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Does mortgage regulation affect speculation in the housing market?

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This thesis is a part of the MSc programme at BI Norwegian Business School. The school takes no responsibility for the methods used, results found, and conclusions drawn.

FOREWORD

This master thesis represents the last work on our Master of Science in Business-degree at BI Norwegian Business School.

We decided on an early stage that we wanted to do a research within the real estate market. With newly implemented regulations, we discovered a subject within a fascinating field of current interest. The project has challenged us in many ways, both theoretical and practical. We were able to apply several theories and methodologies learned throughout our studies and discovered both interesting and surprising results.

The project would not have been possible without support. We would like to give our upmost gratitude to all the helpful individuals who have shared their wisdom and helped us with insights, comments and contributions throughout the process. Our helpful supervisor, professor Samuli Knüpfer, deserves to be mentioned for his valuable guidance and advices along the way. He gave us a direction within a field of infinitive possibilities, truly cared about our progress and pushed us to reach our goals. We would also like to thank Eiendomsverdi AS, Eiendom Norge and Kartverket for providing us with observations and the necessary data. Without their desire to support research, students and academia this master thesis would not have been possible to accomplish.

Oslo, 25.06.2019

Oskar Bragnes & Peder Romslo

ABSTRACT

This paper examines the contribution of mortgage regulations to changes in housing speculation. By defining speculative behaviour in the housing market as short-term investments with a resale within 12 months, we were able to distinguish the effect from mortgage regulations on condominiums purchased with or without a speculative purpose. Looking at empirical evidence from the Norwegian housing market, we discovered that municipalities with historically high price growth experienced a fall in the relative number of condominiums resold within 12 months. However, we also observed a geographic specific mortgage regulation to trigger a spillover effect, increasing the relative size of speculative transactions in non-regulated neighbouring areas with strong historical price growth.

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1. INTRODUCTION

1.1 Macprudential tools emerged from the financial crisis

The financial crisis of 2007-08 created an academic discussion surrounding housing speculators' contribution to boom-bust cycles within real estate. Regardless, the downfall triggered problems in the financial sector on a global scale, and so on creating the deepest recession since the Great Depression (Crowe, Dell'Ariccia, Igan, & Rabanal, 2012). The crisis showed that monetary policy and micro prudential banking regulation was not adequately efficient to avert systematic risk, hereby risk stemming from aggregated credit dynamics. The solution, according to multiple central banks and supervisory authorities, is macroprudential policy, ought to complement the existing policy for handling the systematic risk (European Central bank, 2010; Saporta, 2009; Swiss Central Bank, 2010; Wong, Fong, Li, & Choi, 2011). As a macroprudential tool, mortgage regulations on loan-to-value¹ (LTV) and debt-to-income² (DTI) was implemented in some countries, e.g. Norway, Sweden, Hungary, Korea, Hong Kong SAR and Malaysia (Financial Supervisory Authority of Norway, 2012; Hwang, Park, Lee, Yoon, & Son, 2010; Igan & Kang, 2011; Magyar Central Bank, 2010; Qin & Yunhua, 2010; Finansinspektionen, 2010).

1.2 The Norwegian economy's vulnerability towards the housing market

The Norwegian housing market is a fundamental part of the Norwegian economy, as households holds real estate valued to approximately 201 % of GDP in 2017 (Statistics Norway, 2019a). As 60 percent of the amount lent to Norwegian borrowers are residential mortgage (Finanstilsynet, 2018), it is reasonable to assume a large portion of these values to be financed by debt. In 2018, the household debt as a percentage of net disposable income increased to almost 240 percent on average, which is the third largest debt burden in Europe (OECD, 2019). Despite the interest rate being at a historically low level, the debt servicing ratio³ is historically high. Households financial situation is therefore highly sensitive to interest rate changes (Norges Bank, 2019).

¹ Expressing the ratio of a loan to the value of an asset.

² The ratio of total debt to gross income.

³ The share of income that serves interest and normal installments.

To address this rising issue, the Financial Supervisory Authority of Norway (FSA), issued guidelines for mortgage loans in March 2010, and stricter guidelines with respect to LTV-ratio, DTI-ratio and stress testing debt service ability for households in December 2010 and May 2012 (Zeidler & Faure, 2013). It subsequently became regulated in 2015, with fixed requirements the financial institutions had to assess before issuing mortgage loans. The regulation involved, among others, an LTV-limit of 85 percent of the property value, and an assessment of debt service ability based on a five percent interest rate increase (Lovdata, 2015). The regulation was tightening further in 2017 with an DTI condition, that prevent the borrower's total debt to exceed five times gross annual income. In addition, it was introduced a stricter LTV-limit of 60 percent for secondary housings in Oslo (Lovdata, 2016).

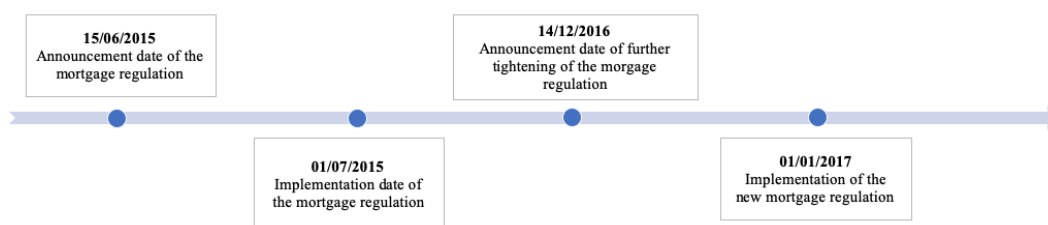


Figure 1.1: Timeline illustrating the Ministry of Finance's announcement and implementation of the regulations (Explained in detail in Appendix 1).

1.3 Motivation behind the research

The Norwegian government stated that their intention with a tighter mortgage regulation was to “limit speculation and create less pressure in the bidding process for young people and families who are to establish themselves in their first home” (Regjeringen.no, 2016). This declared objective implicates a belief of mortgage regulations targeting speculative behaviour in a larger degree than other market participants. Although, the current literature does not provide any clear evidence on who regulations affects the most, which leads to the question this paper intends to answer:

“Does mortgage regulations affect speculative behaviour in the housing market?”.

To answer the question properly, we want to examine whether the regulations either has changed the market size of speculative housing transactions, or the speculators preferences in housing objects. To the extent of our knowledge, this is an area where

Norwegian research is inadequate. Therefore, our research is built from the ground, combining data from different sources to adequately give insights to an unknown part of the Norwegian housing market.

In a broader sense, we want to contribute to what is acclaimed, by the Norwegian economist and researcher on housing bubbles, André Anundsen as a subject with “extremely limited research”, namely effects of macroprudential tools (Dreyer, 2019). With a global tendency of increased use of macroprudential tools the research area should be of current interest (Galati & Moessner, 2013).

1.4 Methodology background

To address the issue, we first establish whether the speculators represents a significant group in the housing market. If they play a small part in the total market, limiting speculation would not cause a substantial improvement in the housing market’s stability. As reducing speculative behaviour are a stated objective by the Norwegian Ministry of Finance (Jensen, 2018), it implicates that the authorities believe that speculators contribute to a considerable portion of housing transactions.

When the speculators role in the market is verified, we will further estimate the impact from the implemented mortgage regulations and whether the directives have affected speculative behaviour more than other market participants.

2. LITERATURE REVIEW

2.1 Irrational speculative behaviour

The classical approach to explain fluctuation in house prices is to analyse current and future “fundamentals”, such as user cost of capital, rental incomes and construction costs (Poterba, 1984). Speculation would in this case be minimal relative to investments, as the fundamentals in housings have low volatility. Empirically, the “efficient markets”-theory within real estate has encountered difficulties (Stein, 1995). Data suggest that house prices cannot solely be driven by fundamentals (Case & Shiller, 1989). Therefore, a high number of researchers have concluded a non-fundamental speculative phenomenon as a driver of boom-and-busts within real estate (Stein, 1995). According to research by Cristopher Mayer

and Alex Chinco, Eric J. Levin and Robert E. Wright, and Robert Shiller, speculators trade on less than fully rational behaviour.

Erik J. Levin and Robert E. Wright found evidence that autocorrelated housing prices can be explained by housing speculation (Levin & Wright, 1997). This is a significant finding, where speculative components were also able to predict turning points in inflation-adjusted housing prices. This suggest that proper action to stabilize the speculative component would ultimately stabilize the housing prices.

Robert Shiller's (1990) research argues for extrapolative expectations as the key to understand booms and busts in the housing markets. His hypothesis is that speculators bases their predictions on previous market performance, leading to an unjustifiably change in prices. In his research mass psychology is deemed the most important mechanism in driving the housing prices (Shiller, 2006).

2.2 LTV and DTI limit's effect on housing speculation

Macroprudential tools are used by governments to stabilize housing prices, by stabilizing the speculative component and other key factors. In a paper for Hong Kong Monetary Authority, the authors credits LTV and DTI limits for stagnating Hong Kong's boom in housing prices (Wong, Tsang, & Kong, 2016). Under the Asian financial crisis in 1997, no more than 1,43 % of mortgages payments were delayed. Eric Wong et. al. (2016) states LTV policy as the main reason for the low level of delays and as an efficient way to decrease speculative behaviour. However, LTV caps did not seem to affect the demand for mortgage loans much, suggesting a limited impact on the property market.

As housing speculators do not invest in primary residences, but rather objects with potential price fluctuations, they do not necessarily invest in their own neighbourhood. Chinco and Mayer (2016) found out-of-town speculators contributing to significant price appreciation in some metropolitan areas in the US, which indicates that speculation from outsiders could be a source of additional pressure due to extra demand. Speculators could therefore accelerate real estate booms, which justifies the need for area specific macroprudential regulations.

A study from Igan and Kang (2011) found households to expect a lower sale price in the real-estate market. Activity in the real estate market decreased substantially the first three months after the regulatory tightening became effective. The study concludes expectations in the real estate market as the central driver for prices, and that tightening of mortgage loans lowered the expectations of growth, and thereby creating less incentives for speculation.

Cristopher Crowe, Giovanni Dell’Ariccia, Deniz Igan, and Pau Rabanal (2013) support the usage of LTV and DTI limits as tools for stabilizing the housing market, as monetary policy has shown to be less efficient. They argues that during booms in real estate, expectation of profits in the housing market can be much higher than the change in fundamentals (Crowe et al., 2013). Therefore, monetary tightening wouldn’t directly affect speculation on the demand side. Edward Glaeser, Joshua Gottlieb and Joseph Gyourko (2010) found similar house price runups in many markets not exclusively explained by fundamental factors such as lower interest rate, income growth and increased credit. Further, Christopher Crowe assess monetary policy as unlikely to cause changes in speculation since subprime loans, that often are linked to speculation, does not appear to be systematically related to monetary policy (Crowe et al., 2013). LTV and DTI regulation intends to affect speculation by systematically decrease the issued mortgage level, and so on the massive price growth. In that way, the attractiveness of speculation will be lower. In addition, speculators will expect profit drops, as regulations makes a substantial increased equity investment required.

The findings are supported by research with causal loops done by Hwang et al. (Hwang et al., 2010). They state loosening of LTV limits as a stimulation source for demand, supply and transactions. Based on their analysis, regulation of mortgage loans significantly affects consumer’s economic activities, and thereof speculators. From their point of view, LTV limits seems to have a causal relationship with factors causing speculation, supporting macroprudential tools as efficient regulations.

2.3 Financial institutions impact on speculative behaviour

Agency problems within the financial and non-financial institutes in real estate is believed to fuel speculative bubbles. As upside reward is higher than downside risk because managers' incentive scheme promotes high returns and their worst-case outcome is losing their jobs (Allen, 2001). Thereby, financial institutes lending practices allows the speculator to borrow against his capital gains and collateralize with an optimistic market value of real estate, as it in the good state of the economy increases profits (Malpezzi & Wachter, 2005). With an inflating bubble, both the lender price loans inefficient, and the speculators' incorrect expectations is self-fulfilling, creating moral hazard incentives for the lenders to provide excessive credit (Malpezzi & Wachter, 2005; Wachter & Herring, 1999). Mortgage regulation can address this issue by imposing fixed requirements the financial institution need to assess before granting a mortgage. A DTI limit would impose a limit for lenders based on a current stable income, and thereby eliminate the risk of loans being provided due to unrealistic expected capital gains. Regulations on LTV also implicates an equity requirement, providing limitation to inefficient loans, and slows down the excessive lending to speculators.

2.4 Weaknesses with the LTV and DTI limits

In another article by Christopher Crowe et al. (2012), the authors acknowledge possible circumventions to the LTV limits which reduces its efficiency. In their opinion monetary policy needs to correspond to the macroprudential rules, if not it will offset the effect from the rules by incentivizing risk and leverage built up. Currently, one can argue that Norway suffer from this state, thereby suggesting insignificant change in speculation from the isolated effect of macroprudential tools.

This view is concretized by the International Monetary Fund's annual global financial report (IMF: Monetary Capital Markets Department, 2011). The report points to the threat of a loophole where the LTV limit only applies to some parts of the financial system, and so encourage speculators to seek lending from unregulated sectors. However, empirical literature shows that this potential problem seems to be very temporarily and supports LTV limits ability to tame a real estate booms, also at the cost of a temporarily regulatory arbitrage (Crowe et al., 2013).

2.5 Alternatives to LTV and DTI limits

Malpezzi (1990) found significant evidence of housing speculation being linked to supply conditions. They show how lagged supply response can create real estate cycles. With speculators drawn to volatility, markets with responsive regulatory environment and less natural constraints experience more elastic supply, thereby less volatility. In a later paper, Stephen Malpezzi and Susan Wachter recommend policy makers to improve supply efficiency, instead of credit rationing (Malpezzi & Wachter, 2005).

Nathanson and Zwick compel a similar argument for supply driven booms and busts cycles within housing (2018). However, their solution to limit the volatility based on observations prior to the financial crisis is not deregulation of supply, but constraining speculation of undeveloped land.

3. THEORY

3.1 Fundamental mechanism in the housing market

As any other market, the housing market is mainly driven by supply and demand. However is that a residence can be a consumer good, an investment or a savings object (NOU 2002: 2, 2002). The supply comes from both resale of existing housing and newly built properties, while the demand is combined by the actual demand for living purposes and demand for investment objects. As construction takes time and is low relative to the housing stock, the supply will be constant short-term. An inelastic market supply would respond with higher prices to increased demand (Ohls, Weisberg, & White, 1974). However, supply will adapt in the long term (Jacobsen & Naug, 2005).

3.2 Credit institutions impact on the market

Households' investments in real estate are transcendently different from other investments, with an extraordinary high LTV ratio. According to the FSA's yearly mortgage survey, the average LTV for new housing mortgages were to 67 percent in 2018 (Finanstilsynet, 2019). Other financial investments are, on the other hand, estimated to be 5 percent leveraged on average (Crowe et al, 2013). Consequently, economic stability is more vulnerable towards downturn in real estate than less leveraged markets. This came to show with the US real estate crisis in 2007

transforming into a global credit crisis, while the dot-com bubble around the millennium had a relative mild effect on the economy (Crowe et al., 2013). The funding was less leveraged, and thereby less spillover to other asset markets. Crowe et. al. points out that two-thirds of the history's banking crises came in the wake of a housing decline.

As the real estate industry is highly leveraged, financial institutions plays a large role in the market. Mortgage lending activates transactions, and thereby directly influence the demand (Hwang et al., 2010). Since the lenders' profit comes through mortgage loans, the institutions have incentives for providing households with financing. Also, while the primary mortgage market is an exchange between a borrower and a mortgage originator, there is also a secondary mortgage market between the originator and an investor (Clauret & Sirmans, 2003). This allows the mortgage lender to split the risk and freeing capital for more mortgages. In sum, this gives incentives to the financial institution to provide more housing financing, which will increase the demand in the market and so on drive housing prices. The goodwill from credit institutions towards the housing market does not only make the financing easier for speculators, it also makes the market more attractive.

3.3 How the housing market attract speculators

In efficient markets, there are no incentives to speculate. However, researchers have found evidence supporting violation of the random walk and rational expectations hypothesis in real estate (Riddiough, Steven, Yi, & Yoshida, 2001). While a regular investor is buying objects because the price is attractive relative to intrinsic value, speculators buys solely because the they think others will pay more for it in the future (Chaplin, 2017). In other words, a speculator will be attracted to volatile markets where the price can be expected to fluctuate without changes in the fundamentals. As the housing market in short terms is a volatile market with price fluctuations, it will attract speculators. A housing speculator can thereby be defined as an investor with a short-time horizon, who buy and sell more rapidly than the usual buyer on an expectation of a future change in price.

Tversky and Kahnemann (1973) discovered decision-makers base the perceived likelihood of an event occurring by subjective probability assessments. Herbert

Simon (1978) displayed evidence suggesting humans disregard subjectively the least probable outcome, suffering from a phenomenon he called threshold heuristic effect. Extending to real estate, the speculator disregards busts when the subjective probability of it occurring dips below a threshold. With house prices more than fivefold since 1992 (Statistics Norway, 2019b), investments in dwellings has shown to be profitable, despite heavy transaction costs associated with property purchases (Smith, Rosen, & Fallis, 1988). Malpezzi and Wachter (2005) show evidence of speculators with no real estate downfall experience, neglect its possibility and values the real estate based on a firm belief of continuous increase in demand and limited supply. Shiller (1990) defines this as “adaptive behavioural”, where agents base their actions on their most recent experiences. Igan and Kang (2011) and Wong et al. (2016) found this to be the case in both Korea and Hong Kong, where realized increase in real estate prices attracted speculators with extrapolative expectations.

3.4 Mortgage regulations on the housing market

The government expect the general market principle of lower housing demand to affect house prices negatively. Tightening the DTI and LTV limits makes the qualifications for mortgage loans higher and thereby reduces the relative size of borrowers and thus also the demand. As house prices decrease, investors obtain lower rental profits, which will increase their instalments exposure. When the market value of the residence used as collateral also decreases, the default risk heightens. For these reasons, the originator (the one providing the mortgage), have lower valued mortgages, incentivizing the originator to lend out fewer mortgages (Hwang et al., 2010).

Cristopher Crowe et. al. (2012) elaborates how macroprudential tools can stabilize narrow objectives more efficiently than monetary and fiscal policies. In case of real estate, a DTI limit will decrease the household’s debt service and an LTV limit will reduce the likelihood and/or magnitude of booms. However, empirical evidence on the effectiveness of these measures is mixed (Crowe, Dell’Ariccia, Igan, & Rabanal, 2011).

4. HYPOTHESIS

We have chosen to use Chaplin's (2017) definition of a speculator; a short-term investor, assumed to buy properties solely for capital gain purposes. The other market participants are assumed to invest in housings due to several reasons beyond expected short-term capital gains and with a longer ownership horizon. As the Norwegian tax system benefits residential ownership above 12 months by tax free sales profit⁴ (Skatteetaten, 2019), we assume other market participants have incentives to keep their purchased housings for at least one year. By the assumption of speculators not using the properties as their residence, the tax benefit will not apply to them. We have therefore defined speculative behavioural as resale within 12 months after purchase.

We will analyse the relative size of speculators in the housing market as an indicator of their significance as a market player. As the volatility and housing price growth differ between the municipalities, we expect large differences in the relative presence of housing speculators. The higher historical price growth, the higher we expect the share of speculative transactions to be. This is based on Shiller's (1990) and Malpezzi and Wachter's (2005) discoveries of speculators valuating real estate based on a firm belief of continuous increase in demand and limited supply.

Oslo is the biggest city in Norway, the second most volatile (appendix 2), and with the highest housing price increase both short- and long-term prior to our research starting point in 2013 (appendix 3). Therefore, Oslo attract speculators suffering from adaptive behavioural and we expect the presence of speculators to be significantly higher than in other observed municipalities, Bergen, Skedsmo and Bærum. Speculators in municipalities with relative low numbers of speculators would not suffer from adaptive behavioural in the same degree. This enables other reasons beyond expectations of short-term capital gains from previous market performance to affect speculative behaviour.

⁴ As long as the residence is used as primary accommodation for at least 12 of the last 24 months.

Therefore, our hypothesis is that mortgage regulation significantly decreases the relative speculation size in markets with a high speculation size. We believe this will happen due to three different reasons:

1. The regulations limit the amount of granted loans, and thereby lower the demand and price growth.
2. Regulatory requirements make the financing of purchases with speculative purpose harder.
3. A lower leverage than desired could reduce the expected return on equity.

5. DATA AND VARIABLES

5.1 Housing transactions

The data used in this study has been provided by Eiendomsverdi AS and Kartverket (Norwegian Mapping Authority). Our dataset consists of transactions from the municipalities Oslo, Bergen, Skedsmo and Bærum, in the period between 01.01.2013 and 31.05.2019. As townhouses and houses generally have a higher price, residential size, and number of days before sale, the data only cover apartment transactions.

As the obtained data originates from two different sources, their content differs somewhat. One of the datasets only contained information for individual ownership, which forced us to exclude stock apartments and cooperative apartments from the analysis. Where one of the datasets contained the full real estate cadastre⁵, the other did not include section numbers. As the section numbers separates the individual apartments on an address, they are necessary in the way of identifying resale of the same apartment. Filtering by address and size, we found 11.553 potentially identical condominiums when combining the two datasets. These have been verified manually, to ensure that the relative size of speculators is correct. The manual verification process was very time-consuming, but the combination of the two databases gave more detailed information about each apartment, and thereby a better insight on speculative behaviour in the Norwegian housing market. In the end, we could confirm 7.710 out of the 11.553 condominiums to be identical.

⁵ The real estate cadastre includes property registration numbers and section numbers for each unit on each address.

An additional advantage by combining the two datasets was that we also were able to identify purchases made without official ownership transactions. As the transaction costs associated with property purchases are relatively high, it is incentivized for housing speculators to use conveyance documents without claim of ownership. Professionals within the real estate business believes this to constitute a “hidden” part of the housing market with regards to speculators.

The combined, new database thereby included transactions both with and without ownership claim, the full real estate cadastre, sale and ownership date, sales price, apartments size and construction year for each condominium sold in each municipality during our period.

The dataset has been cleaned for abnormal transactions deemed not to be a part of the regular housing market. This includes transactions with a price less than 500.000 NOK and above 50.000.000 NOK, in addition to listings with abnormal sales history⁶. After the cleaning, we have been left with 52.664 transactions of condominiums in Oslo, 17.452 in Bergen, 2.716 in Skedsmo, and 9.262 in Bærum.

For each transaction we have included a dummy variable indicating whether the transaction is defined to be a speculative transaction or not. If the bought apartment is registered for sale less than 12 months after the purchase date, the dummy will indicate the purchase to be a speculative transaction.

We sort the data in monthly ratios of speculators from the period 01.01.2013 until 31.05.2019, disregarding the monthly ratios after 31.05.2018. The observed months after this date will not sufficiently present the correct ratio of speculators, as a resale could have been listed after our end date but still within 12 months. We end up with 65 observations of monthly speculator ratios. Monthly observations were deemed the most appropriate time interval as it is the shortest time period for our independent control variables.

⁶ Many sales in a short time (e.g. several times during the same month) and very large price variation is considered abnormal purchasing history.

5.1.1 Descriptive statistics

Overall, the data indicates that during the defined period, 12,2 percent of each purchased condominium in Oslo have been resold within 12 months (appendix 5). We see a 183 % average increase when we include the purchases without ownership claim, which confirms the necessity of combining our datasets and capture these transactions. To compare, in Bergen and Bærum the share of resold condominiums within the same time frame is significantly lower, varying around 7 and 4 percent.

For the period between 1.1.2013 and the time the first mortgage regulation came in place, 1.7.2015, 13,1 percent of purchased residences in Oslo was registered for resale within 12 months after the purchase. After the regulation and until the new regulation was implemented in January 2017, the share decreased to respectively 11,9 percent, before an additional drop to an average of 9,4 percent in the period from 1.1.2017 – 31.05.2018. Figure 5.1 illustrates the monthly share of purchased residences registered for resale within 12 months in Oslo, Bærum and Bergen during our observation period.

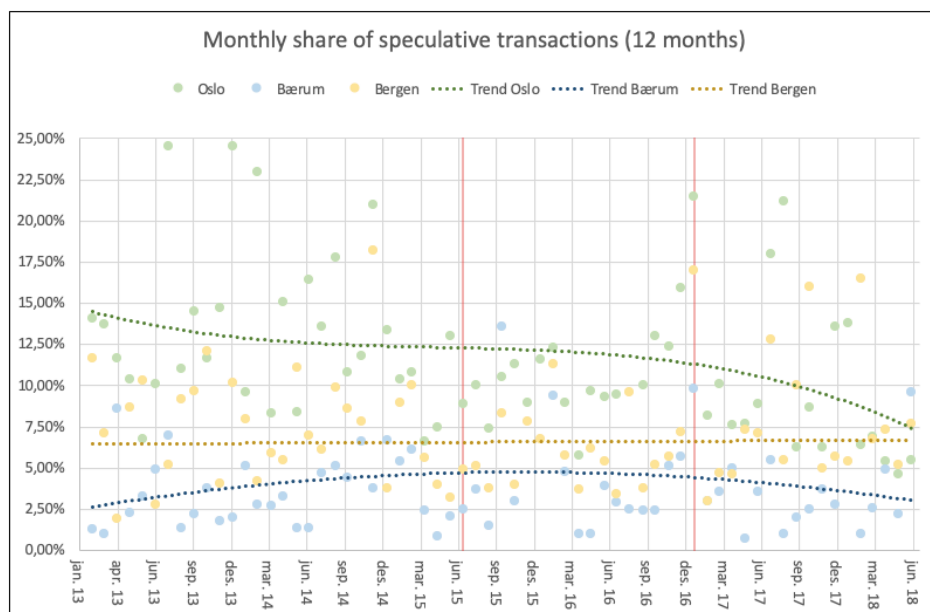


Figure 5.1: Share of purchased residences registered for resale within 12 months in Oslo, Bærum and Bergen. The red lines indicate the implementation time of the mortgage regulations.

We find a highly consistent shift in the relative share of speculative transactions in Skedsmo. From an average of 8,8 percent until 2017, the data implies an increase to 60,5 percent on average after the new mortgage regulation came into play (Figure 5.2). As a nationwide mortgage regulation theoretically should decrease the

speculative behaviour, these results are extraordinary and worth investigating further.

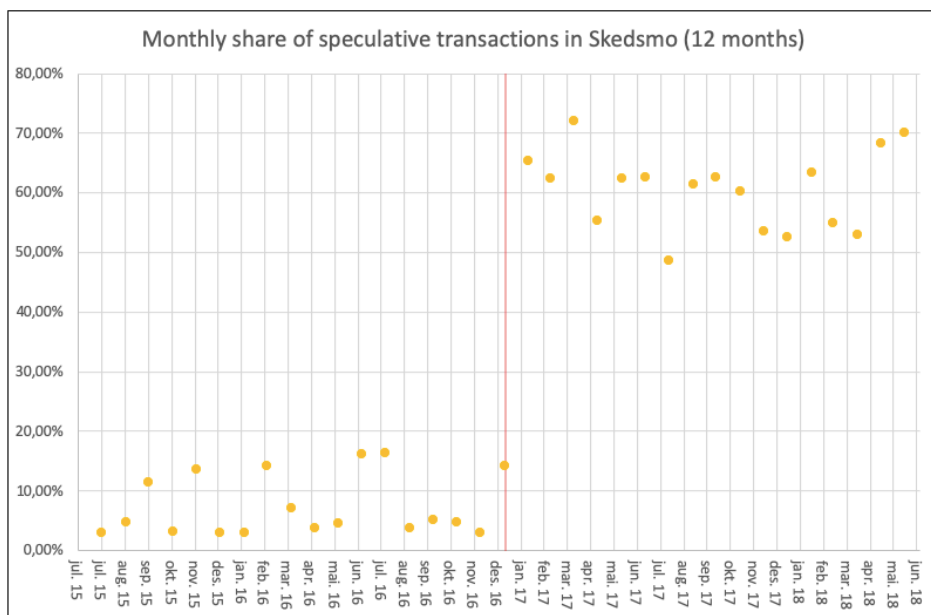


Figure 5.2: Scatterplot indicating the share of resales within 12 months after purchase in Skedsmo in the period after the first mortgage regulation. The red line indicates the implementation date of the tightened mortgage regulation in 2017.

5.2 Control variables

We include macroeconomic numbers to control for variation assumed not to be caused by the mortgage regulations (appendix 7). We acquired a set of 13 potential control variables, gathered as monthly observations for each municipality, from Eiendom Norge and Statistics Norway.

We believe these factors potentially can affect speculators suffering from adaptive behavioural in a higher degree than other market participants in general, and therefore find it necessary to exclude the effect caused by changes in these from our estimates. As population growth, income growth and the number of new buildings projects are likely to not have any short-term effects on speculative behaviour, we eliminated these factors from further analysis.

The remaining control variables included the number of sales and the number of objects in the market, nominal and seasonally adjusted housing price, and the average days before sales and days before sale of objects not sold after first bidding

round. As these variables are highly correlated, we had to remove one from each pair, to avoid a multicollinearity problem.

Number of sales provide a better economic foundation for the supply and demand as it quantifies an equilibrium number of sellers and buyers willing to transfer under the given conditions. We therefore assume this variable to better measure changes in the relative number of speculators, than number of objects for sale.

Neither days before sale, nor days before sale of objects not sold after first bidding round seemed to cause a statistically significant change in the speculation ratio. Regardless, days before sale was chosen based on a belief as a better prospect of indicating a short-term scepticism in the housing market.

Nominal house prices were also chosen, as valuation by mortgage providers and transactions are not seasonal adjusted, and we believe it to sufficiently cover seasonal patterns in housing prices with the sale number variable.

Ultimately, we end up testing five control variables for their causation of change in the relative speculation ratio (table 5.1).

Variable description	Variable name in regression
Number of sales	<i>Sale</i>
Number of days before residence is sold	<i>Sale Days</i>
Nominal percentage price change index	<i>Price Change Nominal</i>
Number of objects not sold	<i>Unsold</i>
Norway's base rate	<i>Interest rate</i>
Percentage sale change	<i>Sale Change</i>

Table 5.1: Description for variable name in the upcoming regression models display.

6. METHODOLOGY

6.1 Descriptive

As previously stated, Oslo is believed to be an attractive region for speculators in the housing market. To examine whether the implemented regulations have had the intended effect, we will compare the relative numbers before and after the

regulations came in place. We will also compare the findings with similar municipalities, both geographically (Bærum and Skedsmo) and in size (Bergen).

Since the 2017 regulation involved an Oslo specific LTV limit for secondary housing (appendix 1), the housing market in the capital can be considered as a treatment group with the other municipalities as the control group. This opens up for the use of a difference-in-differences (DD) regression.

The difference-in-differences method involves a set up where the outcome for two different groups is observed for two time periods, where one of the groups is exposed for a treatment (treatment group) in the second period, while the other is not (control group) (Imbens & Wooldridge, 2007). None of the groups is exposed for the treatment in the first period. By comparing the average gain in the treatment group with the average gain in the control group, one can remove the biases from time differences between the two periods and thereby be able to estimate the permanent differences from the treatment.

For the DD method to be valid and unbiased, it requires similarity in the observed characteristics between the treatment group and the control group. As one is measuring the treatment group's deviation from the control group's evolution, the baseline trend has to be similar and believed to perceive so without any treatment. Neither of our comparable municipalities follows an equal trend line as Oslo, but there are indications of a better basis for comparison with Bærum than the others.

The 2015 regulation did not differentiate on geographical location, so there is not possible to compare with speculators not affected. However, the results from a multiple regression indicates whenever the regulation had an impact on the market or not, and thereby support the findings from the 2017 regulation.

6.2 The exogenous variable

As the intention is to estimate the relative size of speculative transactions during a specified period, the dependent variable in the analysis will be the monthly relative share of such transactions, named the speculator ratio. A speculative transaction is

previously defined when the condominium is listed for resale within 12 months after purchase.

Our findings with a linear model largely violated the assumption of a normally distributed error term. To get a more appropriate distribution, the speculator ratio has been converted to a logarithmic scale, as this eliminated the outliers and seems to better be explained linearly by the independent variables. The dependent variable on logarithmic scale has been confirmed stationary for all municipalities.

$$\lg \text{spec.rate}_{i,t} = \text{LOG} \left(\frac{\text{number of speculators}_{i,t}}{\text{Number of market participators}_{i,t}} \right)$$

i = Municipality

t = Month

Number of speculators = condominiums sold within 12 months

Number of market participators = All condominiums sold

6.3 Control variables

Each of the previously mentioned control variables has been tested for multicollinearity, Granger causality and stationarity. The multicollinearity test between the remaining control variables showed no significant correlation. The Granger causality test gave no indication of “granger-causality” or bidirectional relationship between the variables. The control variables have also been tested for stationarity, by both an ADF- and a KPSS-test. The tests indicate an increasing trend in the nominal price variable, which have been eliminated by calculating the percentage price change from previous month. With no multicollinearity, no Granger-causality and confirmed stationarity, the significance of the control variables has been tested against the speculator ratio in each municipality.

6.4 Model selection

Our findings are based on regression analyses adjusted for the significance of present, 1-month and 2-month lags of every control variables. The final regression model for each area have been tested for the remaining OLS assumptions using White’s test, Breush-Godfrey test, Durbin Watson test, Jarque-Bera normality test and zero mean of the residuals. With a model not violating any of the general OLS-assumptions, we applied both backward selection and forward selection of variables

to establish the best model. R-squared adjusted became the ultimate decider. We have ended up with the following final regression models:

6.4.1 Multiple linear regression model

$$\lg \text{spec.rate}_{i,t} = \beta_0 + \beta_1 2015_{i,t} + \beta_2 2017_{i,t} + \beta_j CV_{q,i,t} + \beta_w CV_{q,i,t-1} + \beta_z CV_{q,i,t-2} + u_{i,t} \quad (1)$$

lg spec.rate = The relative share of monthly speculative transactions, on logarithmic scale

i = Municipality

t = Month

2015 = A dummy indicating whether the period is before (0) or after (1) 1.7.2015

2017 = A dummy indicating whether the period is before (0) or after (1) 1.1.2017

β_j = Explains the estimated effect explained by each of the controlled macro-economic variables, CV_q

β_w = Explains the estimated effect explained by each of the controlled macro-economic variables, CV_q , lagged one month

β_z = Explains the estimated effect explained by each of the controlled macro-economic variables, CV_q , lagged two months

u_i = Represents the error term

6.4.2 Difference-in-difference model

$$\lg \text{spec.rate}_{i,t} = \beta_0 + \beta_1 2017_{i,t} + \delta_0 Oslo_{i,t} + \delta_1 2017_{i,t} \times Oslo_{i,t} + \beta_j CV_{q,i,t} + u_{i,t} \quad (2)$$

lg spec.rate = The relative share of monthly speculative transactions, on logarithmic scale

i = Municipality

t = Month

2017 = A dummy indicating whether the period is before (0) or after (1) 1.1.2017

Oslo = A dummy indicating whether the transaction is made in Oslo (1) or not (0)

$2017 \times Oslo$ = The interaction term which only applies if the treatment is initiated (post 2017) and the observation is exposed for the treatment (Oslo)

β_j = Explains the estimated effect explained by each of the controlled macro-economic variables, CV_q

u_i = Represents the error term

7. FINDINGS

7.1 Mortgage regulations effect in Oslo

Firstly, we wanted to estimate the effect on speculative behaviour in Oslo. The regression on the mortgage regulation and control variables in Oslo for the period between 01.01.2013 and 31.05.2018 gave us statistically significant results. Using a backward-selection strategy we eliminated the least significant variables one-at-a-time until our model only had statistically significant variables at the 5 percent significance level, leading to regression 7.1 (3). An F-test of the eliminated

variables confirms that we could not reject the null hypothesis that they were different from zero at a 5 percent significant level.

VARIATION IN LOG-SPECULATION RATIO EFFECT BY MORTGAGE REGULATION ADJUSTED			
Dependent var.: lg-speculation ratio in Oslo	(1)	(2)	(3)
2015-mortgage regulation	-0.104 (0.111)		-0.5671** (0.256)
2017-mortgage regulation	-0.373*** (0.113)	-0.355*** (0.090)	-1.081*** (0.316)
Sale		-0.000411*** (8×10^{-5})	-0.00055*** (0.076)
Price Change - nominell			-9.622*** (2.55)
Interest Rate			-0.635** (0.314)
Observations	65	65	65
R-squared adjusted	0.122	0.365	0.489

Notes: Each specification is estimated using OLS regressions. Description of the control variables can be found in figure 5.3.

Standard errors in parentheses:

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Regression 7.1: Mortgage regulation effect on speculators in Oslo with and without control variables.

The OLS regression suggest mortgage regulations substantially reduced the relative number of speculators when we control for other variables believed to affect short term capital gains. The 2015-mortgage regulation seems to cause a 43 percent⁷ decrease in the relative speculation number, while the 2017-mortgage regulation seems to cause a 66 percent decline in the relative number of speculators.

The regression suggest that the independent variables are able to explain 52,9 percent (R-squared) of the variation in the logarithmic speculation ratio. All

⁷ Activation of the 2015 mortgage regulation estimates a -0.5671 change in log (speculation ratio). $e^{-0.5671} - 1 \approx -0,433 \approx 43$ percent decrease.

positive changes in the control variables estimate a negative change in speculation. This makes sense, since buying high (present prices are high), and borrow capital expensively (the interest rate is high), in a liquid market (number of sales are high), decreases expected capital gain from a future sale.

The findings display speculators as more sensitive to monthly changes in their behavioural. This supports our assumption of distinguished differences between speculators and other market participants. The OLS assumptions tests indicated no violations in figure 7.1 (3), therefore we find the goodness-of-fit and estimates to be valid.

7.2 Mortgage regulations effect in Skedsmo, Bergen and Bærum

A housing market where speculators and other market participants are equally qualified for a mortgage before and after the mortgage regulation, and not change willingness to pay for a condominium under the new circumstances similarly display no significant findings for the independent variables in our regression analysis. Neither the mortgage regulations, the control variables, or a combination of the two seems to affect speculators more than other market participants in Bergen. In Bærum, we find the mortgage regulation in 2015 to be significant at the 10 percent-level as the best fitted model to explain the variation in the dependent variable. An F-test for Bærum and Bergen could not reject the null hypothesis that all independent variables were different from zero at a 5 percent significance level.

The findings detect differences in sensitivity to monthly changes between speculators in Oslo, the similar sized municipality (Bergen) and the neighbour municipality (Bærum), relative to other market participants. Previous price growth within each municipality, which attracts speculators possessed with adaptive behavioural, could explain the differences as we believe they are more sensitive to fluctuations in the housing market.

In Skedsmo we detect an extremely statistically significant effect from the mortgage regulation in 2017 adjusted for significant control variables. As the nominal speculator ratio for the municipality showed an extraordinary leap at the time, this was quite expected. An F-test of the eliminated variables confirms that we could

not reject the null hypothesis that they were different from zero at a 5 percent significance level.

VARIATION IN LOG-SPECULATION RATIO EFFECT BY MORTGAGE REGULATION ADJUSTED			
Dependent variable: log-speculation ratio in Skedsmo	(1)	(2)	(3)
2015-mortgage regulation		-0.161 (0.194)	
2017-mortgage regulation	2.197*** (0.183)	-2.137*** (0.197)	2.2*** (0.182)
Sale			-0.00204** (0.076)
Price Change - nominell			-14.583** (7.32)
Observations	65	65	65
R-squared adjusted	0.691	0.69	0.709

Notes: Each specification is estimated using OLS regressions. Description of the control variables can be found in figure 5.3.

Standard errors in parentheses.

*** $p < 0,01$, ** $p < 0,05$, * $p < 0,1$

Regression 7.2: Mortgage regulation effect on speculators in Skedsmo with and without control variables.

The positive shift in the relative size of speculators is of an abnormal size and quite constant, explaining the significance and size of the 2017-mortgage regulation effect (figure 7.2). According to regression 7.2 (3) the relative size of speculators increases by 802 % because of the 2017 mortgage regulation. Speculators compared to all market participants react similar to the base rate and the 2015 mortgage regulation in Skedsmo, unlike the regression model for Oslo. The clear difference in effects from the two mortgage regulations indicates a sudden change in Skedsmo's attractiveness from outside speculators. Therefore the 2017 mortgage regulation is believed to be grossly overestimated. The Oslo-specific regulation could explain a gap of this size, supporting speculators suffering from adaptive behavioural expecting higher capital gains in Skedsmo after the regulation.

7.3 *Difference in speculative characteristics between municipalities*

Previous multiple regressions show differences between Oslo speculators and speculators in Bergen and Bærum. However, we choose to further test this by combining our data from Oslo and another municipality. By testing for similar effects with a larger set of observations and a different approach, the strength of our findings increases. Therefore, we test if the independent variables significant for Oslo in the multiple regression are significant in a DD regression between Oslo and another municipality. The estimation Oslo-specific treatment should be less than the estimated combined effect of the general mortgage tightening of 2017 and the Oslo-specific mortgage regulation for Oslo in the multiple regression model.

VARIATION IN LOG-SPECULATION RATIO EFFECT BY THE OSLO-SPEC. MORG. REG. ADJUST.

Dependent variable: log-speculation ratio in Oslo - Bærum	(1)
Oslo	1.294*** (0.103)
Oslo2017	-0.345*** (0.153)
Change in Sales	-0.137*** (0.05)
Observations	130
R-squared	0.576

Notes: Each specification is estimated using OLS regressions. Description of the control variables can be found in figure 5.3.

Standard errors in parentheses.

*** $p < 0,01$, ** $p < 0,05$, * $p < 0,1$

Regression 7.3: The Oslo-specific mortgage regulation's effect on 12-month speculators in Oslo and Bærum with and without control variables.

VARIATION IN LOG-SPECULATION RATIO EFFECT BY THE OSLO-SPEC. MORG. REG. ADJUST.

Dependent variable: log-speculation ratio in Oslo – Bergen		(1)
Oslo	0.578***	(0.083)
Oslo x 2017	-0.363***	(0.124)
Observations	130	
R-squared adjusted	0.263	

Notes: Each specification is estimated using OLS regressions. Description of the control variables can be found in figure 5.3.

Standard errors in parentheses.

*** $p < 0,01$, ** $p < 0,05$, * $p < 0,1$

Regression 7.4: The Oslo-specific mortgage regulation's effect on 12-month speculators in Oslo and Bergen with and without control variables.

Our regression model estimates the treatment-effect (Oslo x 2017) as similar to the total estimated effect of the mortgage tightening for secondary housings in Oslo, -0.345 (regression 7.3) and -0.363 (regression 7.4) versus -0.373 (regression 7.1 (1)) and -0.355 (regression 7.1 (2)). In addition, there is only one significant, independent control variable in one of two DD-regressions (regression 7.3), while the multiple regression stated several variables as significant for Oslo.

Our regression models display similarities in their indication of separating speculators from the municipality with the historically highest price growth (Oslo) and less performing markets (Bærum and Bergen). This finding shows why a DD-regression does not adequately estimate the effect of the Oslo-specific rule alone, as the speculator group in Oslo is unique. Regression 7.1 (3), regression 7.3 and regression 7.4 do not violate any of OLS assumptions tests.

7.4 The spillover effect from the Oslo-specific mortgage regulation

Bergen and Bærum seems to possess speculators with non-significant difference effects of mortgage regulations and other variables that theoretically should change expected short-term capital gains. Meanwhile, speculators in Skedsmo experienced a substantial increase from the mortgage regulation in 2017, according to our multiple regression model (regression 7.2 (3)). To verify, we analyse the effects comparing Oslo with Skedsmo.

VARIATION IN LOG-SPECULATION RATIO EFFECT BY THE OSLO-SPEC. MORG. REG. ADJUST

Dependent variable: log-speculation ratio in Oslo - Skedsmo	(1)
2017 - mortgage regulation	2.194*** (0.149)
Oslo	0.5749*** (0.10797)
Oslo x 2017	-2.5317*** (0.211)
Observations	130
R-squared adjusted	0.63

Notes: Each specification is estimated using OLS regressions. Description of the control variables can be found in figure 5.3.

Standard errors in parantheses.

*** $p < 0,01$, ** $p < 0,05$, * $p < 0,1$

Regression 7.5: The Oslo-specific mortgage regulation's effect on speculators in Oslo and Skedsmo with and without control variables.

The 2017-mortgage regulation have approximately the same estimate as the mortgage regulation effect calculated for Skedsmo in regression 7.2 (1), indicating a joint effect from the Oslo-specific regulation and the national DTI tightening to multiple the relative number of speculators with 8. Neither Bærum nor Bergen have indications of an effect from the mortgage regulation in 2017, supporting

geographic specific regulation in Oslo as a trigger for speculators in Oslo to transfer to Skedsmo. Lack of other variables to be of statistical significance in the DD-regressions support this indication further. If our hypothesis is right, the combination of expectations of less capital gain because of the mortgage regulation in the Oslo area and strong previous performance in Skedsmo would be the reasons for the transfer. Oslo was the only municipality with a higher accumulated apartment price growth over the last five years, and Skedsmo had the highest 1-year price growth before the regulation (appendix 4).

7.5 Mortgage regulations' effect on preference

Based on our data and definition of a speculator, we have observed the typical speculative object to average +/- 60 square meters and with a construction year around 1990. This is smaller than the average apartment sold during the period, which is 70 square meters. The average apartment is more than 20 years older than the typical speculative object, with 1967 as the average construction year. We also notice that the nominal price of the residences purchased by speculators is approximately 90% of the average price. These findings are relatively constant during the observed time period and between the municipalities (appendix 6).

We used multiple linear regressions with the same independent variables as before but estimated the monthly difference between speculators and all other market participants of either purchase price, construction year or apartment size instead of number of speculators. We observed none indications of different preferences emerging for either speculators or other market participants by the regulations. However, the fact that the speculators generally prefer smaller apartments in the lower price range supports the presumption that speculators and young people in the establishment phase have similar buying preferences.

7.6 Limitations of our findings

7.6.1 Small sample size and number of comparisons

As this research was dependent on restricted data the time period and municipalities accessible were limited. In addition, the regulations are implemented relatively recently with regards to our study. This is limiting the size of data available for empirical research. With the last regulation implemented 1.1.2017 and a defined

speculative timeframe of 12 months, the observation period is limited to 17 months (until Mai 2018). Therefore, a probability of making a type 2 error as the tests suffer from low statistical power. Few comparisons between municipalities allows a present possibility of association due to randomness instead of casual relations.

7.6.2 Omitted variable bias

Our analysis only controlled for general macro-economic statistics for the given municipality. This might give biased estimations if changes in circumscisions contribute to variation in speculation rate changes at the same time as one of the mortgage regulations. We have not taken other political decisions, upgraded infrastructure or area development etc. into account.

7.6.3 Loop activation

As mentioned in our theory part, the regulations activates a loop which theoretically should negatively affect both price change and transaction activity, two of our significant control variables. Our regression analysis suggests a decrease in these to cause an increase in the relative number of speculators. Therefore, our regression underestimates the effects of mortgage regulations. However, the Granger-causality-test suggest no predictive power of mortgage regulation on decreasing prices or sales volume within the next 2 months. This can suggest a time delay between the different parts of the loop. Therefore, adjusting for transaction activity and price change could seems not to underestimate the mortgage regulation impact on the relative speculation size short-term.

7.6.4 Wrong size measurement of speculation

As it is incentivized for housing speculators in Norway to use conveyance documents without claim of ownership, new residential contracts, and limited liability companies to decrease transaction costs, the speculative market size is difficult to measure.

7.6.5 Weakness in group selection

Due to privacy legislation, there has not been possible for us to identify the characteristics of the buyer or his intentions with the purchase. The identification of a speculative transaction is therefore solely based on a chosen timeframe before

resale, argued for in the hypothesis part. This might have resulted in wrongful characteristics for speculators.

8. DISCUSSION

8.1 Relative speculation size indicates adaptive behavioural

Oslo has the highest accumulated price increase the past 5, 10 and 15 years calculating to 2013 (appendix 3). Oslo had prior to the mortgage regulations an average of 13,1 percent of condominiums resold within 12 months, 48,9 percent, 87,1 percent, 227,5 percent higher than Skedsmo, Bergen and Bærum, respectfully. Therefore, our findings suggest a significant size of speculators that trades on previous price growth in the market. It seems like speculators possessing adaptive behaviour cluster in the municipality with the highest nominal price increase, if the mortgage regulations apply equally in every municipality.

Skedsmo has the second highest accumulated price increase the last 5 and 15 years calculating until the second regulation 1st of January 2017 (appendix 4). As we assume speculators transacts mainly based on expected capital gains, our hypothesis about this phenomenon strengthens by a highly significant increase in the relative numbers of speculators in Skedsmo, which most likely is caused by the Oslo-specific rule for secondary residences. As the expected capital gains from Oslo change, Skedsmo is the municipality with the highest expected capital gain based on previous performance, and therefore a natural transfer for some of the speculators possess this irrational valuation method.

8.2 Relative low speculation size indicates no adaptive behavioural

Our regression analysis suggests significant differences in how speculators are affected by macroeconomic factors that theoretically should decrease speculative behaviour. Bærum and Bergen seems to have a relative low portion of speculation (53,4 percent and 30,5 percent lower than Oslo), and no significant findings of changes related to macroeconomic factors such as mortgage regulations and price change. What drives these speculators relatively more than other market participants are beyond the scope of this thesis.

8.3 Mortgage regulations' effect on speculators suffering from adaptive behavioural

Our research find support for a spillover effect from geographic specific mortgage regulation. Speculators have exploited a form of regulatory arbitrage where they have been able to keep the low equity investments without lowering their expected return. Estimating how big the spillover effect actually are, requires an extensive survey on all municipalities in Norway over a larger period. However, if our findings of speculators suffering from adaptive behavioural clustering in the best historically performing market are correct, many of the speculators suffering from adaptive behavioural turned their investments to Skedsmo when the LTV limitation for secondary residences was implemented in Oslo.

The first mortgage regulation seemed to decrease the relative number of speculators per month by 43 percent, while the second mortgage regulation with the Oslo-specific rule seemed to decrease the relative number of speculators per month with 66 percent in Oslo. Skedsmo's relative number of speculators increased by approximately 8 times. The spillover effect in our findings, seems to involve approximately 19 speculators a month⁸, which is 55,9 percent of the decline in Oslo. This is a massive transfer between two municipalities, especially considering the large market size difference.

The analysis strongly indicates historical performance as a decisive part, where 36,5 percent (19 out of 52 speculators) of speculators seems to transfer from Oslo to Skedsmo, because of the Oslo-specific rule. As stated in the hypothesis, there are three reasons for why the Oslo-specific rule can cause a transfer of speculators. As we don't possess housing speculators capital structure, we cannot adequately determine what drives them in further debts than presumably expectations of highest possible capital gain.

⁸ The monthly average of speculators prior to the first regulation was 92 out of 702 total sales per month in Oslo. After the first regulation it was 52 out of 702 and 18 out of 702 for the second mortgage regulations. For Skedsmo, the 2015 mortgage regulation was not statistically significant, and we therefore estimate the average from January 2013 until December 2016. In Skedsmo the monthly average speculators before 2017 was 3 out of 34 and 24 out of 34 after.

9. CONCLUSION

9.1 Conclusion

In the introduction we established that the world economy in general, and particularly the Norwegian economy, were vulnerable for changes in the housing market. Therefore, the need to regulate risky, irrational behaviour could be essential. In the literature we find evidence of how presence of speculators within the housing market, adds additional pressure on market prices. Our research finds prove of speculative behaviour to play a significant role in the Norwegian market. Speculators reselling within 12 months after purchase, claims between 4 and 13,1 percent of the markets we have observed.

We further find markets with historically high price growth to have more speculative behaviour than other markets. This supports the theory of speculators suffering from an adoptive behavioural, which previous research has linked to real estate booms. As speculative presence seems to be based on irrationality and simply previous price inflation in market with historical high price growth, they might be a risk towards the housing market's stability.

One of the mortgage regulation's stated intentions, was to limit speculation, as supported by most of the existing literature. Whether such regulations affect the speculative behaviour in the housing market is therefore the main objective this paper intend to provide an answer to. Our findings indicate a decrease in the relative size of speculative transactions relative to all other market participants, after the implication of the mortgage regulations in zones with previous historical high price growth. The most remarkable effect is seen from the regulation involving a tightened LTV limit on secondary housings, which reduced the monthly speculator ratio with 66 percent.

However, speculators within historically less-performing markets seems to be equally affected to the mortgage regulations as all other market participants. In addition, we did find evidence of a significant spillover effect from the area with stricter regulation to a nearby, historical well-performing municipality not affected by the additional requirements.

Summarized, we have confirmed the speculative part of the housing market to count for a significant part of the market, especially in high price growth municipalities like Oslo. The belief that speculators expose a genuine threat towards the Norwegian economy's stability can be justified as our research indicates irrational behavioural. This argues for implementation of regulations on mortgages, as we find speculative behaviour based on previous performance shrinks. However, not without significant spillover effect where the regulation is constrained within an area. Therefore, if the goal is to mainly target housing speculators, our results suggest a nationwide stricter LTV limitation on secondary residences as the best instrument.

9.2 Further research

9.2.1. Speculators' financing

For further assessing the risks involved in the present housing market, one could analyse housing speculators debt levels and distribution of ownership. If housing speculators operates with significantly higher debt levels than non-speculators, they pose a larger risk to financial stability, as the originator is more exposed. Same goes for the distribution of ownership. If speculators own a homogenous type or geographically located residences, shocks especially affecting these certain areas or residences could expose a large group of debt-driven investors. If these exposers are not properly accounted for by financial institutes, they might underestimate the housing market risks.

9.2.2 Speculation in the new-residential market

No sources of data are publicly available in the new-residential market as residence purchases doesn't get registered in official files until the developer transfer the ownership rights to the buyer. This is usually done after the construction is finalized and upon takeover of the property. In the meantime, the option on the futured residence could switch hands by a sellable contract. By selling before the possession date, one avoids registration fee and document duties. This gives incentives for an alternative way of short-term speculating in the housing market. In addition, a speculator can obtain pre-approved financing from several banks with no intermediary bank communication on this area. Although it is the speculator himself undertaking grey-area betting with borrowed money, the developer bears the

downside risk with the speculator as the bank is not obligated to finance if the premise of the pre-approved financing change.

9.2.3 Researching adaptive behavioural

An interesting concept showing up during our research is “adaptive behavioural”, or the “disaster myopia theory”. This theory argues for how agents tend to underestimate the probability for adverse outcomes from the past to occur the more distant the outcomes get. Especially during optimistic circumstances, agents tend to overrate the probability for future profit, based on the previous period’s success. In a Norwegian housing market with increasing prices for a whole generation, indications of presence in such behaviour is shown in our paper. Examining how this might have contributed to motivate even more speculative behaviour, and so on the growing debt burden could give valuable insight.

9.2.4 Importance of knowledge about speculative behaviour in the housing market

Short term housing speculators is an interesting phenomenon, as there is an especial debt driven investment practice. The fact that the investments also operates in the same market as where people find their dwellings makes it even more interesting. It is likely to believe that during the short period between purchase and resale, the properties stands empty and thereby removes a portion of potential homes from the market. We encourage researchers and government officials to deepen the understanding of how short-term investors put pressure on the market and impedes for young people and families in their establishment phase.

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APPENDICES AND SUPPLEMENTAL MATERIALS

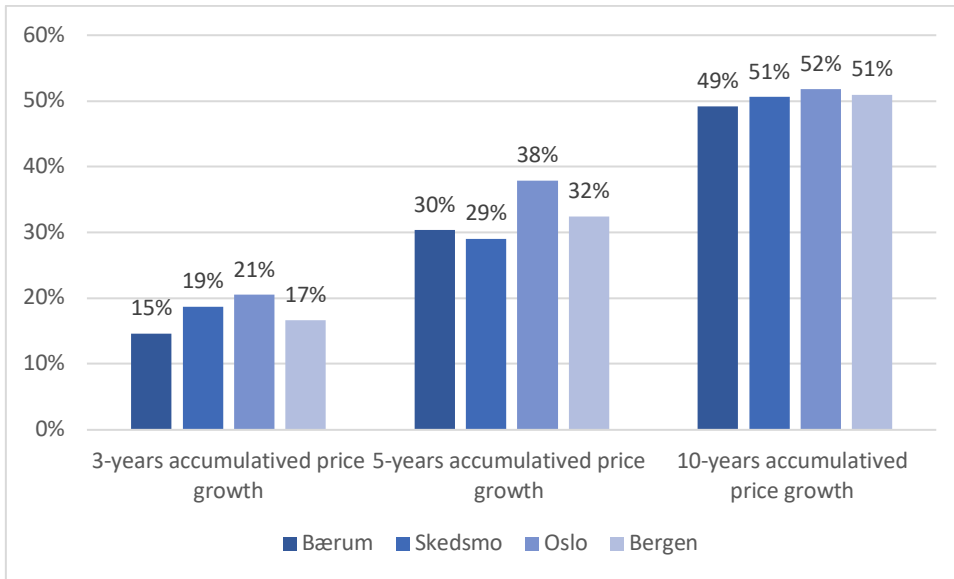
Appendix 1 table: Macroprudential regulation on requirements for residential mortgage loans in Norway. Based on Ministry of Finance's public announcements.

Announcement date	Implementation period	Key takeaways	Geographic specific regulation
15/06/2015	1/07/2015 – 31/12/2016	<ul style="list-style-type: none"> - LTV ratio for mortgages loans capped at 85 per cent. - Lenders should assess the borrower's debt-service ability with a 5 % interest rate increase. - With LTV ratio above 70 % loans with repayments are required. - Lenders can approve 10 % of loans not fulfilling all requirements per quarter, except when moving loans from one bank to another. 	
14/12/2016	01/01/2017 – 30/06/2018	<ul style="list-style-type: none"> - LTV ratio for home equity credit lines lowered from 70 percent to 60 percent in the new regulation. - Amortization of repayment loans applies to loans with an LTV-ratio of above 60 percent. - DTI ratio of 5 times gross annual income. 	<p>Oslo:</p> <ul style="list-style-type: none"> - Lenders can approve 8 per cent of loans not fulfilling all requirements. - LTV ratio of 60 percent for secondary homes.
19/06/2018	01/07/2018 – 31/12/2019	<ul style="list-style-type: none"> - Continuation of the previous regulation. 	

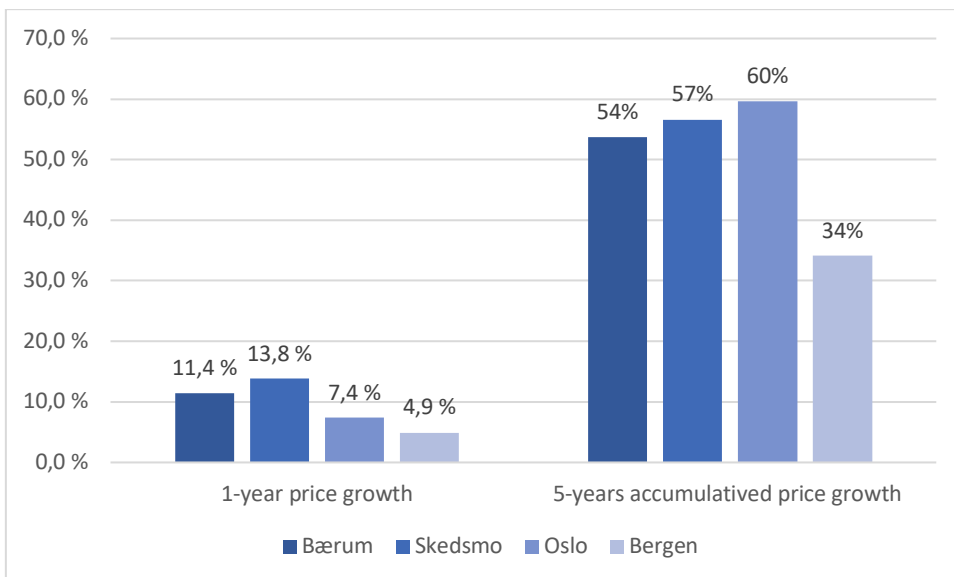
Appendix 2 table: Ranking of volatility in the housing market by region. Table based on 20 years of monthly data gathered from Eiendom Norge.

Area	Volatility
Stavanger region	8,832 %
Oslo	7,876 %
Bergen	7,190 %
Bærum	6,647 %
Agder and Rogaland	6,623 %
Vestlandet	6,586 %
Follo	6,064 %
Kristiansand	6,037 %
Viken (w/Oslo)	6,021 %
Bodø (w/Fauske)	5,892 %
Skedsmo	5,519 %
Trondheim	5,516 %
All regions (whole country)	5,160 %
Drammen region	4,973 %
Tromsø	4,945 %
Ålesund region	4,505 %
Nord-Norge	4,462 %
Midt-Norge	4,389 %
Porsgrunn / Skien	3,970 %
Hamar (w/Stange)	3,945 %
Vestfold and Telemark	3,767 %
Fredrikstad / Sarpsborg	3,724 %
Tønsberg (w/Færder)	3,505 %
Innlandet	3,492 %

Appendix 3 graph: Price growth for apartments until 2013. Graph based on yearly data gathered from the Statistics Norway, table 06035.



Appendix 4 graph: Price growth until the year 2017. Graph based on yearly data gathered from the Statistics Norway, table 06035.



Appendix 5 table: Relative share of speculative transactions (Oslo). Table based on transaction data gathered from the Eiendomsverdi AS and Kartverket

Speculation with ownership claim Residential	total	% of total
3060	71478	4,3 %
Speculation with and without ownership claim condominium	total	% of total
6159	50368	12,2 %

Appendix 6 table: Difference in the average compendium between speculators and all market participants in Oslo. Table based on transaction data gathered from the Eiendomsverdi AS and Kartverket.

Preference/time	All time	Pre 1.7.2015	Post 1.7.2015	Post 1.1.2017
Average size	87 %	88 %	86 %	85 %
Average market price	91 %	93 %	90 %	88 %
Average construction year	24,27 yr	25,71 yr	22,67 yr	23,47 yr

** Limiting the effects from outliers by constraining the property values of the price from 0.5 MNOK and 50 MNOK, Size between 20 sqm and 350 sqm and construction year after 1850.*

Appendix 7 table: Macroeconomic factors likely to affect short-term capital gain in the housing market.

Relationship between factor A and B	Variables	Source
House transactions (+) House price	Volume of Sales Volume of Sale objects Volume of unsold objects Days from listing to sale Days from listing to sale for units not sold	(Hwang et al., 2010)
House price (+) Worth of mortgage	House price index Geographic area price index	(Bernanke, 2008)
House price (-) Expected profit from trading	House price index Geographic area price index	(Kim & Kim, 1999)
Base rate (+) Interest rate of ARM	Base Rate Norway	(Clauret & Sirmans, 2003)
Base rate Interest (+) housing prices	Base Rate Norway	(Jacobsen & Naug, 2005)
Population growth (+) housing prices	Geographic specific price growth	(Jacobsen & Naug, 2005)
Unemployment (-) housing prices	Income Growth	(Jacobsen & Naug, 2005)
1. Quarter and 2. Quarter (+) housing prices 3. Quarter and 4. Quarter (-) housing prices	Months Quarters	(Statistics Norway, 2019c)
Construction (-) housing prices	Number of new building projects	(Jacobsen & Naug, 2005)

Notes: +/- indicating positive or negative relationship between the factors. ARM = adjustable-rate mortgage.