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Consumer Borrowing after Regulations on Mortgages:

An empirical analysis of the impact of stricter residential mortgage regulations on the use of consumer credit loans in Norway.

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Abstract

Over the past six years, consumer credit loans have grown at twice the rate of mortgage loans. Yet, policymakers have up to now only manifested regulations on lending practices for residential mortgage loans. In this thesis, we investigate how consumer credit borrowing has changed in regard to house prices in the event of the policy shifts in 2015 and 2017. Drawing on data from a bank offering consumer credit loans and a consumer loan-agent, we find that consumer credit loans increased with house prices in contrast to pre-regulation in which house prices impacted consumer credit loans negatively. By using the difference-in-difference method, our results show that the effect is more prominent in areas where higher educated people reside as well as in the areas outside the four largest cities in Norway. The results are consistent with arguments that people substitute low-cost mortgages with high-cost consumer credit loans. Hence, the empirical findings are inconsistent with the regulation`s goal of reducing household debt in Norway.

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Key terms

Consumer credit loans

Unsecured loans that on average carry a higher interest than on secured debt. The loan amount usually offered to customers is between 5,000 and 500,000 NOK, with a nominal interest rate varying from 6.78 % to 24.4 %. Interest is based on individual scoring models rather than fixed rates. The down-payment period has traditionally been one to fifteen years, although new regulation from 2019 limits new loans not used for refinancing to a maximum of five years. For this thesis, we refer to consumer credit loans as consumer loans.

Credit cards

Equivalent to consumer loans, credit cards are unsecured but offer a disposable line of credit that usually carry no interest if the borrowed amount is paid within 14-60 days. Outstanding debt generally has a higher interest than consumer loans with effective interest rates above 20 %. Credit cards often provide insurance and/or discounts for certain products, making them a preferred payment method over debit cards. Credit card debt is revolving but requires a minimum payment each month.

Mortgage

Specialized residential loans with housing as collateral. Mortgages carry one of the lowest interest rates for personal loans. Most mortgages in Norway have a floating interest rate, determined by the policy rate set by The Central Bank of Norway (Norges Bank) and a premium for the banks. In 2018 the average interest rate was 2.49 % before tax and 1.87 % after tax.

Loan-to-Value (LTV) ratio

A calculation of lending risk. LTV-ratio is determined by the mortgage loan amount in the percentage of the property`s value.

Mortgage Equity Withdrawal

The amount of equity that individuals withdraw from their houses through lines of credit and cash-out refinances or home equity loans.

Borough

Geographical area within cities that have administrative tasks. In some cities, elected officials represent different boroughs in the city council. Boroughs differ in demography, and some areas are traditionally perceived as wealthier than others. The residential composition also varies, with some areas having mostly detached houses and other a higher share of apartments.

County

A sub-national, geographical area between the state and the municipalities with administrative tasks. Norway is divided into 18 counties.

First stage of regulation = The regulation of 2015
Second stage of regulation = The regulation of 2017

1. Introduction

During the last few years, the Norwegian government have made regulations on lending practices with housing as collateral in response to a strong growth in debt and house prices (Ministry of Finance, 2016). But how are such regulations affecting the use of unsecured loans? Despite their high cost, consumer loans have increased in popularity. In 2018, the outstanding consumer debt including both consumer loans and credit cards for Norwegian households was 112.5BNOK *(Finanstilsynet, 2018b)*, which amounts to 21,257NOK per capita if distributed evenly. Consumer loans have increased by 80 % from 2012 to 2018. Meanwhile, mortgage loans have increased by 42 % (Finanstilsynet, 2013, 2019; Revfem, 2019). In this thesis, we analyse how the regulation affected the use of consumer loans.

Following the guidelines from 2010, the regulation was manifested in law for the first time in 2015 (Ministry of Finance, 2015). In brief, it requires banks to limit their lending in regard to the borrower's debt-serving ability and the loan-to-value (LTV) ratio. In 2017, the government made further restrictions to the regulation concerning the borrower's overall debt. Additionally, Oslo was imposed with a separate requirement on LTV-ratio for secondary house purchases *(Olsen & Hægeland, 2018b)*.

When assessing the initial regulation of 2015, the Finance Sector Union of Norway stated that they observe tendencies on borrowers using capital through unsecured debt to meet the requirements on equity (Hellman, 2016). Similarly, The Consumer Authority expressed that the increase in unsecured loans the last few years correlates to stricter requirements for mortgage loans. The consequence of this is contradicting the regulations goal on reducing the debt burden (Øverli, 2016). In 2017, the brokerage firm Privatmegleren conducted a survey asking how people financed the equity requirement for their first home, with 5.5 % of the respondents answering that it originated from unsecured loans (Hoemsnes & Mikalsen, 2017).

We enlighten how the legislation has affected the consumer credit market by taking advantage of two separate data sets on application data and disbursed consumer loans provided by Norwegian banks. By using both pooled OLS and fixed-effect regression, in addition to difference-in-difference estimation, we examine how this policy shift is affecting consumer behaviour towards consumer loans. For the difference-in-difference framework, we use boroughs and counties as an identifier for different socio-economic groups and will refer to these groups as treatment and control groups. We acknowledge that this is not proper treatment and control groups, considering that the regulation is targeting all boroughs in Norway. However, we will follow the traditional framework of difference in difference analysis to shed

light on how the policy shift has affected areas with specified characteristics differently.[1] For the OLS and fixed effects analysis, we use house price indexes as a proxy for the policy shift.

Despite the attention paid to unsecured debt, the policy discussion lacks empirical research on how the mortgage regulation is directly affecting unsecured loans. Data sets on unsecured loans are not available to the public and are challenging to obtain. Previous research using qualitative data has presented how *education levels* affect unsecured loans and how they differ from other groups, e.g. income. Poppe (2017) shows that the likelihood of having consumer loans is less prominent for people with a university degree than others with a lower education level. The central bank of Norway document by using aggregated quantitative data on total household debt that overall debt levels and house prices have increased at a lower rate after the regulation. However, this does not examine how the debt composition has changed after the regulation. Furthermore, they find that *cities* are more affected by the policy change than districts (H. Borchgrevink & N. K. Torstensen, 2018). In particular, we use primary data on consumer loan to examine these characteristics on *education* and *cities*.

Our results show that house prices historically have impacted consumer loans negatively, which is consistent with Poppes (2017) findings that people make mortgage equity withdrawals when house prices increases. However, after the initial regulation in 2015, we find a shift where consumer loans have a significant positive relationship to fluctuations in house prices. The percentage change in consumer loans per percentage change in house prices on a national basis amounted to 0.98 %. Furthermore, we find a positive relationship of 7.57 % per percentage change in house prices for the four largest cities after the second regulation. We also document that an increased usage of consumer loans as equity for mortgage loans after the regulation of 2015. People with this purpose borrowed on average almost 75 % more than the other groups, with this proportion having increased with 5.09 % after the first regulation was implemented. The results are conforming with a report conducted by *Comparo* in 2016 showing that 7 % of consumer loans had the purpose of "*housing*". The corresponding loan amounts were higher than the average loan amounts, concluding the results to be consistent with the observed inclination of people using unsecured loans as equity for mortgage loans (Comparo, 2018). Thus, we argue that the high consumer loan amounts that relate to mortgages are likely to increase house prices, hence counteracting the objective of the regulation.

[1] Control groups are used as benchmarks in cases where one group receives treatment (treatment group) and the other does not (control group). Where the group should be as similar as possible to the treatment group except receiving the treatment (Wooldridge, 2010). A proper control group in our case would be areas in Norway that were not restricted by the mortgage regulation.

Using a difference-in-difference analysis, we find that in contrast to previous literature on financial literacy´s effect on secured borrowing (Anderloni, Bacchiocchi, & Vandone, 2012), that consumer loans in boroughs with lower education levels *reduced* with 3.73 % compared to boroughs with medium to high education levels after the policy shift of 2017. We also find that after the second regulation was implemented, habitants in the four largest cities reduced the consumer loan amount with 8.07 % compared to those living outside these major cities. A plausible explanation for this is that it is easier to make mortgage equity withdrawals on properties in cities where the turnover is higher after the regulation in contrast to more remote, low-liquidity areas where the uncertainty around price levels is greater (Head, Lloyd-Ellis, & Sun, 2012).

We estimated that, on a national basis, the regulation on mortgage loans resulted in an increase of 8.75BNOK in consumer loans after 2015, ceteris paribus. Furthermore, the second regulation increased consumer loans in the four largest cities with roughly 5.2BNOK in 2017, holding other factors constant. We estimate that a maximum increase of roughly 13.95BNOK in consumer loans is due to the regulation on mortgages, constituting approximately 12 % of outstanding consumer loan amounts in 2018. Considering some overlap in the estimates, this likely lowers the amount to some extent. Our analysis indicates that consumers have shifted towards borrowing high-cost consumer loans instead of mortgages after the regulation. This suggests that the regulation failed to lower the interest burden for the population.

To the best of our knowledge, no previous paper discusses policy change on mortgages towards unsecured lending. However, our findings contribute to studies on the effects of policy shifts, house prices and consumer borrowing; Kartashova & Tomlin (2017) using Canadian household-level data, find a significant positive relationship between unsecured borrowing and house prices. Bhutta, Goldin and Homonoff (2016) discovers that bans on unsecured pay-day loans in the U.S resulted in individuals shifting to other types of high-cost loans. Furthermore, empirical research from New Zealand document that regulations on mortgages only had a temporary effect on reducing the growth in house prices and debt (Armstrong, Skilling, & Yao, 2018).

2. Motivational background

2.1. Regulation on requirements for residential mortgage loans in Norway

Although there were guidelines for lending practices already in 2010, laws regulating the banks' lending policies were not present until 2015. As a result of the strong growth in household debt and house prices, the first regulation was implemented July, 1st 2015 and was binding until December, 31st 2016 (Finansforetaksloven, 2016). The objective of implementing mortgage regulations was to contribute to a more sustainable development in the housing market and to promote financial stability in Norway (Finanstilsynet, 2012).

Based on the guidelines from 2010, the regulation established that house purchases must be composed of a minimum 15 % equity, thus a maximum LTV-ratio of 85 %. Lenders were obligated to calculate the borrower's ability to serve the mortgage loans from income; accounting for an increase in the interest rate of five percent. Interest-only payments could not be approved unless LTV-ratio was less than 70 %. Refinanced loans could not exceed the size of the existing mortgage at the time of refinancing, maturity could be no longer than the remaining maturity, and the instalment payment had to be equal or higher than the existing loan. However, lenders were allowed to deviate from these rules in 10 % of the value of the approved loans each quarter, thus giving individual assessments (Finansieringsvirksomhetsloven, 2015).

As of September 8, 2016, the Ministry of Finance, sent out a proposal from Finanstilsynet on implementing further restrictions on current regulation. The ministry of Finance expressed concerns that due to high debt, households would get more vulnerable for either a bust in the housing market or increased interest rates resulting in people defaulting their loans or being forced to lower their consumption. The high growth in housing prices and household debt presented a risk for the Norwegian economy and therefore needed additional regulations (Ministry of Finance, 2016). Ultimately, the regulation from 2015 continued as of 2017, but with further restrictions. In Oslo, that resulted in tighter equity requirements for secondary housing due to a stronger increase in house prices than for the rest of the country, reducing LTV-ratio from 85 % to 60 %. The purpose was to limit housing speculation, reduce the press in bidding rounds for young adults and families that are trying to purchase their first homes. New regulations were additionally adopted for all areas in Norway. Lenders were no longer able to issue loans if the total debt exceeds five times the borrower's gross income. Further, for approving interest-only payments, LTV-ratio changed from 70 % to 60 % (Finansforetaksloven, 2016), with the purpose to increase households ability to serve the loan in the event of a possible fall in future house prices. Finanstilsynet also proposed a remove the lenders` opportunity to deviate the requirements with 10 %, or alternatively change it to four

percent (Ministry of Finance, 2016). However, due to reactions and comments in the consultation process, it remained unchanged.

In the event of the proposal, Real Estate Norway responded in the consultation letter to the Ministry of Finance that a more stringent mortgage regulation would result in decreased house prices. Given the population growth and the demand for housing, a fall in housing prices as a result of stricter regulations causes a decline in housing starts, when in the meantime, the need for housing indicates increased housing construction. Consequently, it would be tougher for people to enter the housing market. Real Estate Norway also contended that it is crucial that the regulation is not overly strict, allowing banks to assist single households by deviating from the equity requirement in critical phases of life, e.g. when buying their first home. In brief, they expressed that the government must be cautious when regulating, as this affects the development in the housing market (Dreyer & Lundesgaard, 2016). With this in mind, Myhre and Liaan (2018) find that the regulation on mortgages has reduced the growth in house prices as well as making it more difficult for first-time buyers to enter the market. However, the special requirements for Oslo has made it easier for first-time buyers to enter the market in Oslo (Myhre & Liaaen, 2018).

The Finance Sector Union of Norway (Finansforbundet) wrote in their consultation letter to the Ministry of Finance that access to capital from alternative financial sources is too broad, and the regulation does not serve the purpose when it is not affecting the unsecured credit market. The lack of an official debt register also empowers creativity among people to bypass the requirements. In particular, young borrowers are seeking alternative sources of financing rather than turning to established mortgage banks as a source for house financing. Ultimately, it threatens financial stability to a higher degree than if the housing financing comes solely from a mortgage loan (Hellman, 2016).

Table 1: Timeline of regulations on mortgages

Year	***Regulatory change***
2010	Guidelines for lending practices introduced
2015	Guidelines manifested in law: 15 % equity requirement introduced Account for an increase in interest of over five percent Maximum LTV for interest-only payments: 70 %
2016	Renewed 2017 regulation
2017	Maximum LTV for interest-only payments reduced to 60 % The upper limit for loans in total – five times income Secondary housing in Oslo – maximum LTV 60 %
2018 and 2019	2017 regulation still in use

2.2. Regulations on consumer loans

Finanstilsynet (2018a) has pointed out the accessibility to consumer loans as one of the main reasons for the high growth in the Norwegian unsecured lending market. Many banks advertise fast loans and easy applications that are done solely through online. The Consumer Ombudsman has criticized banks for their aggressive marketing towards vulnerable groups that are already heavily indebted (Røed & Vedeler, 2016). The largest specialized consumer bank in Norway, Bank Norwegian for instance, used 80 % of their total costs in 2018 on marketing (Norwegian Finans Holding Group, 2018). To limit the aggressive marketing from consumer credit banks, a new regulation for advertisement was implemented in July 1st , 2017 by the Ministry of Justice and Public Security (2017). Amongst other restrictions, the regulation states that it is illegal to advertise how fast the loan can be issued, ease of application and how low the threshold is to get an application granted.

Guidelines for responsible lending practices were presented in June 2017. The guidelines state, similarly to the regulation on mortgage loans, that customers should be able to manage a five-percentage-point increase on loans based on their income and that the aggregated debt should not exceed five times a person's gross income. Loan contracts should also include instalments and maturity (Finanstilsynet, 2017b).

In February 2019, these guidelines were put into law after failed compliance, and included limitations to existing loans, establishing that loans without instalments required a down-payment period less than five years. When presenting the legislation, the Minister of Finance, Siv Jensen stated that: "*The guidelines from Finanstilsynet as of 2017 have not been followed,*

and that is not good enough! Therefore, we have now laid down requirements that all banks must adhere to" (Finansdepartementet, 2019). Banks have until May 15th, 2019 to implement and follow these regulations.

2.3. Central debt registry

While consumer loans solve liquidity problems for people with a strong economy, it creates payment problems for lower income groups in society (Skalpe, 2011). Today, banks rely on self-reported debt levels and debt that appears in a person's tax return. The tax-return only shows debt that is reported at a years-end. This means that it is often outdated and portrays an incorrect amount of outstanding debt. It is difficult for creditors to control whether the customer has additional debt obligations other than stated in the application form. Implementing a debt registry will ease the screening process for banks and regulatory institutions. It is also supposed to improve compliance with the legislation (Ministry of Children and Families, 2017). Critics argue that the debt register will cause stronger growth in consumer loans as a result of increased efficiency on credit reporting, which in turn will generate more debt victims (Skalpe, 2011). In contrast, advocates of the debt register argue that the register will prevent creditors from granting credit to customers who are already too indebted. Furthermore, it will reduce the financial issues belonging to the society's most disadvantaged people (Ministry of Children and Equality, 2019). The registry will be implemented during the summer of 2019
(Ministry of Children and Families, 2018).

3. Hypothesis development

This thesis aims to establish the relationship between consumer loans and house prices in regard to the regulations for residential mortgage loans that were implemented in 2015 and 2017. How does borrower behaviour change when the government tightens the regulations on mortgage loans and how does the borrower respond to these changes? These questions are important to ask when policymakers are evaluating the regulation and considering how to regulate the lending market in the future. In this section we will in brief review previous work and policy discussions that have been relevant for developing our hypothesises following a presentation of the hypotheses.

3.1.1. Borrowing after regulations on mortgage loans.

The central bank of Norway analysed the effects of the regulation on house prices, residential transactions and debt. Their results show a relationship between growth in house prices and

debt in areas consisting of a higher proportion of people with a debt-to-income ratio over five. The growth in house price in 2017 was less in areas with high leverage. Moreover, the results revealed that the number of homebuyers overall remained high, except for some decrease in Oslo and among young people in Norway. Ultimately, the development of debt in municipalities with a high proportion of people with a gearing ratio over five, had a lower growth of debt in 2017 (H. Borchgrevink & K. N. Torstensen, 2018).

The CEO of BN Bank in Norway states that mortgage equity withdrawal as a result of increased house prices is frequently used to serve consumer loans. However, after the restriction introduced in 2017 on limiting total debt to five times the income, such withdrawals has decreased (Sættem, 2018). Mortgage equity withdrawal is also used to cover a share of the equity for purchasing a secondary property (Ministry of Finance, 2016). More equity allows people with high income that are credit constrained by the LTV- regulation and not the five times the income legislation to purchase more expensive real estate. Hence, if house prices continue to increase at the same level, and people make mortgage equity withdrawals to leverage additional house-purchases, the regulation is ineffective due to the increased demand.

Despite these results, the policy discussion lacks empirical evidence on what effect the regulation on residential mortgage loans has on unsecured debt and essential questions on unsecured loans regarding the mortgage regulations remain unanswered.

3.1.2. Consumer borrowing after regulations on unsecured loans.

Bhutta et al. (2016) studied how borrowers respond to regulations on unsecured "payday" loans using survey data on borrowing behaviour and data on credit product usage through public channels. By using the difference-in-difference methodology, they find that while the number of payday loans reduces in states where payday loans are banned, the number of alternative financial service loans is not reduced as the number of people borrowing from pawn shops increased. If a policy change is reducing one type of loans, but not reducing the total household debt, consumers are shifting to other forms of unsecured high-interest loans (Bhutta et al., 2016).

3.1.3. Effects of financial literacy

Financial literacy is the understanding and ability to handle financial areas in a manner that leads to efficient and sound decisions (Hung, Parker, & Yoong, 2009). While Norway is on the top of S&P´s financial literacy ranking, its' debt-to-income ratio is the third highest among OECD countries (Baker, 2015; Boye, 2017). An American study discovered that households' wealth could be increased by enlarged investing in financial literacy, even after controlling for

schooling. However, the effect of financial literacy reduces by almost half when they controlled for education, suggesting that education is essential for financial literacy (Behrman, Mitchell, Soo, & Bravo, 2012). Furthermore, evidence from Italy finds that financial vulnerability is higher in groups with higher amount of unsecured debt, and these individuals often have short-sighted planning horizons with impulsive behaviour. This study also supports the results from the US, that higher education reduces financial vulnerability (Anderloni et al., 2012). Consumer loans through online agents are in general fast proceeded and have a short disbursement time that might stimulate these individuals over financial literate or higher educated groups.

3.1.4. Effects on cities and districts

The Central Bank of Norway states that the regulation limiting debt-burden is likely to affect people living in the largest cities to a higher degree than for people living outside cities due to higher leverage ratios in cities (H. Borchgrevink & K. N. Torstensen, 2018). It is also likely that more people use housing as an investment opportunity in cities, where a larger increase in secondary housing due to higher exposure to the renting market (Rydne, 2018). With new regulation on maximum 60 % LTV-ratio on secondary homes in Oslo, we expect such investors to shift towards higher-cost loans or reduce investment activity.

The housing market is dependent on liquidity to set efficient prices on assets (Head et al., 2012) Due to lower liquidity markets in more rural areas, it can therefore be difficult to value the housing assets, and the new regulation limits the opportunity to make mortgage equity withdrawals. In turn, if people cannot use equity mortgage withdrawals, they might be more inclined to use consumer loans. This would lead to other results than expected based on the statements from The Central Bank of Norway. However, the regulation might still affect the cities, leading people towards consumer loans, but the liquidity constraint after regulation could dominate this effect. However, we expect people in larger cities to take more consumer loans to combat the regulation compared to counties.

3.2. Hypothesis

We expect to see an increase in consumer loans during stricter policies in the market of mortgage loans. Following the motivational background and previous work, the two hypotheses is as follows:

(1) *Norwegian consumers are more likely to take consumer loans after the policy change.*

The first hypothesis is evaluating whether we can establish if the policy has affected the amount of consumer loans without taking into account the characteristics of different geographical areas. Therefore, the second hypothesis is investigating if certain groups have been even more affected by the regulation.

(2) *People living in boroughs with lower education levels and within cities are more affected by the policy change.*

With the second hypothesis we examine if people living in boroughs with lower education levels borrow more after the policy change. Additionally, we examine if the regulation has a stronger effect for people living within the cities Bergen, Oslo, Stavanger and Trondheim.

4. Data

To answer the hypothesis above, we collected data from multiple sources. To investigate the impact on consumer loans in both hypotheses, we use data on both consumer loans and applications provided by a Norwegian bank and a loan agent that covers a representative part of the unsecured loan market. Additionally, we received house prices on index-level from Real Estate Norway. To control for differences between the boroughs, we take advantage of demographic data obtained from Statistics Norway and NAV. We also received supplementing geographical data for illustrative purposes from the four municipalities of Bergen, Oslo, Stavanger and Trondheim.

4.1. Description of data

Due to the increase in the number of banks offering consumer loans and total outstanding consumer debt, we find it beneficial to use data sets that contain actual consumer loans. Previous papers that analyze the consumer credit market has been using proxies for consumer loans or aggregated data; Hagen et al. (2017) take advantage of aggregated data on tax returns on interest payment and outstanding debt to find the average interest rate. Following this, they assume that individuals paying 8 % or more in interest have consumer loans and make no distinction between consumer loans and interest-bearing credit card debt. Although this method is likely to capture individuals with a high share of unsecured loans in their debt-portfolio, it is not capturing those with a higher share of mortgages or other low-interest loans. Poppe (2017) use questionnaire-data to model the probability of having consumer loans that might include bias from respondents. Furthermore, the analysis is not based on actual amounts of consumer

or credit card loans; they only describe the consumers of unsecured debt. The implementation of the General Data Protection Regulation (GDPR) in the EU-zone, has limited both ability and willingness for banks to offer data for research purposes. Thus, there are no available data on individual loan amounts available to the public.

However, we have acquired two independent data sets from one bank providing consumer loans and one consumer loan agent. Due to strong competition in the segment, both data providers wish to remain anonymous; hence, we will give no further description of data sources. The data set provided by the bank spans from 2015 to 2017 and contains 24,351 loans with the following variables: *pay-out-date, loan amount, the down-payment period in years, effective interest rate and postal-code* as an individual identifier. However, 2015 is removed from the dataset, that we will the arguments behind in the next section. The following tables will only include loan amount grouped by cities, as other factors can be used to identify the data providers. This is also the dependent variable when correcting for population differences in the analysis.

Table 2: Summary statistics of the data set provided by the bank on city-level in 2016

	1st Qu.	***Mean***	***3rd Qu.***	***SD***	***Median***	***N***
Bergen	50,000	108,179	140,000	64,111	95,000	653
Oslo	56,130	111,522	150,000	64,412	100,000	1,235
Stavanger	70,000	121,433	150,000	67,367	100,000	187
Trondheim	55,000	99,960	125,000	50,052	92,500	210

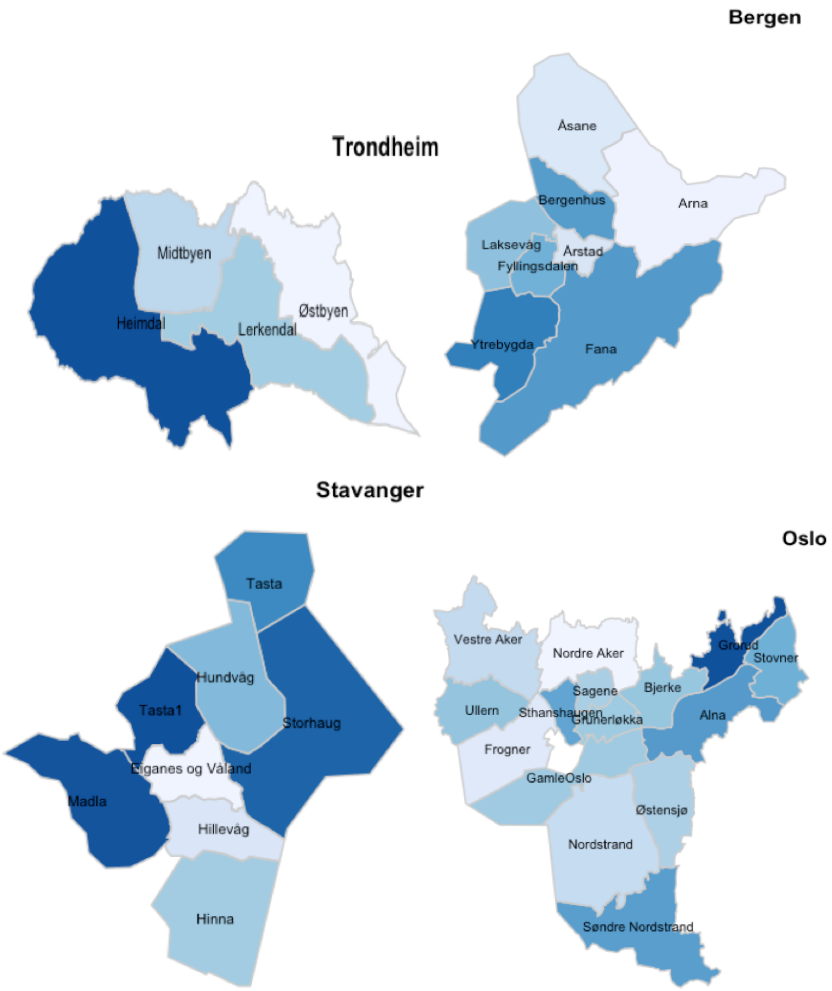
Table 3: Summary statistics of the data set provided by the bank on city-level in 2017

	1st Qu.	***Mean***	***3rd Qu.***	***SD***	***Median***	***N***
Bergen	50,000	99,196	130,000	68,280	80,000	802
Oslo	50,000	104,479	140,000	69,394	90,000	1,560
Stavanger	53,000	110,817	150,000	71,622	100,000	252
Trondheim	50,000	94,536	125,000	57,880	83,207	323

From the tables above, we see that the mean and median amount that people borrow has decreased after the regulation was implemented for all cities. However, the standard deviation has increased, indicating that the difference in borrowed amount has changed. The increase in the standard deviation can be attributed to changes in the bank, where the maximum loan amount offered increased and the minimum loan amount decreased during 2017. Furthermore, the number of loans has increased from 2016 to 2017, leading to an increase in total loan amount of 16.18 %. Due to the relatively small sample size and structural changes, there might be some sample issues in the analysis.

Figure 1 illustrates the loan amount per capita in each borough. The boroughs with the darkest colours represent the boroughs with the highest average loan amounts, whereas the lightest colours represent the boroughs the lowest loan amounts.

Figure 1: Consumer loan amount per capita in boroughs



Source: Data set provided by the bank

The data we use in the analysis with county as geographical identifier is obtained from a loan agent and consist of 377,165 observations in the time frame 2013 to 2018. It contains application data with county as an individual identifier, and the loan amounts representing the amount requested in the application form. It also includes whether or not a loan was approved. The data provided by the loan agent consists of the following variables: *Year, Loan amount requested, Age, Gender, Living situation (6 levels), Mortgage (Dummy = 1 if the applicant has a mortgage, 0 otherwise), Purpose (9 levels) and Offer (Dummy = 1 if the applicant received an offer, 0 otherwise).*

Table 4: Summary statistics of data provided by the loan agent on county-level from 2013-2014

	1st Qu.	*Mean*	*3rd Qu.*	*SD*	*Median*	*N*
Akershus	50,000	128,209	195,000	99,579	100,000	8,630
Aust-Agder	41,250	116,246	161,425	97,981	87,000	1,538
Buskerud	50,000	120,918	176,516	98,414	90,000	4,389
Finnmark	50,000	133,331	207,000	96,423	100,000	1,666
Hedmark	42,736	118,272	170,000	95,848	90,000	2,471
Hordaland	45,000	123,117	185,000	99,358	95,000	6,727
More og Romsdal	50,000	124,572	182,647	99,424	100,000	2,844
Nordland	45,000	121,189	179,000	97,082	90,857	3,730
Oppland	40,000	116,125	160,000	97,180	85,000	2,343
Oslo	49,509	125,821	200,000	102,495	100,000	10,002
Østfold	45,000	123,013	180,000	101,332	95,000	5,198
Rogaland	47,000	127,231	199,000	103,029	100,000	5,402
Sogn og Fjordane	45,000	120,643	180,000	97,504	100,000	920
Telemark	45,000	118,983	172,905	97,508	89,800	2,423
Troms	50,000	120,299	170,000	96,853	90,000	2,477
Trøndelag	40,000	114,157	155,000	94,309	87,700	5,264
Vest-Agder	40,000	114,185	155,000	98,277	80,000	2,099
Vestfold	46,526	118,703	165,000	95,308	93,731	3,648

Table 5: Summary statistics of data provided by the loan agent on county-level from 2015-2018

	1st Qu.	*Mean*	*3rd Qu.*	*SD*	*Median*	*N*
Akershus	50,000	158,391	220,000	134,610	119,800	30,833
Aust-Agder	50,000	142,938	200,000	127,019	100,000	5,605
Buskerud	50,000	150,753	201,000	131,327	101,000	14,743
Finnmark	50,000	153,570	205,000	130,088	110,000	5,758
Hedmark	48,000	145,423	200,000	131,367	100,000	10,361
Hordaland	50,000	148,332	200,000	130,744	100,000	25,406
More og Romsdal	50,000	151,917	209,915	132,170	101,000	12,164
Nordland	50,000	150,261	200,500	132,761	100,000	13,977
Oppland	45,000	141,372	200,000	128,311	100,000	9,452
Oslo	50,000	155,968	210,000	134,964	110,000	36,195
Østfold	50,000	146,690	200,000	128,559	100,000	18,622
Rogaland	50,000	156,754	225,000	136,476	110,000	20,901
Sogn og Fjordane	50,000	153,186	218,500	135,186	100,000	3,655
Telemark	47,000	144,430	200,000	129,147	100,000	9,209
Troms	50,000	146,601	200,000	128,641	100,000	10,090
Trøndelag	50,000	141,567	200,000	126,158	100,000	20,970
Vest-Agder	49,000	144,242	200,000	127,908	100,000	7,758
Vestfold	50,000	145,639	200,000	128,197	100,000	13,579

Inspecting the summary statistics from the loan agent data, we see that the average loan amounts have increased overall after the regulation in 2015. Number of loans in the counties have also increased when correcting for the additional year in the second table, indicating that people have applied for higher loan amounts and that the number of applications has increased. The loan agent data set is less likely to have sample issues due to more observations and longer time-frame.

In addition to the loan amount, the purpose of the loan is of our interest. Table 6 show the different purposes of borrowing.

Table 6: Different purposes stated when applying for consumer loan

	2013-2015	***2015-2018***	***Total***
Mortgage	2.6 %	2.0 %	2.2 %
Health	3.6 %	3.3 %	3.5 %
Leisure	4.0 %	3.9 %	4.0 %
Boat	6.8 %	5.9 %	6.2 %
Bills	7.4 %	7.1 %	7.4 %
Renovation	10.8 %	9.9 %	10.4 %
Car	11.8 %	6.4 %	7.8 %
Other	12.2 %	13.6 %	13.7 %
Second Loan	40.8 %	47.8 %	44.7 %
N	71,771	269,278	331,079

Inspecting the table, we see the fraction using consumer loans as equity for mortgages has reduced slightly since the regulation of 2015 was implemented. As a supplementary analysis, we will examine how this group has changed after the regulation. Furthermore, we observe an increase in number of applicants that use consumer loan as a second loan over the time-horizon, indicating that more people refinance expensive debt assuming to mostly originate from credit cards.

4.2. Transformation of data

Considering that the data set provided by the bank included postal-codes, it enables us to compare observations between geographical areas on a *borough* level that captures differences within cities in contrast to the data set provided by the loan agent is on county-level. We used a list of postal codes and their corresponding boroughs to pair the loans into *boroughs* (Bolstad, 2018). Due to privacy issues and sample size, we excluded the *boroughs* with few loans and low population; Marka and Sentrum in Oslo. Additionally, given an abnormal firm-specific occurrence in the data, we also removed 2015 from the data set.

Table 2 and 3 illustrate the observations we use in our analysis of the data set provided by the bank in percentage of the total data. Cities plus counties cover all areas in Norway. We have excluded the observations within cities for the counties containing Bergen, Oslo, Stavanger and Trondheim, to avoid double-counting. The difference-in-difference analysis on education is based on the *boroughs* with the lowest education levels as treatment groups: Stovner, Grorud, Arna, Alna, Heimdal, Søndre Nordstrand, Hundvåg, Laksevåg and Åsane. For the difference-in-difference with cities, we define the cities Bergen, Oslo, Stavanger and Trondheim as the treatment group.

Table 7: Data filtering of observations

N; Before aggregated into boroughs	Cities and Counties	Cities	DiD within cities	DiD with cities and counties
All observations	24,351 (100 %)	7,109 (29 %)		
After excl. 2015 and outliers	17,682 (73 %)	5,196 (21 %)		
Treatment group before treated			634 (3 %)	2,275 (9 %)
Treatment group after treated			826 (3 %)	2,275 (9 %)
Control group before treated			1,641 (7 %)	10,526 (43 %)
Control group after treated			2,095 (9 %)	14,444 (59 %)

Table 8: Data filtering after location transformation

N; After aggregated into boroughs	Cities and Counties	Cities	DiD within cities	Did with cities and counties
All boroughs and counties	159 (100 %)	106 (66 %)		
After excl. 2015 and outliers	100 (63 %)	68 (43 %)		
Treatment group (N of boroughs)			9 (6 %)	34 (21 %)
Control group (N of counties)			59 (37 %)	17 (11 %)

In the data set provided by the loan agent, we aggregated the loans into counties, and no further assignation is therefore necessary. The data contained some missing values that we removed, reducing the observations from 377,164 to 341,049. Other than grouping observations on county-level, we made no further adjustments to the data from the loan agent.

Norsk Eiendomsverdi AS provided us with house price indexes for the areas in our sample from 2003 to 2018. Oslo was the only city in the data set that had already been divided into *boroughs*, while some of the *boroughs* in other cites had been grouped. Due to the lack of granularity in this data set, some *boroughs* have the same price indexes. The distribution of the index to *boroughs* is described in the table below.

Table 9: Placement of house index to boroughs

Stavanger	**Trondheim**	**Bergen**
Downtown (Eiganes and Våland & Storhaug)	*Downtown* (Midtbyen)	*Downtown* (Bergenhus & Årstad)
West (Hinna & Madla)	*West* (Heimdal)	*West* (Laksevåg & Fyllingsdalen)
South (Hillevåg)	*South* (Lerkendal)	*South* (Ytrebygda & Fyllingsdalen)
North (Hundvåg & Tasta)	*East* (Østbyen)	*North & East* (Åsane & Arna)

4.3. Data quality

In this section, we assess the suitability of the data regarding validity, reliability, coverage and measurement bias.

4.3.1. Validity and reliability

Validity refers to what extent the question the researcher asks is measuring what they want it to measure (Saunders, Lewis, & Thornhill, 2012). Data that fail to deliver the information needed to answer research questions will result in incorrect answers.

The two data sets for consumer loans provided us with the necessary data to capture changes in consumer loans both before and after the two stages of policy changes. The data set provided by the bank only capture the regulation in 2017, while the loan agent data set captures both the 2015 and 2017 regulation. The granularity of the data set provided by the bank allows us to conduct the analysis on borough level, while the data originating from the loan agent is on counties. The usage of data directly from the source benefit the analysis compared to previous research that uses proxies or questionnaires, resulting in more need for assumptions. Moreover, regarding that the data set provided by the loan agent consist of application data, and not only paid-out loans, it also captures the borrower's behaviour in terms of demand due to the regulation. This increases the validity of the data set.

In data collection, reliability relates to what extent the data collection techniques can provide the same results if the research was redone (Smith, 2003). If the data is originating from a large, well-known organization, it is likely to be reliable and trustworthy. The data providers are acknowledged and their procedures for collecting and compiling the data is likely to be accurate.

4.3.2. Coverage

It is important that the data *covers* the population of interest, the relevant period, and consist of data variables that enable to meet the objectives and to answer the research questions (Saunders et al., 2012). Our data covers both periods of the regulation and the variables we find necessary

to examine the development of consumer credit. Undoubtedly, using data from the upcoming debt registry would have been preferred; it would have covered the total debt burden in the market for consumer loans. However, we assume that our data is correctly distributed throughout Norway; thus, concluding that it is sufficient enough to conduct our analysis.

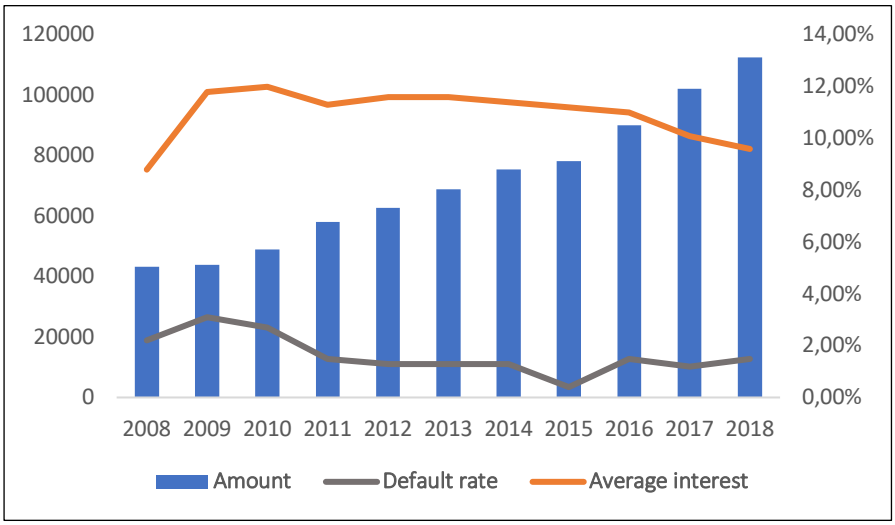
4.3.3. Measurement bias

If data is recorded inaccurately on purpose, there is an occurrence of measurement bias in the data set. The data sets used in our analysis are from well-established organizations that gather data directly from internal systems. By cooperation, the goal of the data providers is also to gain insight into the topic and the data sets is therefore unlikely to include bias.

5. The Norwegian consumer credit market

Roughly half of the unsecured loans are historically credit card debt (Finanstilsynet, 2018a). There is not a clear distinction in bank reports between credit cards and consumer loans as they operate in the same market. In 2018, roughly 45 % of unsecured loans were estimated to be credit card loans, reduced from 49 % in 2017 (Hagen et al., 2017). Hence, the growth in consumer loans is partly a result of the increased usage of credit cards. Sixty-five percent of total outstanding credit card debt was interest-bearing, which means that 35 % paid instalments before the loan carried interest, usually within 14 to 60 days (Finanstilsynet, 2018b).

Figure 2: Development of unsecured loans



Reported unsecured loans to the Norwegian market. Loan amount in MNOK on the left axis and percentage interest and default rate on the right axis. Source: Finanstilsynet (2016, 2017a, 2018b)

Although some of the growth in consumer loans are related to the increased credit card use, there is still a remainder of loans that are spent on consumption or to finance other assets. During the last ten years, multiple specialized consumer credit banks have entered the Norwegian market. The four largest banks in 2017 was *Bank Norwegian, Santander Consumer Bank, yA Bank* and *Komplett Bank*. These four banks have since 2014 been responsible for more than 2/3 of the growth in the segment (Hagen et al., 2017). Bank Norwegian and Komplett Bank are affiliated to other Norwegian businesses (Norwegian Air Shuttle and Komplett.no) and facilitate transactions and down-payment of goods and services as well as providing loans.

We also include the fundamental theories on consumer behaviour that explain why people use consumer loans in appendix 12.2.

5.1. Unique features of the Norwegian market

5.1.1. Enforcement agency

Within the law enforcement branch, there is an *enforcement agency* (Norwegian: Namsfogd/namsmann) that has the authority to claim a borrower's assets in case of default. If the borrower does not have assets that can be claimed, the enforcement agency can confiscate a share of the borrowers' earnings or social security before it is paid to assure that the claim is fulfilled (Politiet, 2019). In practice, the process is expensive and lengthy but provide down-side security for lenders. External debt collectors first try to claim defaulted loans, and if they do not succeed, they forward the claim to the governmental enforcement agency (Hovland, 2018). The enforcement office has felt increased pressure following the growth in consumer loans, with the growth in the number of cases being 32 % in 2018 (e24, 2018). Enforcement officers are struggling with processing and following up the requests from the external debt collectors on time and have pointed out that this is resulted by the increased number of people that cannot serve their debt from consumer loans (Hovland, 2018).

5.1.2. Credit scoring

Interest on consumer loans is determined by individual factors rather than fixed rates as for most other loans in Norway. The interest is often determined by external credit scoring firms that model the default rate and suggest interest to the banks (Bisnode, 2019). These firms usually have access to large amounts of data, and there is secrecy about how the credit scores are calculated. There are, however, some factors that are more likely to have an impact on interest rates than others.

In the Norwegian market, the most important factors is expected to be: *Payment history, other debt, income, stability of employment, age, education, children, geographical location*

and *home ownership* (Poppe, 2017). Based on the application data, we find that 49 % of the applicants received an offer if they had other living arrangements than home-ownership, while 72 % of those that owned a house received a loan offer. Likewise, 73 % of the applicants with a mortgage received an offer.

5.2. Customers of consumer credit loans

In the wake of regulations, we find it essential to describe some key features of consumers that borrow through consumer loans. Moreover, we use some of the characteristics in the analysis. All characteristics are gathered from Zmarta Groups report (2017) and discussed in light of reports from Norges Bank (2017), Poppe (2017) and the data set provided by the loan agent for our analysis. Zmarta Group compare loan offers from 20 different banks and is expected to be a representative cross-section of the market.

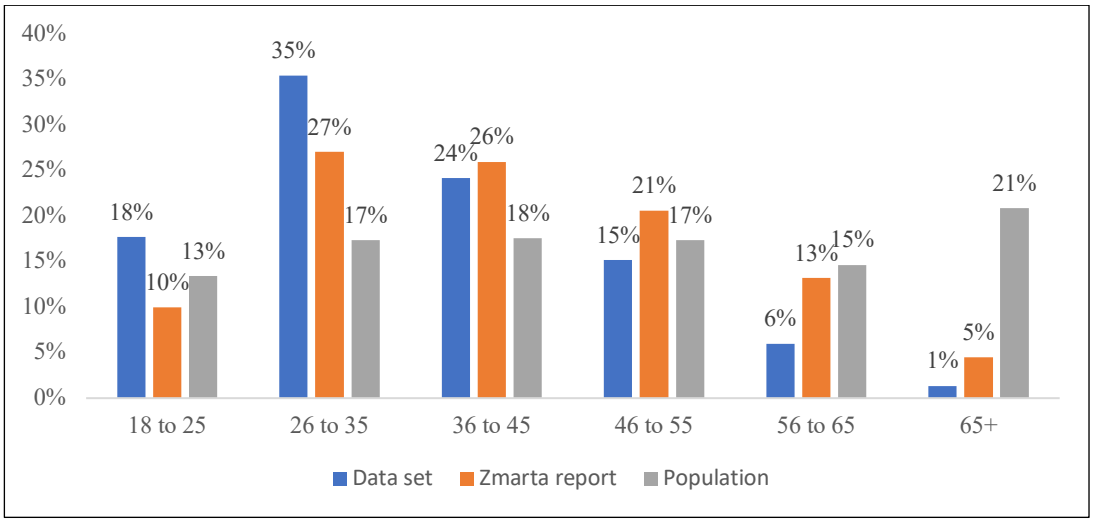
5.2.1. Gender

In 2017, 63 % of consumer loans were borrowed by males through the loan agent Zmarta (Zmarta Group, 2017). From the county-level data set, we also observe that 62 % of applications are from men. Cantero & Sællman (2019) argue that men usually make more financial decisions in households than women. Therefore, the uneven number in gender might be a result of males being reported as the owner of the loan even if the entire household uses it. Men are also more likely to take financial risk and borrowed on average 8,000NOK more than women that also used consumer loans in 2016 (Grable, 2000; Zmarta Group, 2017). A survey conducted by Finn.no in 2016, revealed that 17 % of women earned between 500,000 and 700,000, while 28 % of men had the same income level. The difference of 11 % indicates that it might be easier for men to both redeem and serve a consumer loan (Comparo, 2018).

5.2.2. Age

Most banks require borrowers to be 23 years old or older to apply for consumer loans, but some banks also offer loans to individuals over the legal age of 18 (Poppe, 2017). Credit cards are more common among younger people; it is both easier to access and more established as unsecured loans (Poppe & Lavik, 2015). As seen in the figure 3, the consumers that borrow most through consumer loans are in the age bracket of 26 to 55, whereas fewer loans belonged to the lowest and highest age groups. Poppe (2017) finds that the likelihood of having consumer loans increase with age and then reduces after 45 years old**,** although observations from our data set indicate that the turning-point is from 35 years old.

Figure 3: Age of consumer loan borrowers

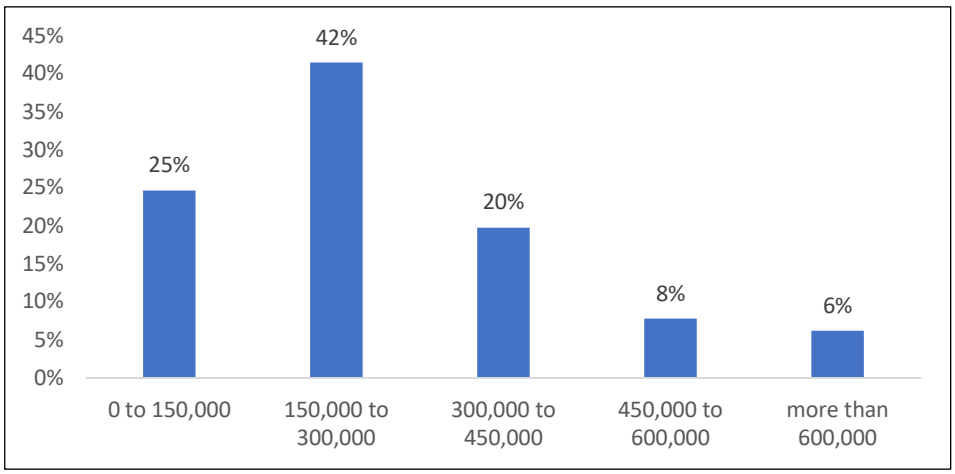


Source: (Zmarta Group, 2017) & (Statistics Norway, 2019a).

5.2.3. Income

Almost half of the total loans in 2016 belonged to borrowers with a gross income between 150,000 and 300,000NOK, while one fourth had an income of 0 to 150,000NOK. Although the banks often report that most borrowers have medium to high income (Øksnes, 2018), this is not coinciding with the income levels reported by Zmarta. In comparison, the average and median income in Norway for 2016 was roughly 519,000NOK and 470,000NOK respectively (Statistics Norway, 2018). The reported different income levels might be due to a shift in the customer base from earlier years, as previous reports also state that consumer loans are more frequent in high-income households (Poppe & Lavik, 2015). Seventy-four percent of Zmarta`s applicants were working full time, and roughly 13 % were on disability benefits.

Figure 4: Income distribution of consumer loan borrowers

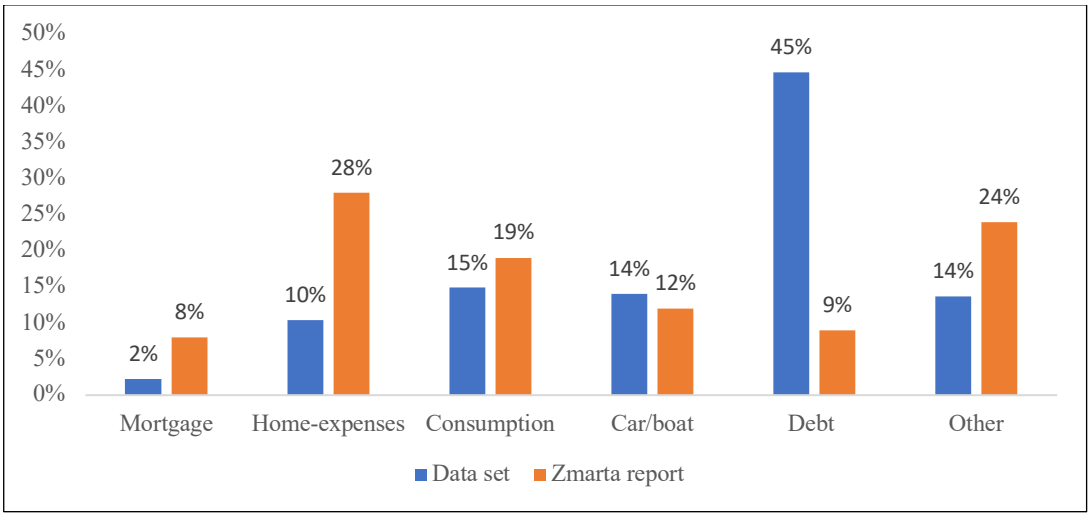


Source: (Zmarta Group, 2017).

5.2.4. Purpose

Based on the data set on counties, refinancing debt is the purpose of nearly half of all the loans. Advertisers often highlight refinancing debt as one of the main advantages to apply for a consumer loan. The refinanced debt is expected to originate from credit cards, although it might also contain refinancing of previous consumer loans or other debt. Most banks do not approve consumer loans if the applicants report the purpose to be equity for mortgages, although this has been advertised before (Vedeler, 2016). Although most banks claim to not offer loans with mortgage as purpose, various reports give different numbers, ranging from two percent to eight percent, as mentioned in section 1.

Figure 5: Purpose for consumer loans



Source: (Zmarta Group, 2017) and the data set provided by the loan agent

6. Residential real estate in Norway

The Norwegian housing market is estimated to be worth roughly 8.027 BNOK, approximately 2.4 times the annual GPD or almost the same value as the Norwegian Sovereign Wealth Fund in 2017 (Eiendom Norge, 2017; Norges Bank, 2019; Statistics Norway, 2017). Housing differs from most other assets, giving utility to households while exposing to risk through the market (Jordà, Knoll, Kuvshinov, Schularick, & Taylor, 2017). We also include the fundamental theories on what is affecting house prices in Norway in Appendix 12.3.1.

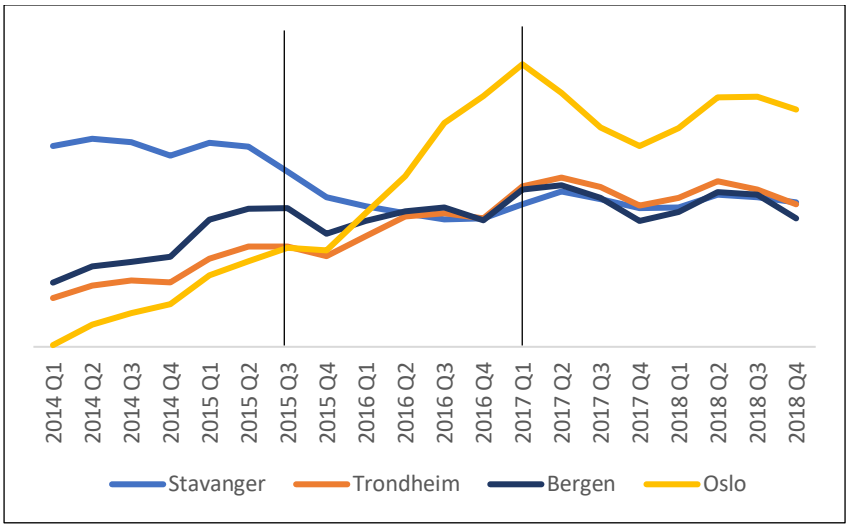
6.1. Development of residential real estate in Norway

After the second world war, there has been a bipartisan agreement to stimulate home-ownership in Norway. The number of young homeowners reached a new record in 2015, with 84 % of

Norwegians over the age of 25 owning a residence and 98 % of Norwegians owning a home during their lifetime, which is higher than other nations in Scandinavia (Eiendom Norge, 2019). Increases in income levels and interest rates dropping to historically low levels are some of the reasons for this development (Iversen, 2016).

Figure 6 illustrates the house price index from 2014-2018 for the four cities used in the borough models. As the data used on house indexes started in 2002, each city has different starting points, which is corrected for in the analysis. However, for illustrative purposes, we use different starting points for 2014. The lines in the graph represent the starting point of the regulations in 2015 and 2017.

Figure 6: Development in house indexes from 2014 Q4 to 2018 Q4



As seen from the graph, Oslo has had the largest growth over the period, while house prices in Stavanger reduced from 2014. It seems like the second regulation has affected house prices in Oslo in particular. However, it is difficult to draw any conclusions on the effect of the regulations from the plot. With attention to Stavanger, the decline in house prices from 2014 is likely attributed to the oil-crisis Norway experienced this year, and might therefore not only be due to the regulation.

6.1.1. BSU

Young adults housing savings (BSU) is a product offered by banks to stimulate savings for residential real estate, with tax-deduction financed by the government. Deposits to a BSU-account can only be used to purchase a house or to pay mortgage instalments and interest along with a few other house-related expenses. Interest on deposits are higher than on regular saving accounts, and new deposits include a 20 % tax return on taxable income. Maximum deposit

each year is 25,000NOK with a total account limit of 300,000NOK excluding interest. Furthermore, the benefit is restricted to young adults up to the age of 33 years old (The Norwegian Tax Administration, 2019). The BSU system was implemented to encourage more young adults to save equity for home purchases and a subsidy towards home ownership.

7. Research design

7.1. Fixed effects regression

Differences between *boroughs* and *counties* are often a result of factors that cannot be observed or is difficult to measure, so-called *unobserved effects* (Wooldridge, 2016). Instead of finding instrumental variables, it is acknowledged that there are differences for each individual and time period which are accounted for. The fixed effects method also reduces the possibility of Omitted Variable Bias in the models, as the potentially omitted variables are treated as unobserved (Angrist, 2015). We use fixed effects models to estimate the between-group variation to explain how the policy change has affected the use of consumer loans.

7.1.1. Fixed individual effects

To estimate individual fixed effects, coefficients for each individual is estimated (Angrist, 2009). In our models, the *individuals* are either *boroughs* or *counties*. By estimating the individual effects, we address factors that varies between *counties* or *boroughs* but these effects are difficult or impossible to measure. For our model that means controlling for demographic factors, housing composition and other characteristics. By doing this, each *borough* or *county* gets a different interception, effectively making individual regression lines for each individual (Wooldridge, 2010).

7.1.2. Fixed time effects

Along with unobserved individual effects, there might be some *unobserved time effects*. The effects are estimated by adding coefficients to time dummy-variables (Angrist, 2009). In our analysis, fixed time effects are especially important, as there are multiple aspects that affect consumer loans that would be difficult to implement. In particular are effects of advertising and the increase in banks offering consumer loans examples of such fixed time effects. The time fixed effect removes bias from unobservable changes over time but is equal to all *individuals* (Wooldridge, 2010).

7.1.3. Fixed effects model

Following the notation of Piche & Angrist (2009), the fixed effects model is formulated as:

$$Y_{it} = \alpha_i + \lambda_t + \rho H_{it} + X_{it}\beta + \varepsilon_{it}, \tag{8.1}$$

in which Y_{it} is the response variable, λ_t time fixed effects, ρ the causal effect on the variable of interest, X_{it} a vector of control variables, ε_{it} the composite error term, and $\alpha_i = \alpha + A_i'\gamma$ the individual fixed effects. In our case, the variable of interest is House Prices, H_{it}.

In the *borough*-models, we use a panel data set with two time-periods. In that case, the fixed effects equation is equal to the first differenced equation, where the means are subtracted from each observation:

$$\Delta Y_{it} = \Delta\lambda_t + \rho\Delta H_{it} + \Delta X_{it}\beta + \Delta\varepsilon_{it} \tag{8.2}$$

To assesses that the OLS and Fixed Effects models are the most efficient models, a number of assumptions must hold. We found presence of homoscedasticity and serial correlation in all models. To correct for this, we implemented clustered standard errors on *borough*/*county* level. Clustered standard errors also best represent the variation, as the degrees of freedom would be over-stated otherwise (Wooldridge, 2016). A further explanation and evaluation of each assumption along with tests can be found in Appendix 12.4 and 12.5

Our models include an interaction term for after the policy and house prices to evaluate the effect of house prices on consumer loan after the regulation:

$$Consumer\ Loan\ Amount_{it} = \alpha_i + \lambda_t + \beta_1 H_{it} + \rho(H_{it} * D_t) + X_{it}\beta_2 + \varepsilon_{it}, \tag{8.3}$$

in which D_t is a dummy for time-periods after the policy in either 2017 (*borough* models) or before and after 2015 (*county* models). We use all periods after 2015 in the county models to examine the post-regulation relationship after *both* the 2015 and 2017 regulation, as it is more likely that the first regulation had a greater impact than the second. The second regulation is expected to have affected cities more. In all estimations, the unobserved *individual effect* is removed through transformation (Wooldridge, 2016).

7.1.4. Pooled OLS

One of the draw-backs of using Fixed Effects is that it measures the *between* effect of each *borough* or *county* (Baltagi, 2006). When the *within* variation is large, fixed effects might therefore not be the best method. To compare the results of the fixed effects regression, we use Ordinary Least Squares (OLS) that is not taking into account the fixed individual effects. However, it does however include time dummies in all models to counteract the effect that time has on variables in the model and includes an intercept due to not removing the individual effect, α_i.

7.2. Difference in Difference analysis

Difference-in-difference is a research design used frequently in quasi and natural experiments. A quasi-experiment is used to estimate the causal effect of an intervention, such as a policy shift on a target population. The study is conducted without a random placement, meaning that the group each participant is assigned to is not random (Wooldridge, 2010).

Table 10: Categorization of variables

Treatment group before policy change	*Treatment group after policy change*
Control group before policy change	*Control group after policy change*

Despite no precise treatment and control group regarding the policy change, as mentioned in section 1, we decided to conduct two difference-in-difference analyses with different definitions of control and treatment groups. We divided the *boroughs* based on education levels followed by comparing the policy change`s effect on the cities and more rural areas.

7.2.1. Difference-in-difference model

The difference in difference-estimator is estimated using formula 8.5

$$\hat{\delta} = (\overline{y_{t,T}} - \overline{y_{t,C}}) - (\overline{y_{t-1,C}} - \overline{y_{t-1,C}}), \tag{8.5}$$

in which *T* is the treatment group, *C* is the control group, *t* is the treatment period, and *t-1* is the pre-treatment period. $\hat{\delta}$ is the estimated average treatment effect or difference-in-difference estimator (Woolridge, 2010).

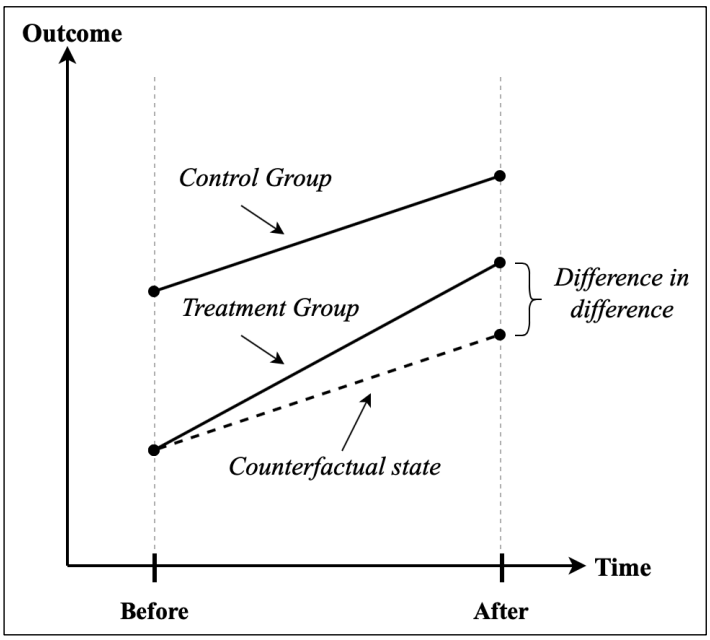
In practice, the difference-in-difference framework is implemented by creating dummy variables for both the *treatment group* and *treatment period.* The difference-in-difference

estimator is the interaction between these variables and is only equal to one for the treatment group after treatment:

$$Y_{it} = \gamma_i + \lambda_t^P + \delta D_{it} + X_{it}\beta + \varepsilon_{it}, \tag{8.6}$$

where γ_i denotes the treatment group, λ_t^P refers to the treatment period and $D_{it} = \gamma_i * \lambda_t^P$ (Angrist, 2015; Baltagi, 2006).

Figure 7: Graphical illustration of the difference in difference methodology



Source: Angrist & Pischke (2009)

7.2.2. Education as treatment group

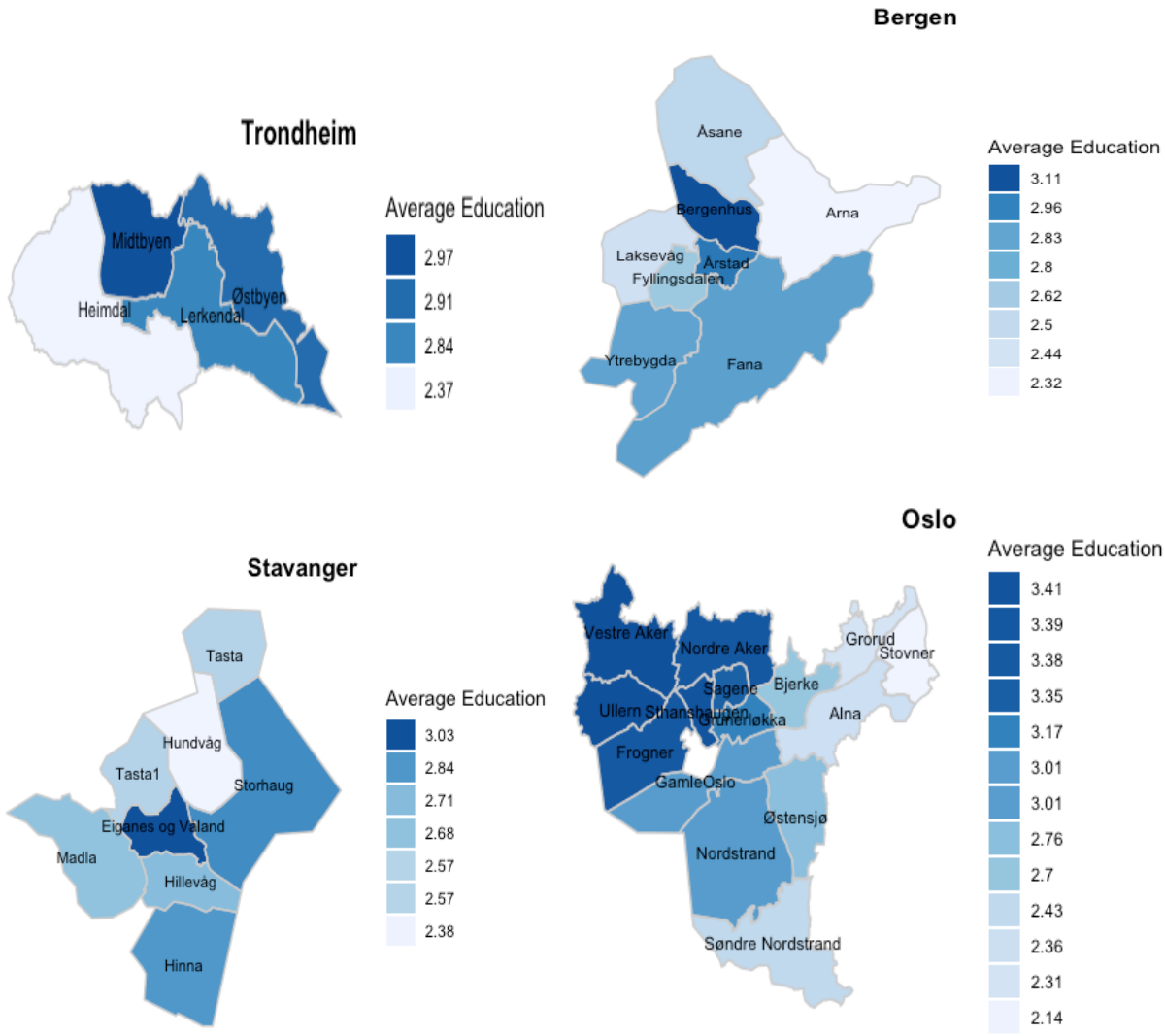
Poppe (2017) finds that lower-educated people have a higher amount of consumer loans than other groups, and we wish to evaluate whether this is true on *borough* level as well.

The Central Bank of Norway wrote a letter to the Ministry of Finance pointing out the effects of the new regulation on mortgage loans. Among others, they identified that higher income households were more affected by the requirement on LTV-ratio, while the debt-servicing capacity requirement had the most impact on lower income households (Olsen & Hægeland, 2018a). Considering that the new part of the 2017-regulation on mortgages restricts the loan based on income and people with higher education usually have higher income, we use education to evaluate this part of the regulation. Thus, we define the *boroughs* consisting of

people with lower education as treatment group for the regulation, and the medium to high – educated *boroughs* as control group.

Figure 9 illustrates the weighted average of education in Bergen, Oslo, Stavanger and Trondheim. The darkest colour on the scale represents the *boroughs* with the highest education, and the lighter colours represent the *boroughs* with lower education in each city that we have used as the treatment group for the policy shift.

Figure 8: Education levels in boroughs



7.2.3. Cities as treatment group

As mentioned in the hypothesis, section 3.1.4, there might be a disparity between the cities and more rural areas. Housing assets outside cities can be difficult to value, as the market is less liquid, making mortgage equity withdrawals not as accessible outside cities (Head et al., 2012). Given this point, the regulation would be expected to increase this difference. However, due to the high leverage ratio in the cities pointed out by the Central Bank of Norway, we expect the regulation to impact the cities even more (H. Borchgrevink & K. N. Torstensen, 2018).

We have utilized all the observations in the data set on consumer loans by grouping the observations not used earlier on the county level and by year. By aggregating the data doing so, other cities are captured in the aggregated county levels. Some of these cities might not have the same liquidity issues as more rural areas but is unlikely to have the same level of transactions as the four large cities. It is likely that the model still captures some of this effect, but estimates should be interpreted taking into consideration of both effects.

7.2.4. Difference-in-difference assumptions

To conclude with statistical interference, it is important that the two groups are comparable, which is difficult to assess, considering that there is no possibility of examining the outcome to the treatment group if the treatment never occurred. To examine the reliability of the difference-in-difference analysis, several assumptions must hold.

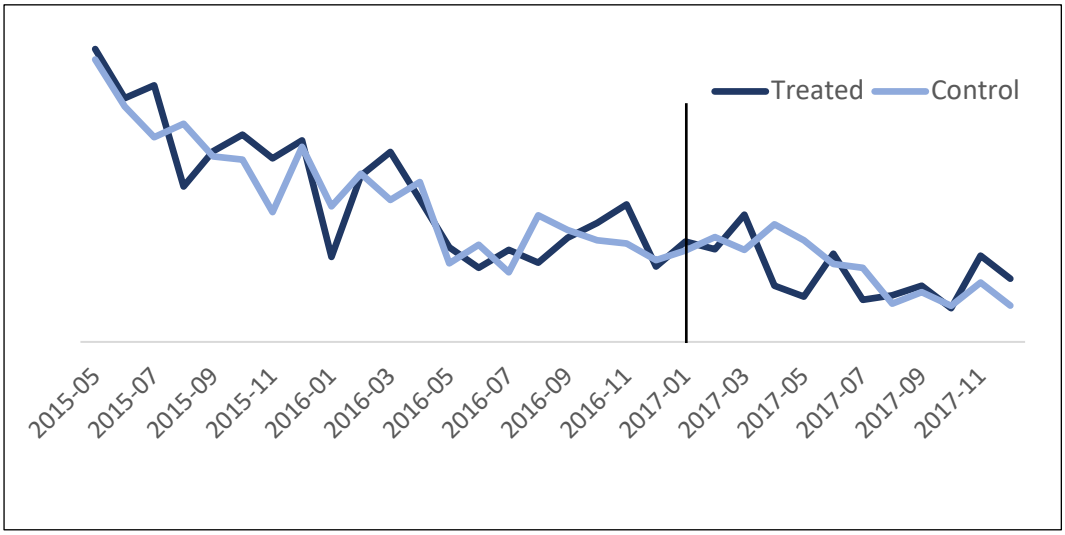
Parallel pre-trend

This parallel pre-trend assumption implies that there is a common trend between the treatment and control group. In other words, if there is not a common trend between the two groups, we compare two groups that were not comparable to each other before the treatment. Thus, we need to inspect the data graphical with trend lines for the two groups before the pre- and post-treatment period. Doing so, we can visually inspect whether the lines between the groups are parallel or not, and thereafter conclude to what extent the assumption holds (Wooldridge, 2010).

Figure 9 & 10 are graphical illustrations of consumer loans from 2015 to 2017 for the different groups. Each data point is the average of all loans aggregated into months that are borrowed by the people living in the boroughs defined as the control group, and likewise for the treatment group. Considering that the trends are not perfectly parallel in these graphs, we must be careful stating that the parallel pre-trend assumption holds. However, the groups are to some extent parallel. The graphs with education as a measure for the treatment group is, however, more parallel than city as the treatment group. It is also interesting to notice the jump

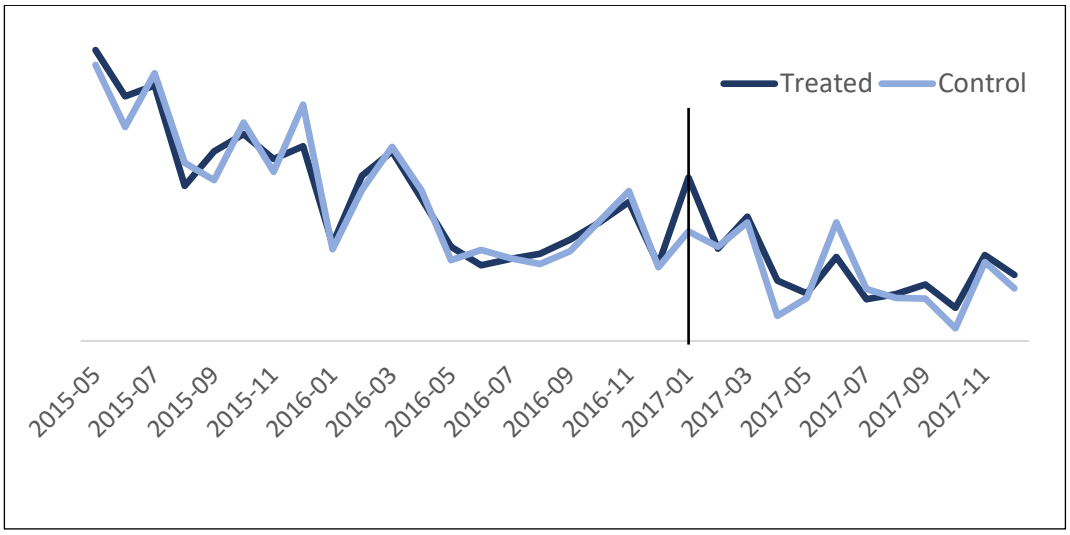
in average consumer loans surrounding the policy shift in 2017 for the boroughs with the lowest education.

Figure 9: Illustration of cities as treatment and rural areas as control group



Based on data provided by the bank

Figure 10: Illustration of low education as treatment and medium to high education as control group



Based on data provided by the bank

Strict exogeneity of the treatment event

Strict exogeneity requires the independent variable to be strictly unaffected by the dependent variable, whereas the dependent variable can be affected by the independent variable. That is to say, house prices cannot be affected by consumer loans, but consumer loans can be affected

by house prices. In difference-in-difference design, this implies that the policy shift should not be a result of a change in the dependent variable (consumer loan amounts). To put another way, if the policy change affected the borrower's behaviour when the market was informed before it was implemented, the assumption would be violated. Considering that the policy change was announced before it was implemented, the market could have responded to this before the treatment year. Hence, we believe it to be likely that a change manifested in the dependent variable before the treatment year, and therefore it is a possibility that the assumption is violated (Freyaldenhoven, Hansen, & Shapiro, 2018).

Stable unit treatment value assumption

Stable unit treatment value assumption stipulates that there is no interference between units and that there are no variations in the treatments. No interference requires the treatment of any unit to not affect the outcome of another unit. No variation in the treatments require the treatments for all units to be comparable (Morgan & Li, 2014).

Whereas all areas in Norway were exposed to the same policy change, Oslo had an extraordinary requirement implying that debt cannot exceed 60 % of the house's value for secondary residence, as mentioned in section 2.1 (H. Borchgrevink & K. N. Torstensen, 2018). The LTV requirement for Oslo may have resulted in a spillover effect such as increased emigration for those involved in house speculation. As seen from Figure 6: Development in house indexes from 2014 Q4 to 2018 Q4, house prices in Oslo decreased more than the other cities after the second regulation, which suggest that the stable unit treatment assumption is violated. By omitting Oslo, we would fulfil this assumption, but given that it is the city with the most people, we would dismiss a large portion of the treatment group.

8. Variable Selection

To capture the effects of house prices on consumer loan in the regressions, it is essential to select correct variables on both sides of the equation. We are measuring the change in consumer loans based on house prices and use control variables to isolate the effect. Table 11 displays the variables included in the different models we use for our analysis unless otherwise stated in the section of the model.

Table 11: Variable selection

Variable	***Type***	***Models***
Loan Amount Per Capita	Dependent Variable	All models
House Prices	Independent Variable	Fixed effects models
Weighted Average Education	Control Variable	All models
Male Percentage	Control Variable	All models
Weighted Average Age	Control Variable	All models
Unemployment Rate	Control Variable	All models
Average Debt	Control Variable	Borough models

For the first difference-in-difference model, treatment and control groups are determined based on the *Weighted Average Education* variable. In the second difference-in-difference model, geographical location determines the groups.

To avoid spurious regression due to non-stationarity, all variables except the dependent variable has been first-differenced unless already stationary. See appendix 12.4.7 for more details on the method and tests we have used to address non-stationarity.

8.1. Dependent Variable

The dependent variable should capture the loan amount within each *borough* or *county*. Consider that each *borough* and *county* have different population sizes, the population size for each borough has been adjusted in order to display the loan amount per capita.

$$Loan\ Amount\ Per\ Capita_i = \frac{\sum Loan\ Amount_j}{N}, \tag{8.1}$$

where i is each *borough* or *county*, j is each loan, and N is the population in the *borough* or *county*.

Although this accurately portrays the average loan amount per capita if the population in total were present, we are only able to capture a small sample of the actual loan amounts. The output value should therefore not be interpreted as the entire market.

The aggregation of data and a small sample size compared to the population, indicates that it is most likely some noise present in our dependent variable. Noisy variables contain more information than just the effect of interest (Angrist, 2015). When some *boroughs* or counties contain higher number of loans than others, it is more likely that these *boroughs* or *counties* with a higher number of loans are more representative of the true average compared to those

with lower number of loans. The noise present likely correlates to the number of loans. In order to avoid heteroscedasticity and increase the validity of our results, we have added a weighing factor to the fixed effects and pooled OLS regression models. For all *boroughs* and *counties*, the weighing factor is $\sqrt{n_{loans}}$. The factor provides observations with a higher number of loans a greater magnitude in the models allowing for a better fit (Angrist, 2009)

8.2. Independent variable

Kartashova & Tomlin (2017) find a significant relationship between house prices and unsecured borrowing. Evidence from the UK also suggests that house prices affect consumption (Cristini & Sanz, 2011). This in turn could have an impact on consumer loans. As argued in section 3.1.1, mortgage regulations directly impact house prices in Norway. Provided that our hypothesis identifies consumer loans as an alternative credit facility to mortgages, we argue that house prices are also likely to capture the anticipated impact on consumer loans. To do this, our chosen independent variable is house prices within the geographical limitations of our study.

The housing prices are based on an index developed by Eiendom Norge. The index started at 100 in the first quarter of 2003 and is recorded every quarter throughout 2018. The main objective of the index in the model is to explain the annual variation in house prices between *boroughs* or *counties*.

In order to aggregate it on a yearly basis, we calculated the average house index for the four quarters in both 2016 and 2017. There is some overlap between *boroughs*, as mentioned in section 4.2, where the assignment of each index to the corresponding *borough* can be found.

Real Estate Norway uses the *Sales Price Appraisal Ratio (SPAR)*-method with some alteration to develop the index. The first step consists of evaluating characteristics about the property, through a regression model in which each component is given a monetary value and added together to provide the predicted price. In the second step, the difference between predicted and real sale value is calculated. The median difference is the reported change in the index (Eiendom Norge, Finn, & Norsk Eiendomsverdi AS, 2019). The variable used in the model is in percentage change from the previous period.

8.3. Control variables

To account for factors that might affect the results that otherwise would be captured in the explanatory variable, we have included control variables in the analysis. The variables are listed below, along with reasoning for inclusion.

8.3.1. Weighted average education

As argued in section 3.1.3, Poppe (2017) finds a significant negative relationship between education and the likelihood of applying for a consumer loan. His results suggest that people with a university degree are less likely to apply for a consumer loan than other education groups. We therefore expect this variable to capture some of the effects that otherwise would be contributed to the housing prices. Based on education statistics gathered from Statistics Norway on the *borough* and *county* level for the population over 18 years old (Statistics Norway, 2019b), we have given each education level a numerical value:

Table 12: Education levels

Primary school	1
High School	2
Vocational School	3
Bachelor's degree	4
Master´s degree and/or PhD	5

In order to calculate the weighted average education of each *borough* or *county*, we multiplied each education level with the reported number of people within each bracket and divided the sum by the total population for the same *borough* or *county*. Although these numerical values are not continuous and cannot be interpreted directly, it captures differences in education levels.

8.3.2. Male percentage

To control for changes in the gender-composition that might affect consumer loans, we have added the male percentage living in each *borough* and *county* to the regressions, obtained from Statistics Norway (2019a). As discussed in section 5.2.1, males, in general, are more frequent borrowers of consumer loans compared to women (Zmarta Group, 2017). It is necessary to include the male percentage as a control variable because there might be systematic differences in gender composition for consumer loans.

8.3.3. Average age

Hagen et al., (2017) identifies that borrowers in the age group of above 40 years old pay the highest share of interest rates on loans in Norway. Moreover, the interest rate increase with age. Their analysis discovers further that more than 20 % of overall loans have an interest rate over 14 % in the age bracket above 60 years old, compared to less than 10 % for the age group 18 to 29. Poppe (2017) finds that the probability of having a consumer loan increases with age until

45 years old, to then decrease (Poppe, 2017). Due to the tilt in interest rates and Poppes findings on the age component, it suggests that a higher age is a predictor for the demand of consumer loans. Although reports from Zmarta our data set indicate that this might not be true, we expect age to have an impact.

8.3.4. Unemployment rate

Collins, Edwards & Schmeiser (2015) finds a pattern of households increasing unsecured debt as they become unemployed. To control for effects that might disturb the impact our analysis is trying to capture, the unemployment rate is added as a control variable. We collected the data on unemployment rates directly from NAV, that manages unemployment and disability benefits in Norway. The data set consists of monthly numbers of unemployed people in each *borough*. To find the unemployment rate, we aggregated the observations into a yearly average and divided it on the number of citizens in each *borough*. The *county* unemployment rate is gathered from Statistics Norway and is already presented in percentages (Statistics Norway, 2019c)

8.3.5. Average debt

Household debt is mostly related to the purchasing of a house (Jacobsen & Naug, 2004). Although our dependent variable is included in total household debt, consumer loans only constitute three percent of the population`s total debt portfolio (Lindquist, Solheim, & Vatne, 2017), and are therefore unlikely to affect the overall debt levels in a significant manner. Moreover, the house prices are affected by the access to credit, hence the mortgage regulation (Olsen & Hægeland, 2018b). To distinguish the effect that debt has on house prices, we added household- debt to the control variables gathered from Statistics Norway (2019d). Considering that debt levels are closely correlated with income, the inclusion of both income and total debt would lead to multicollinearity. Anundsen & Jansen (2011) find self-reinforcing effects between debt levels and house prices, and based on their empirical evidence, we argue that debt levels are more likely to affect house prices than income. Moreover, we expect the overlap from consumer loans to be small due to the relatively low share of consumer loans compared to the overall debt.

9. Results

9.1. House prices and consumer loans

In this section, we present the results from the regressions we have conducted to test our hypotheses. The table below shows the method used when testing the hypotheses, as well as the data set used for each model.

Table 13: Methods used in analysis

	Method	***Data set***	***Hypothesis***
First policy change	OLS and Fixed Effects	Loan-agent	First
Second policy change	OLS and Fixed Effects	Bank	First
Increased borrowing for mortgage	OLS	Loan-agent	Supplementing
Difference-in-difference on education	OLS and Fixed Effects	Bank	Second
Difference-in-difference on cities	OLS and Fixed Effects	Bank	Second

All coefficients are exponentiated, subtracted one and multiplied with 100 to represent the percentage effect on consumer loans. The process is done with the standard errors.

9.1.1. Model based on the first policy change with counties as a geographical identifier

The data set provided by the loan agent is used in this section to explain the initial regulation and is based on *counties*. These models examine the relationship between house prices and consumer loans using the data set with a longer time horizon, which allows us to examine the before and after policy effect through the interaction term for the fixed effects models. The fixed effects in this model are both time and individual fixed effects in which the time is fixed on a yearly basis and individual is corresponding to each county. Column 1 and 2 are referring to the Pooled OLS models, and column 3 to 5 are Fixed-Effects models.

Table 14: Regression results with fixed effects on county and policy change

	Loan amount effect in percentage					
	Pooled OLS		Fixed Effects			
	(1)	(2)	(3)	(4)	(5)	(6)
House Price	2.01***	2.25***	-0.53***	-0.73***	-0.63***	-1.59***
	(-0.05)	(-0.06)	(0.001)	(0.001)	(0.001)	(0.01)
Before Policy * House Price					-0.97***	
					(-0.0000)	
After Policy * House Price						0.98***
						(-0.01)
Constant	50,383.52***	49,933.00***				
	(0.58)	(1.08)				
Time Effect	Year Dummies	Year Dummies	Fixed	Fixed	Fixed	Fixed
Individual Effects	No	No	Fixed	Fixed	Fixed	Fixed
Control Variables	No	Yes	No	Yes	Yes	Yes
Observations	108	108	108	108	108	108
R^2	0.87	0.87	0.03	0.12	0.14	0.14

*p<0.1; **p<0.05; ***p<0.01

The coefficients for *House Price* in the Pooled OLS models in column 1 and 2 are both significantly positive and show a positive relationship between house prices and consumer loans. Year dummies are added to account for the change in consumer loans over the time horizon.

In the fixed effects models, there is a significant negative relationship between house prices and consumer loans. When house prices increase, it is more likely that people make mortgage equity withdrawals instead of using consumer loans, as argued in 3.1.1. The sample period in this model stretches longer than the *borough* models in the next section and therefore also includes the pre-regulation period. To evaluate if there is a change between how consumers have reacted to changes in house prices, the interaction terms *Before Policy * House Price* and *After Policy * House Price* is added. The coefficients indicate that there has been a shift after the policy when the coefficient is significantly negative before 2015 and significantly positive afterwards. Furthermore, it roughly follows the percentage-for-percentage growth/decline of *House Prices*, supporting the hypothesis that consumers have shifted from mortgages towards consumer loans.

9.1.2. Model based on the first policy change with borough as a geographical identifier

The models in this section measure the second stage of the regulation on mortgage loans of 2017 on *borough*-level through the interaction term, *House Prices * 2017*. The coefficients represent the percentage change on consumer loan amount per capita. Column 1 and 2 show Pooled OLS models and are not accounting for individual or time fixed effects. Column 3 and 4 show both time and individual effects with and without control variables. The fixed effects models are both time and individual fixed effects in which the time is fixed on a yearly basis and individual fixed effects are corresponding to each *borough*.

Table 15: Regression results with fixed effects on boroughs for the second regulation

	Loan amount effect in percentage			
	Pooled OLS		Fixed Effects	
	(1)	(2)	(3)	(4)
House Prices	0.50***	0.98***	1.39***	1.34***
	(-0.02)	(0.03)	(0.005)	(0.01)
2017	31.22***	25.45***	0.03	-6.51***
	(-0.07)	(-1.24)	(-0.05)	(-0.15)
House Prices * 2017	-1.78***	0.39***	5.30***	7.57***
	(-0.03)	(0.01)	(0.01)	(0.02)
Constant	23,542.65***	31,312.25***		
	(0.49)	(66.36)		
Time Effect	Year Dummy	Year Dummy	Fixed	Fixed
Individual Effects	No	No	Fixed	Fixed
Control Variables	No	Yes	No	Yes
Observations	68	68	68	68
R^2	0.10	0.21	0.52	0.55

*p<0.1; **p<0.05; ***p<0.01

Column 1 and 2 have both significant coefficients on *House Prices*, with an increase of 0.5-0.98 % in consumer loan amounts when the housing prices increase with one percent. From 2016 to 2017, the average house price increase in the *boroughs* was 4.1 %, amounting to an increase in consumer loans from 2.1 to 4.0 %. The time effect measured through the coefficient *2017* explains the increase in consumer loans that can be attributed to the yearly effect that is not accounted for by other coefficients. This is reduced when including control variables in column 2. The interaction term shows how house prices have affected consumer loans after the regulation and changes from negative to positive with the inclusion of control variables, indicating that other factors than *House Price* also have a substantial effect on the loan amount.

Unobserved time and individual effects are added in Column 3 and 4, providing an increase in coefficients on *House Price* compared to the Pooled OLS models. With the inclusion of control variables, the positive relationship based on house prices is 1.34 %. The coefficient for *2017* is significantly negative when correcting for other factors, indicating that the within variation is different than the between variation. The interaction terms display a significant effect in *House prices* for 2017 as a proxy for the continuation of the regulation and confirms that individuals borrowed more consumer loans based on house prices than they did before. If the result from column 4 of the positive relationship of 7.57 % is extrapolated to the total population in the four largest cities, the increase would amount to roughly 5.2BNOK, given that approximately 30 % of the population live in these cities and consumer loans constitute half of all unsecured debt.

9.1.3. Increased borrowing by individuals using consumer loans as equity for mortgage loans

As a supplementing analysis, we examine whether the individuals that use consumer loans as equity for mortgages borrow more after the initial policy change. In regard to the regulation on maximum LTV of 85 %, where more equity is required, the increased amount in consumer loans are likely to reflect this change. We used three OLS regressions. The primary objective of this analysis is to explain how this group differentiates from other users of consumer loan.

Table 16: Supplementing analysis on purpose: Mortgage

	Loan Amount In Percentage		
	OLS		
	(1)	(2)	(3)
Purpose: Mortgage * After 2015	4.97***	5.12***	5.09***
	(0.0000)	(0.0000)	(0.0000)
Purpose: Mortgage	72.38***	75.49***	74.30***
	(-0.0000)	(-0.0000)	(-0.0000)
Constant	8,465,159.00***	5,410,548.00***	5,738,031.00***
	(0.0000)	(0.0001)	(0.0001)
Time Effect	Year Dummies	Year Dummies	Year Dummies
Individual Effects	No	No	County Dummies
Control Variables	No	Yes	Yes
Observations	341,049	341,049	341,049
R^2	0.01	0.04	0.05

*p<0.1; **p<0.05; ***p<0.01

After the first regulation of 2015, individuals that use the loan for equity to finance mortgages have increased with 5.1 % based on the preferred model in column 3. During the same period, house prices have in general increased, and this growth can be attributed to a five-percentage-point increase in consumer loans that are used as equity for mortgage loans. Individuals that apply for consumer loans with mortgage purposes borrowed between 72.4 to 75.5 % more compared to the other purposes, indicating that some of the highest loans are used for mortgages. This might fuel the housing market and in turn increase the debt levels for households.

9.2. Difference-in-difference model based on education and the regulation in 2017

By using the difference-in-difference framework on education level, we examine the hypothesis that the people living *boroughs* with lower education levels borrow more consumer loans after the second stage of the policy shift, compared to the areas with higher education. Columns 1 and 2 are Pooled OLS models, while column 3 and 4 are Fixed-Effects models with year as time effect and *boroughs* as an individual identifier.

Table 17: Difference-in-difference on education

	Loan amount effect in percentage			
	Pooled OLS		Fixed Effects	
	(1)	(2)	(3)	(4)
Low Education * 2017	-3.22***	-3.28***	-3.22***	-3.73***
	(0.19)	(0.18)	(0.66)	(0.85)
2017	22.03***	25.71***	22.03***	30.49***
	(-0.19)	(-0.18)	(-0.17)	(0.02)
Low Education	20.43***	13.82***		
	(-0.45)	(-0.54)		
Constant	23,055.90***	23,058.86***		
	(0.45)	(0.46)		
Time Effect	Year Dummy	Year Dummy	Fixed	Fixed
Individual Effects	No	No	Fixed	Fixed
Control Variables	No	Yes	No	Yes
Observations	68	68	68	68
R^2	0.14	0.20	0.46	0.47

*p<0.1; **p<0.05; ***p<0.01

The coefficient for the difference-in-difference estimator, *Low Education * 2017* is significantly negative in all models and remain within the same range of -3.2 to -3.7 % for all

models. Interpretation of the results rejects the hypothesis that people living in *boroughs* with lower education levels borrow more per capita after 2017. From the coefficient, *Low Education* in the Pooled OLS models, we observe that the group in general have borrowed more consumer loans than the control group but have reduced the loan amounts compared to people living in *boroughs* with higher education levels after 2017.

9.3. Difference-in-difference model based on cities and the regulation in 2017

The hypothesis that people in cities borrow more consumer loans after the regulation in 2017 compared to people living outside cities has in this section been tested using a difference-in-difference analysis. Column 1 and 2 are Pooled OLS models, and column 3 is a fixed effects model.

Table 18: Difference in difference on cities

	Loan amount effect in percentage		
	Pooled OLS		Fixed Effects
	(1)	(2)	(3)
City * 2017	-32.72***	-8.07***	-8.07***
	(0.00)	(0.26)	(0.31)
2017	62.71***	31.59***	31.59***
	(-0.12)	(-0.26)	(-0.21)
City		-26.82***	
		(-0.73)	
Constant	-97.31***	-96.68***	
	(0.28)	(0.74)	
Time Effect	Year Dummy	Year Dummy	Fixed
Individual Effects	No	No	Fixed
Control Variables	No	No	No
Observations	100	100	100
R^2	0.22	0.30	0.59

*p<0.1; **p<0.05; ***p<0.01

This analysis utilizes all observations in the data set provided by the bank and is aggregated to *city* and *county* level. From the difference-in-difference estimator, *city * 2017* in column 2, we observe that individuals in cities on average borrowed 8.1 % less through consumer loans than those living outside the four largest cities. Those results are rejecting the hypothesis that city residents borrowed more consumer loan after the second stage of the regulation. The Fixed Effects model yields the same coefficients as the second Pooled OLS model but with different

standard errors. Due to limited access to control variables when cities are extracted from counties, this model includes no control variables.

10. Discussion

This paper analyses the effect of Norwegian mortgage regulations on the use of consumer loans. Based on the analysis conducted in the previous sections, we conclude that there is a significant relationship between house prices and consumer loans. Our results suggest that both the regulations of 2015 and 2017 are elevating the use of consumer loans; on average, it was approximately one percent fewer consumer loans for each percental increase in house prices before the regulation of 2015, in contrast to a one percent increase in the use of consumer loans after the regulation of 2017. In effect, this suggests that when house prices on average increased by 11 % after 2015, consumer loans also increased by 11 %. By using Finanstilsynets´ reported consumer debt in 2015 as the starting point (Finanstilsynet, 2017a), and assuming that 50 % of unsecured debt is consumer loans, the increase in consumer loans from 2015 to 2018 due to the regulations amounts to a total of 8.75BNOK. This equivalates to an average increase of 1,664NOK per person in Norway.

Additionally, we document that individuals using consumer loans as equity for mortgages borrow in general 74 % more than those with other loan purposes, with a significant increase of five percent after the regulation was implemented in 2015. Our results show that people are more likely to substitute reduced mortgage loans with high-cost consumer loans. We see this result in context with the forthcoming debt register, that among other strives to counteract this. It will likely affect the housing prices as the buyers no longer have the opportunity to acquire equity without reporting the origin of the equity.

Furthermore, when analysing the regulations effect from 2017 separately using only the cities of our geographical boundaries, consumer loans increased on average with approximately eight percent for each percentage increase in house prices. However, when we compared the cities with the areas outside those cities, the difference-in-difference results show that consumer loans for the same cities decreased with eight percent compared to the control group.

Overall, we find that the adoption of mortgage restrictions does not appear to meaningfully reduce the utilisation of alternative financial services; borrowers who previously used mortgage loans substitute them for consumer loans. The exception is the lower educated boroughs; although such borrowers, in general borrowed more, the amount reduced with approximately four percent after the regulation of 2017 was implemented.

As a result, although mortgage regulations may be effective in reducing house prices and mortgage debt, our findings suggest such policies may nonetheless increase high-cost borrowing among the higher educated groups and for people living in more centralized areas.

It is important to address some limitations of our study before concluding. Firstly, the data on consumer loans does not cover the total market, and the results should therefore not be interpreted as representative for all of Norway. Secondly, the difference-in-difference results are only valid to what extent the treatment group are receiving treatment, in contrast to the control group. Thirdly, our analysis is limited by the types of borrowing to consumer loans in our data set. Consumers may have different loan-portfolios, and there might have been an increase/decrease in their usage of mortgage loans as an effect of the regulation in which we cannot observe. Moreover, it is not certain that anyone who takes a consumer loan in our data set already holds a mortgage or have an intention to apply for one. Our results should be interpreted with these points in mind.

Despite these limitations, our results provide new evidence on essential questions of lending policies. In particular, our results suggest that the implementation of mortgage regulations cannot be addressed without considering the opportunity of switching to other forms of higher-cost loans. Apart from giving an insight into the effect of mortgage regulations, our results contribute to an understanding of the demand for consumer loans. The fact that people increase the demand for consumer loans when mortgage loans become more inaccessible suggests that the demand is fuelled by impatience and creativity that leads them to find loopholes through the credit market.

Finally, if our analyses were conducted again in a few years, they would likely provide different results because of both the imminent debt register as well as the new regulation on consumer credit loans.

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12. Appendix

12.1. The Norwegian Banks' guarantee fund

Norwegian law requires every bank with its main seat in Norway to contribute to a guarantee fund that secures deposits for each individual in each bank for up to 2 MNOK. There is a total of 145 banks contributing to this fund. There is also no upper limit for how many banks individuals can deposit money in (Bankenes Sikringsfond, 2018). With the advance of specialized consumer banks that have a higher degree of defaults and risk, it is argued that the deposit model should be revised in order to account for the risk levels of each bank. With the current model, consumer credit banks can provide higher interest on deposits than conventional banks. There is however, a higher risk associated with this. Mæland and Døskeland (2016) argues that the current model is unfair for traditional banks as these banks does not have the opportunity to operate with the same risk levels.

12.2. Consumer behaviour

To understand the underlying dynamics of why consumer loans are used, we present theories about the effects that lead to the need for consumer loans.

The Permanent Income Hypothesis (Friedman 1957, Deaton 1992), explains borrowing or saving as a forward-looking expectation on income. This is based on uncertainty or randomness of outcomes. The theory is based on the motivation to consume at a stable rate throughout the person's lifetime. Consumers maximize their utility given their Intertemporal Budget Constraint, which is the present value of their lifetime earnings, including current wealth (Bertola, Disney, & Grant, 2009).

$$\max E_t \sum_{j=0}^{T} \beta^j \, u(c_{t+j}), \tag{12.1}$$

where T is planning horizon, E_t expectation conditional on information available at t, u is the individual or household utility and $\beta = 1/(1+\delta)$, which is the subjective discount factor given the discount rate δ. The optimal solution that solves the maximation equation of u is given by:

$$u'(c_t) = E_t u'(c_{t+1}) \left(\frac{(1+r_{t+1})}{(1+\delta)} \right) \tag{12.2}$$

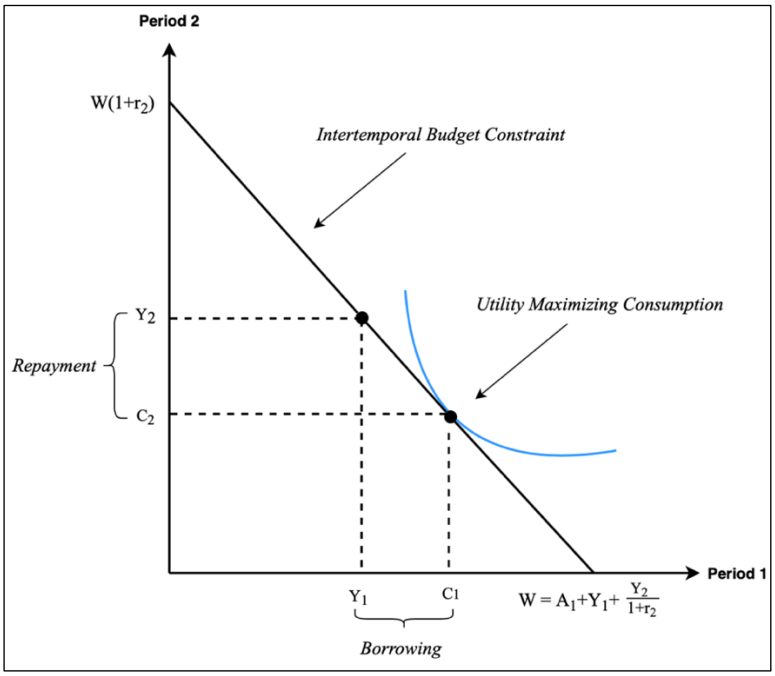
This therefore means that the consumer will change consumption based on personal taste, δ and the interest rate, r (Bertola et al., 2009). If an almost linear marginal utility by consumption is assumed, it is possible to model the permanent income hypothesis based on an intertemporal budget constraint where there is a relationship between savings, consumption and income:

$$s_t = \frac{rA_t}{1 + r_t} + y_t - c_t \tag{12.3}$$

where s is saving if positive and borrowing if negative, A are the current assets and y is income. Over multiple periods, the expectation of income determines the level of savings or borrowing. In households, where income is expected to increase, assets will be used to smooth consumption and borrow if $A = 0$ (Bertola et al., 2009).

In practice, the utility is considered convex, and borrowing is described through Intertemporal Consumption Choice (Deaton, 1992). Following the same notation as above and assuming a two-period world, the consumer can choose to borrow for consumption in period one to maximize utility and repay in period two. This relationship, in which the consumer chooses between two periods, is represented through $u = v(c_1, c_2)$ and illustrated in figure 1. When this equation is extrapolated to lifetime utility, the formula is $u = V(c_1, c_2, c_3 \ldots c_T)$ with T being the life expectancy of the individual.

Figure 11: Intertemporal Consumption Choice for two periods



Source: (Deaton, 1992)

12.3. Housing as a durable good

When durable goods, such as cars or housing, are added to the composition of households' wealth, the formula (12.1) includes the value of the house or other durable goods, d:

$$\max E_t \sum_{j=0}^{\infty} \beta^j \, u\left(c_{t+j}, d_{t+j}\right) \tag{12.4}$$

Such that their asset base is determined by $A_{t+1} = (1 + r_{t+1})(A_t + y_t - c_t - i_t)$, with new durable assets denoted by i. The durable good is also subject to depreciation. For housing assets, it is more likely to increase in value than depreciate. When the house value goes up, there might be a substitution effect, which leads consumers to borrow in order to account for their unrealized capital gain on assets. Empirical evidence shows that households with higher levels of durable goods also have higher levels of debt (Bertola et al., 2009). This usually consists of secured debt, but due to credit restrictions, borrowers might substitute such debt with consumer loans. With the new regulation, the option to make mortgage equity withdrawals is more limited, and consumers might be more likely to use the higher cost of borrowing.

12.3.1. Housing model

The central bank of Norway`s framework developed by Jacobsen & Naug (2005) demonstrates the factors that are predicting the housing prices. The demand function for housing is as follows:

$$H^D = f\left(\frac{V}{P}, \frac{V}{HL}, Y, X\right), \qquad f_1 < 0,\ f_2 < 0,\ f_3 > 0, \tag{12.5}$$

Where,

H^D = Demand for housing

V = Aggregate living cost for an average owner

P = Index for prices on other goods and services than housing

HL = Aggregate living cost for a tenant

Y = The households' real disposable income

X = A vector of other fundamental factors that affect housing demand

f_i = The first derivative of $f(\bullet)$ with regards to i

The function explains how the demand increases when income increases. If prices on other goods (inflation) increases or renting becomes more affordable, the demand for housing decreases. Based on the demand function, the authors build a model to explain changes in house prices. When they tested this model, it explained nearly 90 % of house prices with the primary determinants being the *interest rate, unemployment rate, new construction* and *commonwealth.* House prices reacted particularly fast and strong to changes in the interest rate. Other factors that are also expected to affect house prices are *Migration, governmental regulations, income, debt levels, new buildings* and *credit restrictions* (Naug, 2005).

12.4. OLS and Fixed effects assumptions

To verify that our models are reliable and can be used for causal inference, certain assumptions must be evaluated. The assumptions build on the framework of the Gauss-Markov theorem, but with some alterations for panel data and fixed effects (Wooldridge, 2010). Both the borough and county-level regressions have been tested for the assumptions unless otherwise stated.

12.4.1. Linearity

To fit a linear model, a linear relationship between the variables must be present. We have tested for linearity through plots of residuals to fitted values. To increase linearity, we log-transformed $Amount\ Per\ Capita$. The control variable, $Unemployment$ also showed signs of non-linearity; hence, this was also log-transformed. Claims by Poppe (2017), suggest that the Age should be squared to account for non-linearity, but due to the aggregative nature of our data set, squaring *Age* did not increase linearity. Our variable of interest, $House\ Prices$ proved to be linear in relation to our dependent variable. With this we can conclude that the linear model gives best fit for our data.

12.4.2. Multicollinearity

Perfect collinearity occurs when one independent variable predicts another independent variable in the regression, breaking the independence aspect of the variables. This makes interpretation of the coefficients difficult and might attribute the significance of the coefficients. Especially important is that the control variables are not correlated with our variable of interest, while multicollinearity between control variables are likely to not have any effect on the results as long as these are not interpreted independently (Allison, 2012). One technique used to check for multicollinearity is through correlation matrixes, in which variables above a certain cutoff

should be dropped from the regression. A correlation matrix of the data set shows some higher correlated variables, although this is not likely to affect our analysis.

There might also be one or more variables that are correlated with multiple variables. To address this, we performed a *Variable Inflation Factor* (VIF) test on the model. The year coefficients is especially of interest because of its likelihood to affect multiple variables. All coefficients in the main model are below the cut-off, which is considered to be about 10 (Hair, 2014). However, there might be collinearity between some coefficients that have VIF-scores up to 7.9 that should be taken into consideration when interpreting the results.

Table 19: Correlation matrix based on data from the bank

	Loan Amount	House Prices	Education	Male %	Average Age	Unemployment	Debt
Loan Amount	100 %						
House Prices	15 %	100 %					
Education	24 %	35 %	100 %				
Male %	1 %	25 %	11 %	100 %			
Age	3 %	37 %	15 %	49 %	100 %		
Unemployment	17 %	29 %	40 %	34 %	33 %	100 %	
Average Debt	18 %	19 %	76 %	33 %	14 %	26 %	100 %

Table 20: Correlation matrix based on data from the loan agent

	Loan Amount	House Prices	Education	Male %	Average Age	Unemployment	Debt
Loan Amount	100 %						
House Prices	3 %	100 %					
Education	11 %	2 %	100 %				
Male %	14 %	34 %	20 %	100 %			
Average Age	12 %	19 %	74 %	16 %	100 %		
Unemployment	11 %	2 %	68 %	20 %	66 %	100 %	
Debt	17 %	18 %	73 %	21 %	72 %	73 %	100 %

12.4.3. Zero conditional mean

$$E(\varepsilon \mid X) = 0 \tag{12.6}$$

The zero conditional mean assumption requires no correlation between the error term and the coefficients in the regression. A presence of correlation inflicting bias to the model (Wooldridge, 2016). A plot of residuals and fitted values illustrate that most residuals are located around the mean of zero, with a few observations deviating slightly from the mean. The

plot indicates that this assumption is not violated. However, it might contain some omitted-variable bias, in which more control variables could have been added to ensure better models.

12.4.4. Homoscedasticity

When the residual errors of the model are not evenly distributed depending on the size of the independent variables, there might be a problem with heteroscedasticity. Panel data sets often contain heteroscedasticity due to changes in each unit. Through residual plots, there is a definite problem with heteroscedasticity in our model, with the residuals deviating more when the fitted values are higher. Additionally, we tested for heteroscedasticity using the Breusch-Pagan test, that confirms the presence of heteroscedasticity (Breusch & Pagan, 1979). To address this, we implemented clustered standard errors by using Beck and Katz "Panel Corrected Standard Errors" (1995).

12.4.5. Serial correlation

With geographical data, it is expected that next years' data is similar or can be predicted using the data of the previous year. When this is the case, serial correlation miscalculates the standard errors of coefficients which cause unreliable results and should be corrected if detected (Wooldridge, 2016). To test if the assumption holds for our model, we conducted a Breuch-Godfrey test for panel models (Breusch, 1978). The test showed significant signals of serial correlation, which we corrected for using clustered standard errors as addressed above.

12.4.6. Normality

The residuals in the model must follow a normal distribution in order to conclude statistical inference. To check the distribution of the residuals, we used a Q-Q plot to inspect how the residuals are distributed. Some of the values are slightly skewed in the lower and upper part of the plot on the models using county data but not enough to cause problems regarding interpretation.

12.4.7. Stationarity and unit root

When two variables in the regression model are non-stationary, a concern with spurious regression arise, in which two series explain each other regardless of no trends between them. Spurious regression will result in wrong estimates in t-values of the slope, and R^2 will move towards one of the variables (Wooldridge, 2016). A common way to address non-linearity is to difference the variables until they become stationary. If stationarity is achieved through first

differencing, these variables will have an order of integration of 1 or I(1). Unit root is present when a trend in the variable shifts and does not return to the previous trend. Differenced variables might contain unit roots after stationarity and must then be addressed (Wooldridge, 2010).

In small panel data sets where *n* is larger than *T*, non-stationarity and unit root is generally not regarded as a concern because the *between* variation is larger than the *time/within* variation (Baltagi, 2006). However, cointegration can still lead to misspecification problems if this is not taken care of (Wooldridge, 2010).

Through a Maddala & Wu test for unit root in panel data, we tested all variables for unit roots and stationarity (1999). After first-differencing all variables, there was no occurrence of unit roots nor stationarity. The exception is the dependent variable, that is non-stationary but de-trended by the inclusion of time dummy-variables and fixed time effects, which is common in econometric analysis (Wooldridge, 2011). By differencing the dependent variable, one observation, *T* for all *n* would have been omitted, lowering sample size. Additional tests where the dependent variable was differenced, yielded similar results in coefficients and standard errors as the non-stationary dependent variable-model. Consequently, we decided not to difference the dependent variable in order to increase the sample period.

12.4.8. Fixed effects assumption 1

In addition to the OLS assumptions, there are some assumptions unique to the fixed effects framework (Wooldridge, 2010).

The first assumption states that there must be strict exogeneity of the explanatory variable(s), conditional on the unobserved effect. It allows no correlation between the error terms and the fixed effect, as well as requiring the zero-conditional mean assumption from the OLS to hold. To test this, we conducted a Hausman test, which tests suitability between random effects and fixed effects. The test yielded significant results for fixed effects; thus, the assumption holds.

12.4.9. Fixed effects assumption 2

The fixed effect assumption 2 implies standard rank condition on the matrix of time demeaned explanatory variable, which means that x_{it} must vary over T for any i. In other words, no time-invariant variables can be present in the model (Wooldridge, 2010). In case of an existence of time constant effects, it would be impossible to distinguish the effect of x_{it} and the fixed effects. All variables in the model change between the time periods; hence, the assumption hold.

12.4.10. Fixed effects assumption 3

The third assumption ensures the efficiency of the fixed effects model. It is doing so by imposing the constant variance, the serial uncorrelated error term assumption and proper estimation of the standard errors (Wooldridge, 2010). By using statistical packages, standard errors are normally calculated in a proper manner and this assumption should hold.

12.5. Testing the fixed effects regression model

Through formal testing of the model, address concerns and reasoning behind the implementation of the model.

We tested for serial correlation using the Breusch-Pagan test for panel models. This yielded significant levels of serial correlation in all models. Additionally, we tested for heteroscedasticity with a Breusch-Pagan test against heteroscedasticity. There was a presence of heteroscedasticity in all models. To compare the different effects in the fixed effect framework, an F-test for panel models was conducted. The test showed significant results for individual fixed effects and individual and time fixed effects, while the time fixed effects were barely non-significant. The data set provided by the loan agent on counties, gave best significance for both effects. We refer to the PLM-package in R for documentation of the above mentioned tests (2008)

12.6. Plots of the fixed effects model:

Q-Q and residual plot for the borough model with control variables (preferred model):

Figure 12: Q-Q plot of borough model

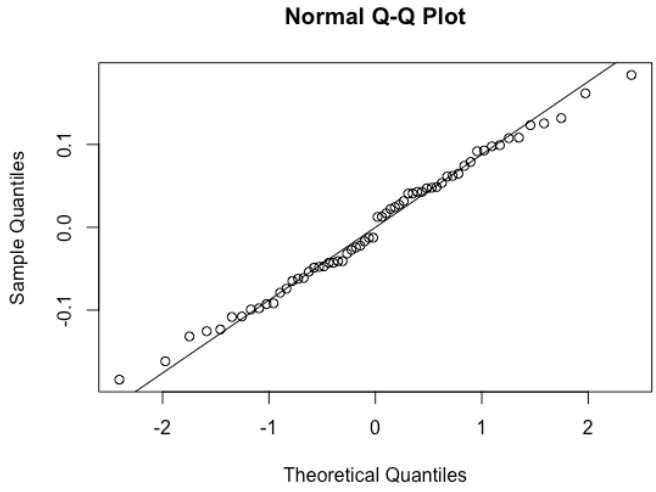


Figure 13: Residual plot of borough model

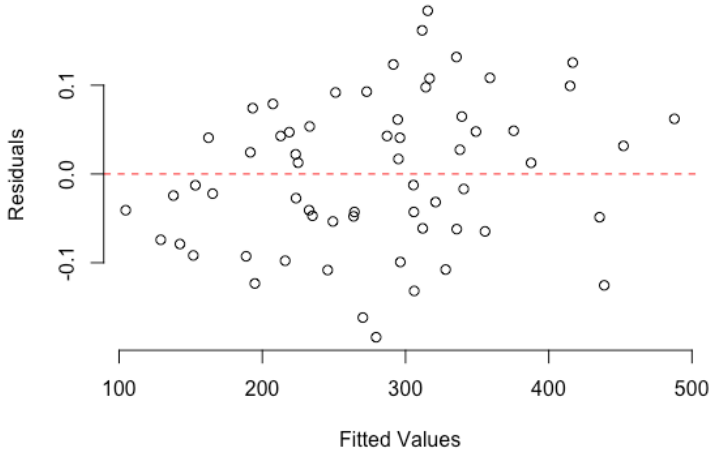


Figure 14: Q-Q plot of county model

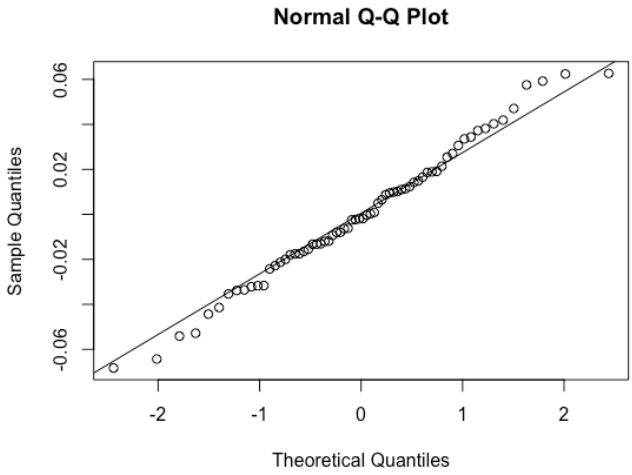


Figure 15: Residual plot of county model