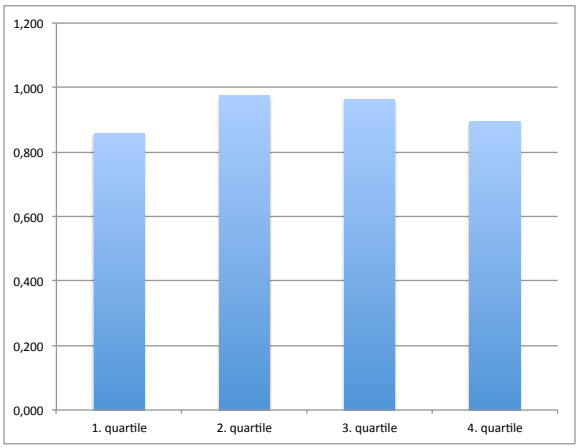


Figure 5.1: Mortgage to House Price by Income Quartiles

“cash-out” effect for each of the income quartiles. The “cash-out” effect is significant for all income quartiles. The coefficient of interest is highest for the 3.quartile. A 1 percent increase in predicted selling price, raises the propensity to extract home-equity by 0.59 percent for households in the third income quartile. Households in the first income quartile respond less aggressively, and “cash-out” 0.423 percent when predicted selling price rises by 1 percent. Performing an adjusted

Wald test, listed in appendix F, we find no statistical evidence of different "cash-out" behaviour across the income quartiles. However, we find households within the first income quartile to respond less aggressively to house price growth, compared to households in the second and third income quartile. The difference is significant on a 10 percent confidence level in both tests.

Table 5.5: Variation of the "Cash-out" Effect by Income Quartiles

	(1)	(2)	(3)	(4)
Income quartile	1. quartile	2. quartile	3. quartile	4. quartile
Left-hand-side variable	log(mortgage/house price)			
log(predicted selling price/house price)	**0.423*** ** (0.077)	**0.586*** ** (0.044)	**0.590*** ** (0.053)	**0.585*** ** (0.067)
Duration of ownership	-0.011**	-0.022***	-0.023***	-0.024***
	(0.004)	(0.004)	(0.004)	(0.006)
log(predicted selling price /houseprice)* Duration of ownership	0.010***	0.010***	0.010***	0.013***
	(0.002)	(0.002)	(0.002)	(0.003)
Age	-0.016***	-0.018***	-0.019***	-0.019***
	(0.002)	(0.002)	(0.002)	(0.003)
Household size	-0.000	-0.010	-0.001	0.050*
	(0.040)	(0.034)	(0.036)	(0.027)
Children	0.059	0.032	0.037	-0.027
	(0.050)	(0.041)	(0.037)	(0.030)
Nr. of working in household	0.066*	0.064**	0.052	0.044
	(0.034)	(0.030)	(0.036)	(0.037)
Y2004	0.038	0.098	0.165***	0.309***
	(0.074)	(0.065)	(0.051)	(0.054)
Y2007	0.134**	0.153***	0.250***	0.319***
	(0.065)	(0.056)	(0.049)	(0.054)
Y2012	0.207***	0.237***	0.274***	0.483***
	(0.059)	(0.050)	(0.043)	(0.049)
Constant	-0.085	-0.006	-0.059	-0.372***
	(0.099)	(0.112)	(0.136)	(0.135)
Observations	10.184	10.692	10.963	10.921
R-squared	0.373	0.359	0.328	0.341

Standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$ The table presents estimates of the "cash-out" effect for each income quartile. Duration of ownership is the number of years since the purchase of the property. Age is determined by the age of the participant in the survey. The base year is 2001. Replicate weights are used in the estimation. In model (4), children, number of working in household, and the fourth income quartile is omitted due to few observations.

The "Cash-out" Effect Across Age Cohorts

Figure 5.2 illustrates the mortgage as proportion of the house price for four age cohorts. The ratio exceeds 100 percent for the cohort of home-owners aged over 79. This is not in line with the theory of young home-owners buying homes and paying of their mortgage as they age.

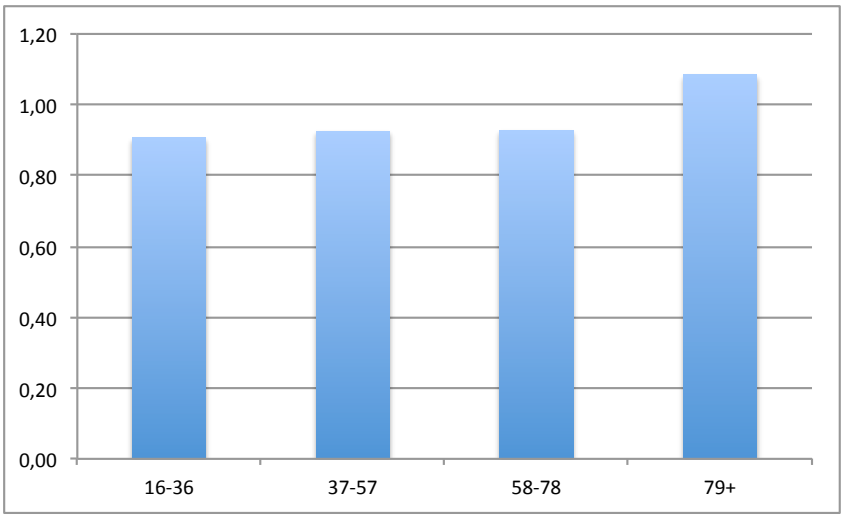


Figure 5.2: Mortgage to House Price by Age Cohorts

In Table 5.6 we study how the "cash-out" effect varies by different age cohorts. The coefficient of interest shows an increasing tendency from the age of 16 to 78. The age cohort consisting of home-owners aged 58-78 extract home-equity most aggressively given an increase in predicted selling price. The youngest age cohort "cash-out" 0,37 percent when predicting a 1 percent higher selling price. The estimate of the interaction term is highest for the youngest age cohort, implying

that these households extract home-equity more aggressively with an additional year of ownership. Further, there is not a statistical significant “cash-out” effect among the cohort of home-owners aged over 79. However, the interaction term is positive and significant on a 5 percent confidence level, which indicates that these home-owners extract additional home-equity the longer they have owned the house.

By performing an adjusted Wald test of joint significance (listed in appendix F), we reject equal “cash-out” behaviour across age cohorts on a 5 percent confidence level.

Table 5.6: Variation of the 'Cash-out" Effect by Age

	(1)	(2)	(3)	(4)
Age cohort	16-36	37-57	58-78	79-99
Left-hand-side variable	log(mortgage/house price)			
log(predicted selling price/house price)	**0.371*** ** (0.073)	**0.548*** ** (0.045)	**0.662*** ** (0.090)	**0.268** (0.290)
Duration of ownership	-0.030*** (0.008)	-0.028*** (0.004)	-0.011** (0.004)	-0.028 (0.018)
log(predicted selling price /houseprice)* Duration of ownership	0.030*** (0.009)	0.011*** (0.002)	0.006** (0.002)	0.014** (0.006)
Household size	0.042 (0.042)	0.044** (0.019)	-0.090 (0.063)	-0.103 (0.270)
Children	-0.034 (0.044)	0.024 (0.022)	0.261** (0.107)	
Nr. of working in household	0.048* (0.028)	0.026 (0.024)	0.140*** (0.038)	
Income 2. quartile	-0.011 (0.048)	-0.006 (0.045)	-0.028 (0.082)	-0.465 (0.376)
Income 3. quartile	-0.044 (0.052)	-0.090* (0.049)	-0.050 (0.104)	-0.865 (0.590)
Income 4. quartile	-0.177*** (0.057)	-0.167*** (0.051)	-0.030 (0.119)	
Y2004	0.138*** (0.046)	0.165*** (0.043)	0.334*** (0.123)	0.437 (0.489)
Y2007	0.149*** (0.035)	0.237*** (0.043)	0.532*** (0.118)	0.249 (0.328)
Y2012	0.149*** (0.036)	0.340*** (0.037)	0.639*** (0.107)	0.579* (0.341)
Constant	-0.512*** (0.069)	-0.882*** (0.057)	-1.663*** (0.150)	-0.871** (0.421)
Observations	11.303	10.055	9.708	11.488
R-squared	0.174	0.274	0.472	0.697

Standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$ The table presents estimates of the "cash-out" effect for households in different age cohorts, listed at the top of each column. Age is determined by the age of the participant in the survey. Replicate weights are used in the estimation. Duration of ownership is the number of years since the purchase of the property. The reference group for income is households within the lowest 25 percentile. The base year is 2001.

The “Cash-out” Effect Across Duration of Ownership

Figure 5.3 illustrates mortgage as proportion of the initial house price for six different categories of duration. On average, a household with duration of ownership over 15 years has a mortgage that exceeds the purchase price of their home. The ratio is increasing with duration of ownership. Performing regression analysis on different durations of ownership makes it possible to examine the time perspective of the household’s decision of cashing out.

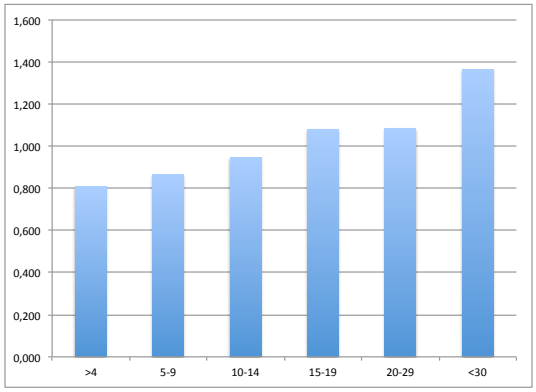


Figure 5.3: Mortgage to House Price by Duration of Ownership

In table 5.7 we estimate the “cash-out” tendency for different durations of ownership. The estimated “cash-out” effect shows an increasing tendency with longer duration of ownership. An increase of 1 percent in predicted selling price for a household that has owned their home for more than 30 years, is associated with a home-equity extraction of 0,81 percent. Households that have owned their home for less than 5 years, is estimated to “cash-out” 0,49 percent with a 1 percent increase in

predicted selling price.

We perform an adjusted Wald test of jointly equal "cash-out" effects between different duration of ownership, listed in appendix F. Equality is rejected on a 1 percent confidence level, hence we can conclude that the "cash-out" tendency differs across various owner-lengths.

Overall, the results in the present subsection indicate that households within the lowest income quartile tend to borrow less against increased home value compared to the other income quartiles. The "cash-out" effect increases with age up to the age of 78. Further, duration of ownership amplifies households propensity to extract home-equity. The findings from table 5.4 estimate higher "cash-out" tendency among larger households. The findings in this section is consistent with Hypothesis III.

Table 5.7: Variation of the "Cash-out" Effect by Duration of Ownership

Duration of ownership	(1) 0-4	(2) 5-9	(3) 10-14	(4) 15-19	(5) 20-29	(6) 30+
Left-hand-side variable	log(mortgage/house price)					
log(predicted selling price/house price)	**0.488*** **	**0.607*** **	**0.691*** **	**0.754*** **	**0.773*** **	**0.813*** **
	(0.055)	(0.059)	(0.079)	(0.062)	(0.057)	(0.047)
Age	-0.015***	-0.018***	-0.016***	-0.027***	-0.028***	-0.014***
	(0.001)	(0.002)	(0.004)	(0.005)	(0.005)	(0.005)
Household size	0.025	0.007	-0.011	0.105**	0.015	-0.256***
	(0.028)	(0.035)	(0.042)	(0.045)	(0.047)	(0.093)
Children	-0.026	0.015	0.059	-0.048	0.132*	0.440***
	(0.030)	(0.039)	(0.048)	(0.059)	(0.068)	(0.139)
Nr. Of working in household	0.084***	0.059*	0.127**	-0.085	0.045	-0.023
	(0.026)	(0.034)	(0.056)	(0.066)	(0.047)	(0.060)
Income 2. quartile	-0.008	0.038	-0.094	-0.122	-0.007	0.112
	(0.043)	(0.057)	(0.096)	(0.142)	(0.105)	(0.119)
Income 3. quartile	-0.050	-0.019	-0.212*	-0.197	-0.086	0.160
	(0.045)	(0.064)	(0.115)	(0.156)	(0.108)	(0.153)
Income 4. quartile	-0.160***	-0.129*	-0.276**	-0.148	-0.124	0.386**
	(0.052)	(0.069)	(0.113)	(0.162)	(0.118)	(0.169)
Y2004	0.016	0.194***	0.321***	0.325***	0.404***	0.940***
	(0.044)	(0.058)	(0.099)	(0.100)	(0.118)	(0.231)
Y2007	0.036	0.226***	0.377***	0.372***	0.716***	1.145***
	(0.037)	(0.053)	(0.087)	(0.115)	(0.116)	(0.228)
Y2012	0.075**	0.317***	0.430***	0.589***	0.807***	1.154***
	(0.034)	(0.046)	(0.081)	(0.097)	(0.105)	(0.213)
Constant	-0.070	-0.252**	-0.523**	-0.123	-0.461	-1.202***
	(0.072)	(0.112)	(0.232)	(0.360)	(0.321)	(0.409)
Observations	10.973	11.362	11.457	11.492	10.958	10.338
R-squared	0.177	0.278	0.291	0.388	0.331	0.454

Standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$ The table presents estimates of the "cash-out" effect for different groups of duration of ownership. Replicate weights are used in the estimation. Duration of ownership is the number of years since the purchase of the property. Age is determined by the age of the participant in the survey. The reference group for income is households within the lowest 25 percentile. The base year is 2001.

5.4 The "Cash-out" Effect and the Household Economy

Recalling the background material and our findings in the previous analysis, the "cash-out" effect is assumed to be sustainable in the Norwegian economy. In this section we examine if the "cash-out" effect can be a potential problem in the Norwegian economy. We investigate how the "cash-out" tendency affects the household economy by using the dummy variable for payment difficulties (introduced in chapter 4), as explained variable. The dummy variable for "cash-out" is the main explanatory variable.

The estimated coefficient in the linear probability model expresses the change in probability of having payment difficulties, associated with a unit change in the explanatory variables. The logistic model reports the odds ratio of the estimated parameters. In table 5.8 both the linear probability model and the logistic model are expressed, using different specifications.

Table 5.8: Payment Difficulties and the "Cash-out" Effect

	(1) OLS	(2) Logistic	(3) OLS	(4) Logistic	(5) OLS	(6) Logistic	(7) OLS	(8) Logistic
Left-hand-side variable				Payment difficulties				
Cash-out	**0.050*** **	**1.444*** **	**0.057*** **	**1.517*** **	**0.057*** **	**1.518*** **	**0.058*** **	**1.520*** **
	(0.014)	(0.140)	(0.014)	(0.152)	(0.014)	(0.152)	(0.014)	(0.152)
Duration of ownership	-0.002**	0.985**	-0.002**	0.985**	-0.004**	0.969**	-0.004**	0.970**
	(0.001)	(0.00599)	(0.001)	(0.00601)	(0.002)	(0.0119)	(0.001)	(0.0118)
Age	-0.002***	0.989**	-0.002***	0.989**	-0.002***	0.987***	-0.002***	0.987***
	(0.001)	(0.00439)	(0.001)	(0.00444)	(0.001)	(0.00434)	(0.001)	(0.00434)
Household size	0.020**	1.143*	0.019**	1.136*	0.024***	1.181**	0.024***	1.181**
	(0.009)	(0.0869)	(0.009)	(0.0866)	(0.009)	(0.0892)	(0.009)	(0.0891)
Children	-0.001	1.032	-0.001	1.031	-0.007	0.983	-0.007	0.983
	(0.011)	(0.0913)	(0.011)	(0.0916)	(0.011)	(0.0854)	(0.011)	(0.0854)
Nr. of working in household	-0.012	0.903	-0.011	0.917	-0.010	0.925	-0.010	0.925
	(0.011)	(0.0709)	(0.011)	(0.0730)	(0.011)	(0.0771)	(0.011)	(0.0771)
Unemployment rate					0.978	2.126	1.386	24.996
					(1.517)	(23.256)	(0.883)	(161.383)
Δ C							-0.001	0.984
							(0.007)	(0.0490)
Δ GDP							-0.010	0.957
							(0.018)	(0.130)
Lending interest rate					0.395	28.70	0.388	27.48
					(0.302)	(68.67)	(0.301)	(65.47)
Income fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	No	No	Yes	Yes	Yes	Yes	No	No
Constant	0.387***	0.722	0.415***	0.870	0.365***	0.568	0.382***	0.614
	(0.037)	(0.170)	(0.039)	(0.215)	(0.059)	(0.234)	(0.078)	(0.345)
Observations	6.322	6.322	6.322	6.322	5.985	5.985	5.985	5.985
R-squared	0.074		0.076		0.078		0.078	

Standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$ Replicate weights are used in the estimation.

In model (1) and (2) we control for household characteristics. Year fixed effects are added in model (3) and (4). Unemployment rate is controlled for in model (5) and (6). GDP growth and consumption growth are additional control variables in model (7) and (8). These additional control variables are only time varying, and thus the year fixed effects are not included in these models. The estimate of the coefficient in both of the models increases when adding the extra control variables.

Within different specifications, the linear probability model predicates 5 to 6 percent increase in probability of facing payment difficulties for households that have a mortgage that exceeds the purchase price of their home. The logistic regression model shows a more dramatic result. The odds ratio is greater than 1 in every specification, implying that the odds of facing payment difficulties is greater among households that have a mortgage that exceeds the purchase price of the home, relative to households that have a lower mortgage to house price ratio. In model (8) the odds ratio of 1,52 implies a 52 percent higher odds of having payment difficulties when the household has the "cash-out" property, when controlling for household characteristics, unemployment rate, consumption growth and GDP growth.

Both the logistic and the OLS regression analyzes predicate an increased probability of facing payment difficulties when the household has the "cash-out" property. All specifications are significant on a 1 percent confidence level.

Chapter 6

Further Discussions

In order to elucidate the "cash-out" tendency of Norwegian households, we performed a pooled cross section analysis using household-level data. The data used in the analysis is representative of the Norwegian household sector, hence we can back out economy-wide magnitude of the estimated "cash-out" effect in Norway. Similar to Mian and Sufi (2011), our findings suggest a significant "cash-out" effect with increasing house prices. The estimated impact of the "cash-out" effect on households mortgage, suggests that this tendency has contributed substantial to the leverage growth in Norway.

We found that the "cash-out" tendency is not uniform across the population. The extraction of home-equity is increasing with duration of ownership. Such heterogeneity may reflect the rapid house price growth experienced by the "long duration" home-owners. We also find a more aggressive "cash-out" behaviour among older home-owners. As pointed out by Campbell and Cocco (2007) older households are expected to increase their consumption with rising house prices. An aggressive "cash-out" tendency must be considered in context of the rapid growth in house prices for the last two decades. When considering the development in the Norwegian housing market, longer duration

of ownership is associated with higher collateral. These findings may not affect the sustainability of the credit market, since the risk of default of these home-owners can be considered relatively low. However, the youngest households show a relatively aggressive borrowing behaviour, considering the fact that they are most likely first-time home buyers, and have just started paying off their mortgages. Further, we find no statistical evidence of heterogeneity across income quartiles. Considering the credit constraints on low-income households, these findings are somewhat unexpected.

Unfortunately, we do not have information about household consumption, and how they spend their extracted home-equity. If extracted home-equity is used to pay down more expensive debt, or buy investment properties, the "cash-out" refinancing may not have a large aggregate impact. On the contrary, if the extracted home-equity is primarily used to pay for current consumption, the impact could be substantial. Our findings suggest that larger households extract home-equity more aggressively, which could indicate that the "cash-out" is used for consumption. The survey "purpose of borrowing" suggests that about 50 percent of new issued loans secured on dwelling, were due to "cash-out" refinancing. However, the purpose of the "cash-out" refinancing and whether the home-equity is used for current consumption, are left for further research.

Home-buyer's expectations are significantly affected by previous experience (Case, Quigley, and Shiller, 2003). The self-reinforcing mechanism identified by Anundsen and Jansen (2011) suggests that an increase in the consumer confidence index immediately affects the house

price growth. Norwegian home-owners have experienced a rapid growth in house prices the latest years. If Norwegian home-owners continue to extract home-equity, then, based on previous experience in the housing market, the aggregate impact may be substantial. Increased leverage makes Norwegian households vulnerable to increased interest and depreciation in the housing market. In addition, high debt to income ratio may amplify a decrease in consumption and housing investments in a cyclical downturn (The Financial Supervisory Authority of Norway, 2014).

Further, our findings suggest a higher probability of facing payment difficulties with unexpected expenditures for borrowers that have a mortgage that exceeds the purchase price of their dwelling. In other words, "cash-out" refinancing increases the probability of not having an economic buffer. This emphasize the argument that Norwegian households are vulnerable to increased interest. The results are somewhat limited because of the definition of the "cash-out" variable, which do not account for people that have refinanced their mortgage and have a lower mortgage than the purchase price of the house. Additionally, the probability of payment difficulties cannot directly be attributed to the risk of default which also limits the interpretation.

Mian and Sufi (2011) finds that "cash-out" refinancing was one of the key drivers of the US subprime crisis. In this context, the "cash-out" effect among Norwegian home-owners is a worrisome tendency in the Norwegian housing market. The credit default rate has been stable and low for the last two decades, which may indicate that Norwegian credit regulations are strict. The link we provide between "cash-out"

and the probability of facing payment difficulties, raises questions of whether the credit regulations in Norway are strict *enough*. A more flexible practise of the equity requirements as suggested by the Norwegian Minister of Finance, is not in line with our findings. The size and the magnitude of the "cash-out" refinancing in the Norwegian housing market rather call for more regulations.

Chapter 7

Conclusion

We provide evidence of a strong link between self-predicted house price growth and home-equity extraction among Norwegian home-owners. Mian and Sufi (2011) finds that "cash-out" refinancing was one of the key drivers of the US subprime crisis. This highlights the importance of our findings. Studying a representative sample of 10433 Norwegian home-owners makes the results applicable for the Norwegian economy as a whole. Furthermore, we estimate how this effect changes over time. Compared to 2001, we find an additional "cash-out" effect in the years 2004, 2007 and 2012.

Next, we measure how the "cash-out" effect changes across household characteristics. We find that the "cash-out" tendency is not uniform across households. Studying the cross sectional heterogeneity, we find that increased household size, age and duration of ownership amplify the propensity to extract home-equity. Further, we find that there is a statistical difference between the categorical models of age and duration of ownership. These findings are consistent with traditional life-cycle theory. We find no statistical significant evidence of a different "cash-out" behaviour across income quartiles. Hence, credit-constrains on low income households are not reflected in the propensity to extract

home-equity.

Contrary to the arguments of a sustainable leverage growth in Norway, we provide empirical evidence of an overall increased probability of payment difficulties due to extracting home-equity. The link provided between a tight household economy and the "cash-out" effect suggests that aggressively extraction of home-equity is not sustainable for Norwegian home-owners. Overall the results in the present thesis call for more regulations in the Norwegian mortgage market.

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Appendices

Appendix A

Consumer Confindence Indicator

The Norwegian consumer confidence indicator (forventningsbarometeret) is developed by asking 1000 randomly chosen participants questions about their economic expectations. The following questions have been asked quarterly since 1992:

1. Would you say that your household economy is better or worse compared to the situation one year ago, or is there no difference?

2. Do you think your household economy will become better or worse in the next year, or no difference?

3. If we look at the Norwegian economy, would you say that the economy is better or worse compared to the situation one year ago, or is there no difference?

4. Do you think the Norwegian economy will become better or worse in the next year, or no difference?

5. Do you think that now is a good time for the general population to buy large households items, or do you think it is a bad time?

The indicator measures the difference between the percentage proportion of optimistic and pessimistic answers for each question, divided by 5. To highlight the development over time the indicator is adjusted for season and random variations effects. The indicators at the end and beginning of the time series are more uncertain, since the season and trend adjustment only are based on the past. As more observations are added to the series, the indicators are revisited (Finans Norge, 2014).

Appendix B

Survey Questions

Table B.1: Relevant Questions from the Survey of Living Conditions

	From register	Self-reported
Age of household head/participant in the survey	X	
Age for the rest of the household	X	
Total household income (gross and disposable)	X	
Number of working in household		X
Nr. of persons who have lived in the household for the last three months *Available to report until 10 persons*		X
Relations to other in household		X
2.Spouse		
3. Cohabitant		
4. Son/Daughter		
5. Stepson/stepdaughter		
6. Siblings/half siblings		
7. Step-siblings		
8.Parents		
9. Step-parents		
10.Parents-in-law		
11. Son or daughter in law		
12. Grandparents		
13. Grandchild		
14. Other relative		
15. Other non-relative		

	From register	Self-reported
County	X	
1. Oslo and Akershus		
2. Hedmark and Oppland		
3. Østlandet otherwise		
4. Agder and Rogaland		
5. Vestlandet		
6. Trøndelag		
7. Nord-Norge		
Tenure status		X
1. Free-owner		
2.Housing association or corporation		
3. Renter		
Occupation		X
1. Gainfully employed		
2. Self employed		
3. Unemployed		
4. Pupil or student		
5. Retirement		
6.Incapacitated		
7. Work rehabilitation program		
8. Conscript or civilian		
9. Work at home		
10. Other, specify		
Which year did you became owner of the property?		X
How much did you pay for your current dwelling? *in NOK*		X
Do the household have a loan secured on dwelling?		X
1. Yes		
2. No		
How many loans secured on the current dwelling do the household have? *Available to report up to 5 loans*		X
Remaining down-payment of the first mortgage *in NOK*		X
Remaining down-payment of the second mortgage *in NOK*		X
Remaining down-payment of the third mortgage *in NOK*		X

	From register	Self-reported
Remaining down-payment of the fourth mortgage *in NOK*		X
Remaining down-payment of the fifth mortgage *in NOK*		X
Do the household have the ability to pay an unexpected expenditure of 10,000NOK *1. Yes* *2. No*		X
Do the household have the ability to pay an unexpected expenditure of 5000 NOK *1. Yes* *2. No*		X
Do the household have the ability to pay an unexpected expenditure of 3000NOK *1. Yes* *2. No*		X
Predicted selling price for dwelling *in NOK*		X

Appendix C

Assumptions of the OLS model

To get reliable estimators for the parameters from a random sample of data it is necessary to make several assumptions for the OLS.

1. The model is linear in parameters. In other words, the formula for the estimators are linear combinations of the random variable y, $y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + ... + \beta_k x_k + u$

2. We have a random sample of n observations, $\{(x_{i1}, x_{i2}, ..., x_{ik}, y_i) : i = 1, 2, ..., n\}$, following the model in assumption 1.

3. No perfect collinearity. None of the independent variables is constant in the sample. There are no exact linear relationship between independent variables.

4. $E(u_t|x_{1t}, x_{2t}, ..., x_{kt}) = 0$ Zero conditional mean. The expected value of the error term given any value of the explanatory variable equals zero, within period t.

5. $Var(u|x_1, x_2, ..., x_k) = \sigma^2 < \infty$ Homoskedasticity. The variance of the error is constant and finite for any given value of the explanatory variable.

6. $u \sim N(0, \sigma^2)$ The population error is independent of the explanatory variables and normally distributed with zero mean and variance σ^2

Under assumptions 1.- 4. we have that $E(\hat{\beta}_j) = \beta_j, j = 0, 1, ..., k$ for any values of β_j. The OLS estimator are unbiased estimators of the population parameter.

Assumptions 1. - 5. are known as the Gauss-Markov assumptions for cross-sectional analysis. Under these assumptions the OLS estimators $\hat{\beta}_j$ for β_j is the best linear unbiased estimator (BLUE). The Gauss-Markov theorem says that for any linear and unbiased estimator, $\tilde{\beta}_j$, $Var(\hat{\beta}_j) \leq Var(\tilde{\beta}_j)$, and the inequality is usually strict. This means that in the class of linear unbiased estimators, OLS gives the smallest variance under these five Gauss-Markov assumptions (Wooldridge, 2009).

Assumption 1. - 6. are called the classical linear model (CLM) assumptions. When including the sixth assumption, the OLS estimators have a stronger efficiency property than they would by only assuming the Gauss-Markov assumptions. (Wooldridge, 2009). The assumption of homoskedasticity is also crucial for the Gauss-Markov Theorem, if this does not hold, the OLS is no longer BLUE.

Appendix D

Assumptions of the Binary Logistic Model

1. The data $Y_1, Y_2, ..., Y_n$ are independently distributed
2. The distribution of Y_i is $\text{Bin}(n_i, \pi_i)$. The explained variable has a binomial distribution
3. There is a linear relationship between the logit of the explained variable and the explanatory variables
4. No strong multicollinearity. None of the independent variables is constant in the sample. There are no exact linear relationship between independent variables.
5. The errors need to be independent, but not normally distributed
6. The use of maximum likelihood estimation to estimate the parameters relies on large-sample approximation

Similar to the assumptions for the OLS method the explanatory variables need to be uncorrelated with the error terms. In other words, there is no omitted control variables, the explanatory variables are

measured without any errors and the explained variable does not affect the explanatory variables.

The probability of having payment difficulties is assumed to be dependent of the set of independent variables, and can be calculated by the formula:

$$P(\text{Paym. difficulties} = 1) = \frac{e^{(b_0+b_1\text{Cash-out}_{it}+\gamma_j x_{ijt}+\gamma_2 z_{lkt}+\delta_1 d04+\delta_2 d07+\delta_3 d12+e_{it})}}{1+e^{(b_0+b_1\text{Cash-out}_{it}+\gamma_1 x_{ijt}+\gamma_2 z_{lkt}+\delta_1 d04+\delta_2 d07+\delta_3 d12+e_{it})}}$$

Tufte, 2000.

Appendix E

Test of Assumptions

The variance inflation factor, VIF, is determined by the correlation between x_j the other explanatory variables.

$$VIF_j = \frac{1}{(1 - R_j^2)},$$

Where R_j^2 is the R^2 from regressing x_j on all the other explanatory variables, and including an intercept (Wooldridge, 2009).The VIF values for the key explanatory variables is listed in table E.1.

Table E.1: Variance Inflation Factor

	VIF			
Year	2001	2004	2007	2012
Explained variable				
log(pred/hp)	6.75	5.71	4.95	5.25
duration of ownership	6.20	5.77	5.53	5.81
log(pred/hp)*duration of ownership	10.40	9.08	7.81	8.35
age	2.51	2.53	2.22	2.19
household size	6.42	5.84	4.85	4.88
children	5.34	5.33	4.54	4.40
nr. of working in household	2.28	2.04	1.74	1.93

Values above 10 are a thumb rule for deciding when there is too much multicollinearity. The VIF value of the interaction term is high in each year, however this is not a big concern because it do not affect the p-value.(ref) None of the VIF values in table E.1 exceed 10, and we conclude that this is not a problem for our main regression (Midtbø, 2012).

Appendix F

Adjusted Wald Tests

Table F.1: Adjusted Wald Test of Income Quartiles

H_0	F(df_1, df_2)	Rejection of H_0
$\beta_1^{1.q} = \beta_1^{2.q} = \beta_1^{3.q} = \beta_1^{4.q}$	F(3,12007)=1,33	No
$\beta_1^{1.q} = \beta_1^{2.q} = \beta_1^{3.q}$	F(2,12008)=1,93	No
$\beta_1^{2.q} = \beta_1^{3.q} = \beta_1^{4.q}$	F(2,12008)=0,00	No
$\beta_1^{1.q} = \beta_1^{2.q}$	F(1,12009)=3,40	Yes*
$\beta_1^{1.q} = \beta_1^{3.q}$	F(1,12009)=3,22	Yes*
$\beta_1^{1.q} = \beta_1^{4.q}$	F(1,12009)=2,55	No

1.q=income quartile 1, 2.q=income quartile 2, 3.q=income quartile 3 and 4.q=income quartile 4

Table F.2: Adjusted Wald Test of Age Cohorts

H_0	F(df_1, df_2)	Rejection of H_0
$\beta_1^{16-36} = \beta_1^{37-57} = \beta_1^{58-78} = \beta_1^{79-99}$	F(3,12007)=2,63	Yes**
$\beta_1^{16-36} = \beta_1^{37-57} = \beta_1^{58-78}$	F(2,12008)=3,55	Yes**
$\beta_1^{16-36} = \beta_1^{37-57}$	F(1,12009)=4,33	Yes**
$\beta_1^{16-36} = \beta_1^{58-78}$	F(1,12009)=6,36	Yes**
$\beta_1^{37-57} = \beta_1^{58-78}$	F(1,12009)=1,29	No

Table F.3: Adjusted Wald Test for Groups of Duration of Ownership

H_0	F(df_1, df_2)	Rejection of H_0
$\beta_1^{0-4} = \beta_1^{5-9} = \beta_1^{10-14} = \beta_1^{15-19} = \beta_1^{20-29} = \beta_1^{30+}$	F(5,12005)=5,09	Yes***
$\beta_1^{0-4} = \beta_1^{5-9} = \beta_1^{10-14} = \beta_1^{15-19} = \beta_1^{20-29}$	F(4,12006)=4,22	Yes***
$\beta_1^{0-4} = \beta_1^{5-9} = \beta_1^{10-14} = \beta_1^{15-19}$	F(3,12007)=3,75	Yes**
$\beta_1^{0-4} = \beta_1^{5-9} = \beta_1^{10-14}$	F(2,12008)=2,46	Yes*
$\beta_1^{0-4} = \beta_1^{5-9}$	F(1,12009)=2,20	No
$\beta_1^{0-4} = \beta_1^{10-14}$	F(1,12009)=4,41	Yes**
$\beta_1^{0-4} = \beta_1^{15-19}$	F(1,12009)=10,29	Yes***
$\beta_1^{0-4} = \beta_1^{20-29}$	F(1,12009)=12,93	Yes***
$\beta_1^{0-4} = \beta_1^{30+}$	F(1,12009)=20,19	Yes***