Reform without ruckus: The house price effect of a tax on high-value homes

Andreas Økland*

June 15, 2022

Abstract

The housing market is an enticing source of tax revenue for governments. But how does a property tax on high-value homes affect house prices? This paper utilises rich micro data to study the introduction of a property tax on such homes in the Norwegian capital of Oslo. The reform was introduced in only one half of a densely populated, homogeneous area along the municipality border. This variation in tax burden is used to identify the effect on house prices. The analysis suggests that the new tax did not have a marked effect on house prices in the treated segment.

Keywords: Property tax, Capitalisation
JEL Codes: H27, H71, R21

*Skatteforsk - Center for Tax and Behavioral Research, Norwegian University of Life Sciences, School of Economics and Business, Norway, andreas.okland@nmbu.no. I thank Annette Alstadsæter, Simen Markussen, Wojciech Kopczuk, Marie Bjørneby, Julie Brun Bjørkheim, Kristoffer Berg, Lars Thorvaldsen, and Tiril Eid Barland for helpful comments and advice. I also owe considerable gratitude to Dag Einar Sommervoll, André Kållak Anundsen, and Erlend Eide Bø for help in initiating this project and getting the data for this project. I thank the participants at The Annual Meeting of the Norwegian Association of Economists, ZEW Public Finance Conference and the NTA Annual Conference on Taxation for helpful comments and questions. Any errors are my own.

1 Introduction

Property taxes are considered around the world, as both national and local governments seek additional revenue sources in the wake of the covid-19 pandemic. A separate tax on high-value homes, a mansion tax, has been raised as an alternative to broad property taxes (Minasi-Smith 2020). A mansion tax would not only increase revenue, but seemingly also counteract the rising inequality in income, wealth, and housing more effectively (Piketty 2014). The extent to how much the tax affects house prices will have implications for analysis of potential revenue, welfare and economic incidence. But the empirical evidence on how property taxes affect house prices is still inconclusive (Elinder and Persson (2017); Bradley (2017); Oliviero and Scognamiglio (2019)).

This paper provides new quasi-experimental evidence on house price responses to the introduction of a property tax on high-value homes.[1] The main finding suggests that the property tax at most had a small impact on house prices when it was introduced in the Norwegian capital Oslo. The analysis does not find support for the capitalisation into house prices that is predicted by theory. Instead, the point estimates suggest that there was no notable effect. The confidence intervals mostly exclude full capitalisation with 95 percent certainty. This is unexpected, as the analysis utilises high-quality micro data in a clear-cut setting with homogeneous treatment and control groups. A small divergence between the number of homes sold in the treatment and control area in one of the quarters after the introduction of the tax means that the results should be interpreted with reservations.

The empirical strategy makes use of detailed micro data on housing transactions[2] and geographical information. The area of investigation is the affluent, western suburbs to Oslo. The reform was introduced in only one half of the densely populated, homogeneous areas along the municipality border. Granular treatment and control areas are constructed using GIS software and location data. The treatment area is the zip codes in Oslo closest to the western municipality border. The counterfactual is the zip codes in the neighbouring municipality, that did not introduce the tax. Only the segment of homes that qualify for a notable effective tax rate[3] is included in the analysis, due to the sizeable standard deduction. The effects of the tax change events are estimated using so called doubly robust difference-in-

[1] The tax covered all houses worth more than NOK 5 million (USD 0.595 million). The effective marginal tax rate for home values exceeding NOK 5 million was 0.24 percent.

[2] The transactions data contain precise information about the exact time of sale, the sales price, common debt included, the listing price, as well as property characteristics like size, number of rooms and bedrooms, and the location of the property.

[3] The homes included are chosen by a simple algorithm: Mean price per m^2 is calculated for each property type in the treated area in the year before the reform. The size that on average qualify for a price of NOK 6.3 million, the valuation where the effective tax rate reaches 0.05 percent, in 2015 is the threshold for inclusion.

difference approaches proposed by Sant'Anna and Zhao (2020) and Callaway and Sant'Anna (2021) to allow for heterogeneous treatment effects and multiple time periods.

The empirical results suggest that there was no marked effect on house prices from the introduction of the property tax. The point estimates of capitalisation are almost uniformly small in magnitude. This holds true for estimates that compare the 12, 18, 24 and 36 months before and after the introduction of the tax. In the case of full capitalisation, an average price fall of 3 percent would be expected for the event. Instead, the estimates skew positively. The full capitalisation result of a 3 percent price fall is outside the 95 percent confidence interval of the point estimate for 9 out of 12 specifications. None of the 12 specifications yield a sizeable negative point estimate. The quarterly difference-in-difference estimates display a stable relative trend between the treatment and control area both in the pre-treatment period and the post-treatment period. But a closer analysis of the housing market activity after the introduction of the tax calls for some cautiousness when interpreting the results. There was a sizeable increase in homes sold in the control area compared to the treatment area in Q2 of 2016, 2017 and 2018. Although a similar pattern was observed in 2012 and 2013, it may also be an indication of selection bias.

This paper studies a question that has been subject to theoretical and empirical analysis since the 1950s (Tiebout (1956); Oates (1969); Brueckner (1982)). Still, the empirical evidence on the effect of property taxes is relatively sparse and inconclusive. But the availability of better data and new methods has spurred new and more reliable empirical results. A recent study by Elinder and Persson (2017) on the Swedish property tax uses similar techniques as the current paper, but on a national reform of the Swedish property tax. They only find signs of capitalisation in the very top segment of the property market. Bradley (2017) looks at the property tax in Michigan, where new homebuyers temporarily inherit the old tax valuations, leading to a temporary tax rebate for homes with too low valuations. The paper identifies houses sold with a large temporary property tax rebate and houses sold with a smaller temporary rebate and finds that the rebate seems overcapitalised into house prices. Bradley proposes that this may be due to the inattention of homebuyers. Oliviero and Scognamiglio (2019) find full capitalisation of the differences in property taxes in Italian municipalities. They exploit how different timing of the upcoming local election drove variation in the tax rates set by the local governments, during a reform where the local governments where obliged to introduce a property tax within a given range of tax rates. They do not rely on transactions data, but municipality level property value estimates from the Italian Real Estate Market Observatory.

The results from these investigations are mixed, covering no capitalisation, full capitalisation, and over-capitalisation. The papers have in common that they leverage oddities and special

cases, rather than evaluating policy changes. This makes for interesting results but limits the external validity of the analysis. The utilisation of the data combined with a transparent event is what makes the current project a unique contribution to our understanding of property taxes. The use of local data to compare a within-housing market variation in property tax rates, comparing houses on each side of the municipality border, makes identification stronger and the common trend assumption more compelling. This is inspired by the border discontinuity literature (Cushing (1984); Black (1999); Fack and Grenet (2010); Gibbons, Machin, and Silva (2013)).

Various mechanisms may explain the apparent absence of capitalisation of the property tax. The current paper discusses three of them, which all assumes that homebuyers are inattentive or misled due to behavioural biases. One of the mechanisms may be the low salience of the property tax combined with bounded rationality. Homebuyers may also be present biased, meaning that they discount future costs with a higher discount rate than current costs, and thus underestimate the significance of recurring taxes. The last mechanism that may drive inattentiveness is that imperfect information about the future tax policy may lead homebuyers to ignore the property tax in the purchasing process.

The results leave a mixed message for policymakers. At face value, the analysis suggests that a moderate property tax on high-value homes may be introduced without distorting the housing market. This has implications for welfare, the incidence of the tax, and how the public views the tax. The deadweight loss may differ from the standard case, being either higher or lower. This depends on how the income effects affect the remaining consumption bundle, as shown by Chetty, Looney, and Kroft (2009). The homeowners who bear the statutory incidence of the property tax will also bear more of the economic incidence. And the sparse economic reaction to the tax may be understood as revelation of preferences and a sign that voters do not put as much weight on the tax in their electoral choices. Conversely, a property tax does not seem to have the same potential in driving down house price growth as economists assume in theoretical models, policy advice and the public debate.

2 The tax reform

Tax reform. Oslo is the capital of Norway. The city introduced a local property tax on high-value homes in 2016, after a close election in late 2015. The tax reform included a nominal tax rate of 0.3 percent on housing. The tax base was only set to 80 percent of the estimated market value, which reduce the effective tax rate to 0.24 percent.[4] The nominal

[4]The nominal tax rate was 0.2 percent in 2016. This was the maximum tax hike, as regulated by the property tax law. The tax rate was further hiked to 0.3 percent in 2017, in line with what was announced

standard deduction was set to NOK 4 million to ensure that the tax was progressive and that only high-value homes were subject to the tax.[5] The standard deduction effectively exempted homes worth less than NOK 5 million (USD 0.595 million) due to the valuation discount. The design means that the effective tax rate does not reach 0.05 percent before a home is worth NOK 6.3 million (USD 0.75 million). This is indirectly used as the minimum threshold for homes to be included in the analysis. The homes included are chosen by a simple algorithm: Mean price per m^2 is calculated for each property type in the treated area in the year before the reform. The size that on average qualify for a price of NOK 6.3 million in 2015 is the threshold.

Timeline:

- **September 2014:** The Labour party elects a famous and well-liked national politician as their main candidate for the September 2015 local election, which was followed by a spike in the polls.
- **November 2014:** The Labour party pledges to introduce a property tax if elected.
- **Period until election:** The polls remain close, with Labour's coalition leading. The gap narrows even more going into the last three months of the campaign, showing both outcomes possible.
- **September 2015:** The Labour party's coalition win a slim majority in the local election. The three main parties start negotiating a coalition platform and city government.
- **October 2015:** The coalition agrees on a platform, which spells out the property tax reform that will later be enacted.
- **January 2016:** The property tax is introduced, starting in the budget year of 2016.

Treatment events. The timeline yields three crisp treatment events. The first event date is set between the Q4 2014 and Q1 2015. Going into Q4 2014, a future property tax in Oslo seemed unthinkable. By the start of Q1 2015, the polls were close, and a property tax seemed certain in the case of a socialist victory. The second event date is set between Q3 2015 and Q4 2015. The election was held towards the end of Q3 2015. Going into Q4 2015, the three parties had started negotiating a platform, and it seemed clear that a property tax was coming. The last event date is set between Q4 2015 and Q1 2016. At this point, the new coalition had been able to agree on a platform, secure the support from the Red

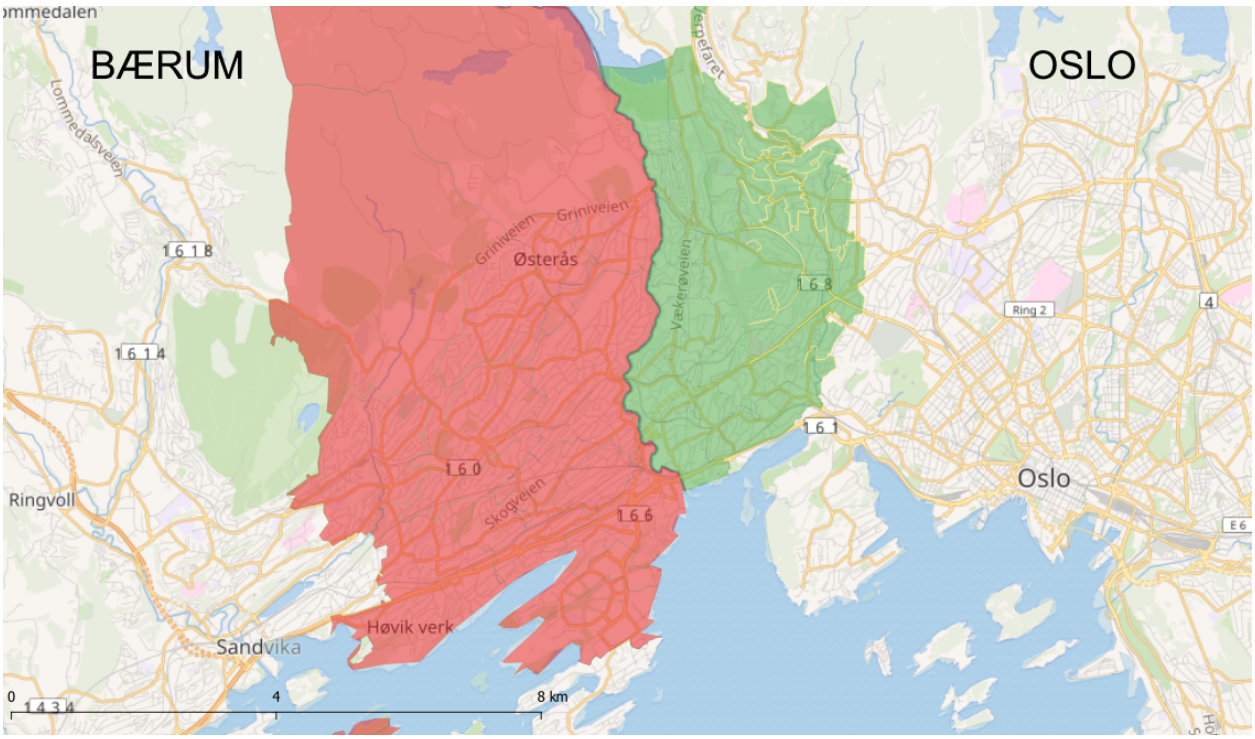
in the fall of 2015.

[5] It has later been increased to account for rising house prices.

Party and communicate their plans widely, including the property tax increase and its extent.

Treatment and control areas. The municipality of Oslo is by far the largest in Norway, with more than 681,000 inhabitants in 2019. It is a modern city, with a diverse population and distinct boroughs. The municipality is the centre of the larger Oslo Metropolitan Area. The western border of Oslo goes through a densely populated suburban area, with the municipality of Bærum on the opposite side. Bærum is also one of Norway's most populous municipalities, with more than 127,000 inhabitants in 2019. Still, it is a relatively affluent and homogeneous municipality, with a profile similar to those of the western boroughs of the municipality of Oslo.

Figure 1: Map showing treatment and control group zip codes.



Source: Norwegian Mapping Authority/Wikimedia

This makes for compelling treatment and control areas, as the border only affect the municipality, not the character of the area. The densely populated nature of the area also means that there is a sizeable sample of transactions and an inelastic supply of housing. The treatment and control areas are constructed by combining zip codes. Only the zip codes with the greatest proximity to the border are included.[6] These are presented in figure 1. The

[6]The construction of the treatment and control groups are made possible by the zip code information in the transaction data and detailed geographical data on Norwegian zip codes compiled by Erik Bolstad. The data is analysed using GIS Software.

shaded area to the right (Oslo) is the treatment area. The shaded area to the left (Bærum) is the control area. The treatment and control areas will subsequently be interchangeably referred to by using the name of their municipalities.

The treatment group covers neighbourhoods in the two most western boroughs of Oslo: Vestre Aker and Ullern. These boroughs had a median household income of around NOK 945,000 and NOK 882,000 respectively in 2019. Bærum had an average income of around NOK 877,000 in 2019. The comparable number was around NOK 648,000 for Oslo as a whole and NOK 686,000 for Norway in general. Further discussion and statistics are supplied in the online appendix. Summary statistics of the homes sold in the main treatment and main control area are also presented in the online appendix. These show that the samples are fairly similar, with both the aggregate price level and the size of properties being in the same range.

3 Data

The Norwegian housing market is regarded as well-functioning, liquid and transparent. This especially holds true for the large, high-activity market in and around Oslo. Most open market sales are handled by an estate agent, which is responsible for the process and has an exclusive right to the assignment. The unit is first posted for sale online and in newspapers, where public showing dates are typically announced. An auction is then held on the first workday after the last showing, typically a Monday or Friday. The auction is arranged as an ascending bid auction, where every bid is legally binding. To arrange for this, a statement of financing that documents proof of access to funding is submitted together with the first bid (Anundsen and Røed Larsen 2018).

The current paper utilises a detailed data set covering the majority of Norwegian property transactions. The data set is obtained from Eiendomsverdi AS's database of transactions. The Eiendomsverdi database is a compilation of data from official records, from Finn.no (an online advertisement firm that covers most of the person-to-person property market in Norway) and from the Norwegian estate agents' organisation. The data spans from January 2010 to December 2018, and covers the largest municipalities in Norway, including Oslo and Bærum. The data contains information concerning the specific transactions, like the date of sale, date of registration of the transactions in official registers and information on sales price, common debt, and list price. The data also contains detailed information about the size, number of floors, number of rooms and bedrooms, the zip code, city district and municipality, build year, site area, estate type, ownership type, parking, balcony, and elevator.

Information on the property tax in Norwegian municipalities is retrieved from Oslo

municipality and the Statistics Norway KOSTRA database.

4 Empirical strategy

The research design builds on the standard difference-in-difference research design, with a treatment group, a control group and a policy change that only affects the treatment group. Recent work by Sant'Anna and Zhao (2020) and Callaway and Sant'Anna (2021) has highlighted potential pitfalls of this design and proposed solutions to circumvent them. The difference-in-difference methodology in this paper builds on these insights.[7]

The relative pre-treatment trends and the effect of the tax reform are estimated over quarterly time periods using the difference-in-differences with multiple time periods approach developed by Callaway and Sant'Anna (2021), to exclude the possibility of negative weights and calculate more robust confidence intervals.

Point estimates for the effect of the tax reform, given cut-off windows[8] and a treatment event date, are estimated following the approach proposed by Sant'Anna and Zhao (2020) and Callaway and Sant'Anna (2021), to account for potential bias when the treatment effect is heterogeneous and co-varies with the control variables. Heterogeneity in treatment has to be assumed: The progressiveness of the effective average tax rate means that larger houses have higher effective tax rates. The model includes the hedonic control variables size(on log form), indicator variables for decade built and a linear time trend.

5 Robustness of identification

The current paper tries to identify and measure the capitalisation of the Oslo property tax on high-value homes. Property prices should in theory fall equal to the net present value of the expected increase in future tax payments in the case of a property tax increase, given everything else equal (Oates 1969). But this assumes a set of conditions to hold. This section discusses how these assumptions are satisfied and other threats to the empirical strategy.

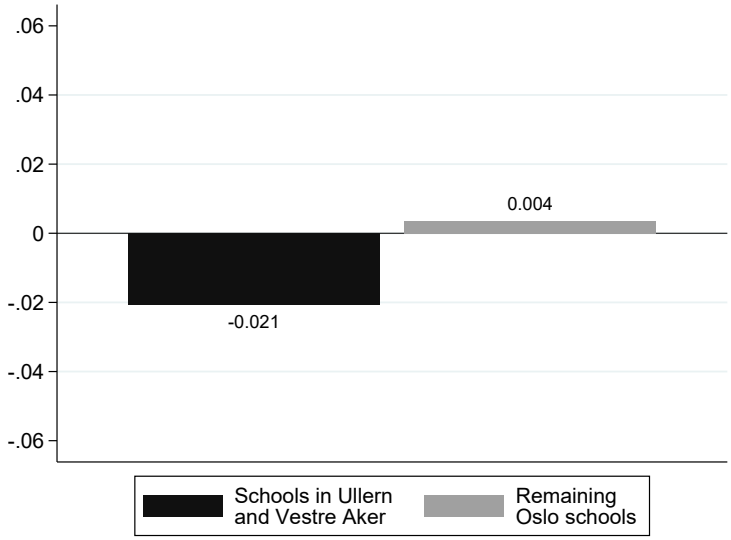
Low or no additional value of new public goods and services financed by the property tax is the most important of these assumptions. If the tax revenue finances new public goods and services that homebuyers appreciate, this should also be reflected in house prices. Brueckner (1982) proposes that in a case where local governments adjust local taxes and spending to

[7]For other contributions to this literature, see for instance: Borusyak, Jaravel, and Spiess (2021); de Chaisemartin and D'Haultfœuille (2020); Goodman-Bacon (2021); Sun and Abraham (2021); Goldsmith-Pinkham, Hull, and Kolesár (2022)

[8]The length of the cut-off windows is set to 12, 18, 24 and 36 months.

be attractive and maximise the value of the housing stock, the effect of new taxes should be just offset by the value of the local goods and services provided by the revenue. But this is not the case for the event under investigation, which is also part of what makes the identification unique. The reform did not lead to increased spending on local public goods and services for the treated households. At least not comparable to the increased tax burden. There are two reasons for this. Firstly, the tax was introduced as an effort to redistribute resources from the wealthy to the poor. Only a minority of homeowners in the municipality pay the property tax, as it was introduced on high-value properties. In 2017, approximately 28 percent of Oslo households paid the property tax. Even fewer paid a substantial amount.[9] Thus, the revenue is spent to benefit far more households than those paying the tax.

Figure 2: Percentage change in school budgets, due to funding reform



Notes: Oslo revised the school funding scheme from 2018. The figure shows the average percentage change in the budget per pupil for schools in the boroughs Ullern and Vestre Aker and the average percentage change in the budget per pupil for the remaining Oslo schools after the 2018 reform.

Secondly, the left-wing local government has chosen to prioritise spending elsewhere. The treatment area only includes zip codes in the affluent boroughs Ullern and Vestre Aker. A notable priority since the 2015 election has been to increase the number of teachers in less fortunate boroughs. This effort started in the fall of 2016 and was gradually expanded. From the fall of 2017, funding for 112 new teacher positions was granted to 34 schools, of which none was in Ullern or Vestre Aker. Figure 2 shows the effect of a school funding reform, that was introduced in 2018. The reform led to a 2.1 percent fall on average in allowed

[9]The analysis only includes the segment of homes worth more than NOK 6.3 million (USD 0.75 million). This is where the effective tax rate exceeds 0.05 percent.

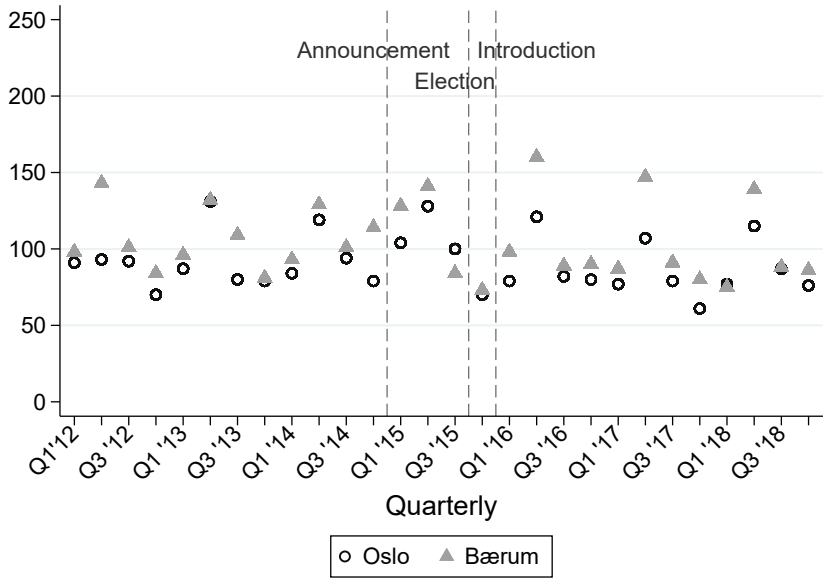
spending per pupil in schools in Ullern and Vestre Aker from 2017 to 2018. The remaining schools in Oslo received a 0.4 percent increase in the budget on average. To make the after-school program free for the youngest children has been another key effort. This was rolled out gradually, borough by borough, meaning that the program was free for children in the prioritised boroughs first. The boroughs Ullern and Vestre Aker were the last two boroughs to be granted the free after-school program for 6-year-olds. They are in 2021 yet to have been granted the free after-school program for kids between 7 and 9 years old, which has been rolled out to more than half of the municipality's boroughs. Together, this creates a free-rider effect, where the benefit from the additional funding for public services is directed towards other households than those that pay the property tax. The objective of the local government is not to maximise the value of the housing stock in the analysed segment.

A second key assumption that needs to hold is that the supply of land and housing is fixed or close to fixed. The more price elastic the housing supply is, the larger deviation from full capitalisation is predicted. There would be no reason to expect capitalisation in prices in the case of a very or infinitely price elastic housing supply. It is thus central to know the price elasticity of the housing supply. Caldera and Johansson (2013) find a long run supply elasticity of 0.5 for the Norwegian housing market, while the updated estimates by Cavalleri, Cournède, and Özsöğüt (2019) indicate a long run supply elasticity of 1.2. Bétin and Ziemann (2019) find substantial regional dispersion in housing supply responsiveness in Sweden and Denmark, Norway's Nordic neighbours. The supply responsiveness crucially depends on geographical and urban characteristics, land use and planning regulations. This points to long run price elasticities markedly below the above-mentioned estimates. The areas under investigation are some of the most densely populated in Norway.

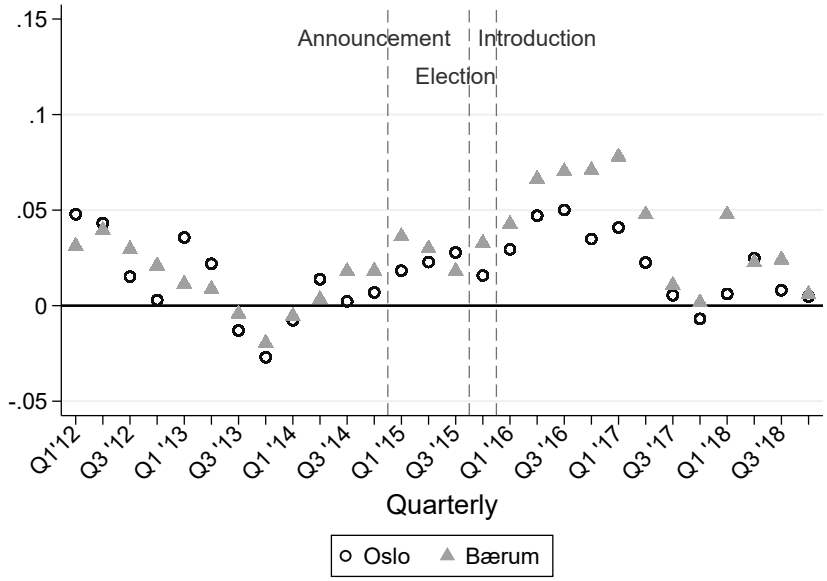
A third assumptions is that there is no anticipation effect that is not accounted for. This relies on establishing the most relevant event timing precisely. If homebuyers expect the treatment in advance and adjust to it, this will bias the measured effect. The probability of this is reduced by the closeness of the election that led to the introduction of the tax. The winning coalition won 31 of 59 seats in the Oslo council, a slight majority. But to control for any anticipation bias, the timing of the pledge by the Labour party to introduce the tax is tested as an event timing, together with the timing of the election result and the introduction of the tax.

Selection bias is another threat to identification in this setting. The sample consists of transactions in the housing market. This may induce selection bias if the tax increase affects what transactions are agreed. Identification rests on the assumption that the properties sold in the period after the tax increase is the same as those that would have been sold in a counterfactual scenario without the tax increase.

Figure 3: Transaction volume and price exuberance, Oslo vs. Bærum



(a) Transactions volume, treated segment



(b) Price in excess of listing price, treated segment

Figure 3 explores this problem in detail. Panel (a) shows the development in transaction volumes before and after treatment. This unveils a clear difference in the number of homes sold in Bærum compared to Oslo in the second quarter of 2016. This means, in isolation, that the results should be interpreted with cautiousness, as the reduced demand for Oslo homes

may be masked by a reduced transaction volume. But this divergence in the second quarter is not unprecedented. Comparable outperformances were evident in the second quarter of 2012 and 2013, as well as in the last quarter of 2014, all before the property tax was ever on the agenda. It is also important that the number of transactions in Oslo did not fall relatively to prior second quarters, the divergence was driven by more transactions in Bærum. While the divergence in transaction volume is nuanced somewhat by prior patterns in transaction volumes, panel (b) of figure 3 underlines that the results should be interpreted with some reservations. It shows the mean difference between the sales prices and the posted list prices. This may work as an indicator for short-term imbalances in the market. It depends on the assumption that list prices are adjusted more slowly and are not adjusted for the tax increase. The figure reveals that there was some deviation between the overheating of the Bærum and Oslo property market in late 2016 and early 2017.

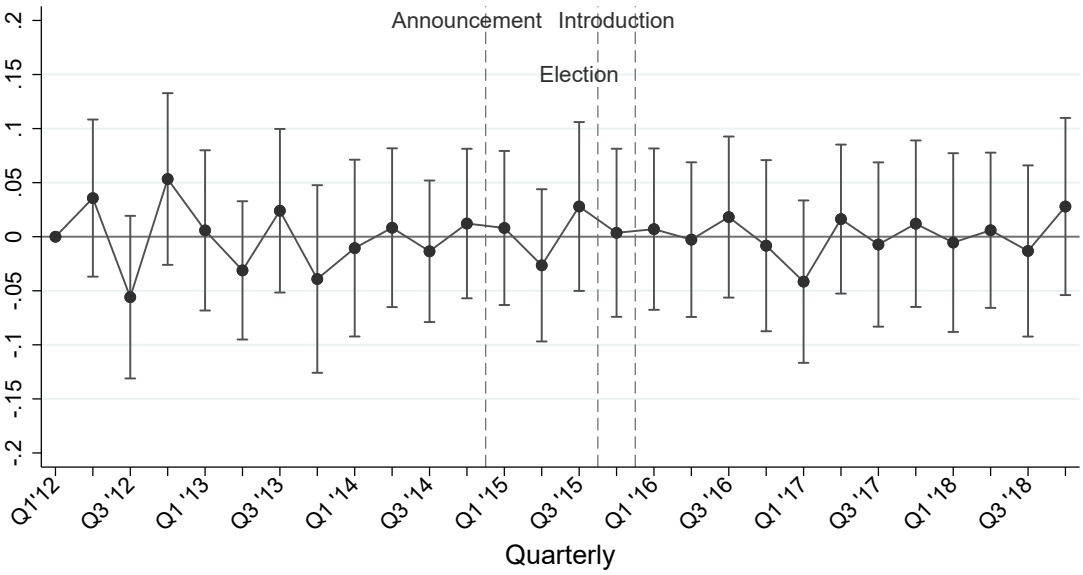
6 Capitalisation results

The property tax introduced in Oslo was moderate in general, but substantial for those who were targeted. The effective tax rate was zero for homes worth up to NOK 5 million, and then gradually increasing towards 0.24 percent, due to the standard deduction. This analysis only includes the segment of homes assumed to be worth more than NOK 6.3 million (USD 0.75 million) in the year before treatment. NOK 6.3 million is the valuation level where the effective tax rate exceeds 0.05 percent.[10] A simple capitalisation model, building on Palmon and Smith (1998), implies an average price fall of 3 percent for this segment.[11] Figure 4 graphically presents the relative trend between the treatment and control areas. The time period is quarterly, with event lines drawn at the start of Q1 2015, Q4 2015 and Q1 2016. These dates are respectively the start of the quarter after the Labour party's pledge to introduce the property tax, the start of the quarter after the election and the start of the quarter after the introduction of the tax.

[10] A simple algorithm is used to include only homes that are assumed to be worth more than NOK 6.3 million: Mean price per m^2 is calculated for each property type in the treated area in the year before the reform. The size that on average qualify for a price of NOK 6.3 million in 2015 is the threshold.

[11] Calculations show an average effective tax rate just below 0.1 percent for this segment. The capitalisation model assumes a discount rate/user cost of 3 percent and the 2017 tax scheme as the permanent tax scheme. This is elaborated further in the online appendix A4.

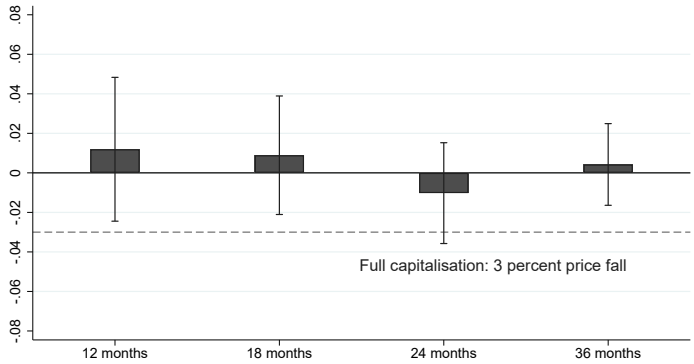
Figure 4: Quarterly difference-in-differences estimates



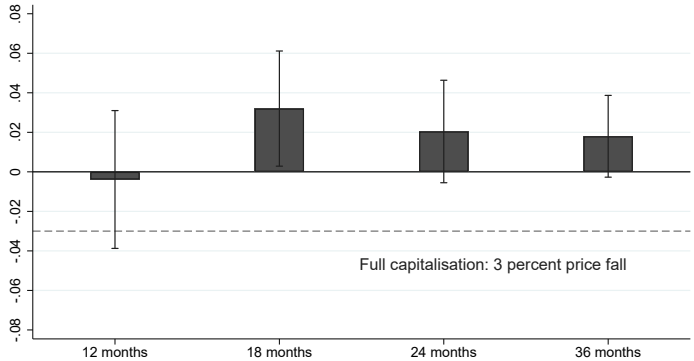
Notes: The figure shows quarterly estimates of the relative price level in the treatment area compared to the control area, calculated using the Doubly robust difference-in-differences methodology developed by Sant'Anna and Zhao (2020) and Callaway and Sant'Anna (2021). Dependent variable is log sales prices including stamp duty. Hedonic controls include size, dummy for the decade built and a time trend. 95 percent confidence intervals displayed. The sample only include homes that based on their size and type are estimated to be worth more than NOK 6,300,000 in 2015, as this is threshold were the effective tax rate is expected to exceed 0.5 percent. Treatment and control areas as described in the paper. First event date: The Labour party introduces their pledge. Second event date: The Socialist coalition is elected. Third event date: The tax is introduced.

Figure 4 shows two things: There is a stable common trend in the treatment and control area. And there is no indication of a marked and consistent fall in relative prices. The price levels in the treatment area and control areas move together from the second quarter of 2012 and until the last quarter of 2014, the quarter before the first event date. The trend remains stable through the post-treatment period. There are outlier movements, for instance towards the second quarter of 2015 and the first quarter of 2017, but these are consistently reversed. The results are not suggestive of a sustained, negative effect after neither of the treatment events. This is confirmed by the following results.

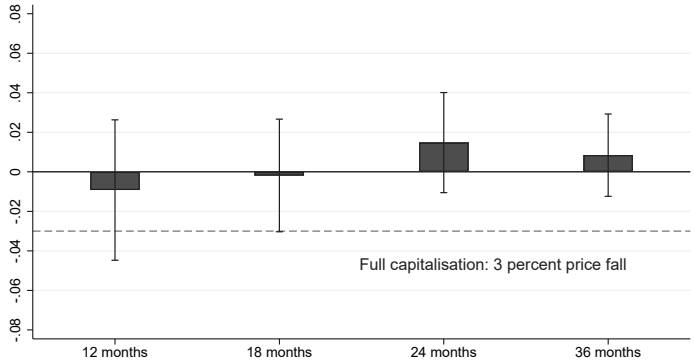
Figure 5: Difference-in-difference estimates, point estimates



(a) Cut-off windows before and after 1st January 2015 (time of pledge)



(b) Cut-off windows before and after 1st October 2015 (time of election)



(c) Cut-off windows before and after 1st January 2016 (time of introduction)

Notes: Estimates are produced using the Doubly robust difference-in-differences methodology developed by Sant'Anna and Zhao (2020) and Callaway and Sant'Anna (2021). Dependent variable is log sales prices including stamp duty. Hedonic controls only include size. 95 percent confidence intervals displayed. The sample only include homes that based on their size and type are estimated to be worth more than NOK 6,300,000 in 2015, as this is threshold were the effective tax rate is expected to exceed 0.5 percent. Treatment and control areas as described in the paper. The expected capitalisation effect of -3 percent is derived from a standard model, assuming a 3 percent discount rate/user cost and the tax design in Oslo after the reform was fully implemented in 2017.

Figure 5 reports the point estimates of the difference-in-difference estimates. These compare time windows before and after the three different treatment events.[12] The estimates confirm the impression from figure 4: That there is no systematic effect from an increase in the property tax on house prices. The main matter of interest is to what degree these estimates reject the theoretical prediction for full capitalisation for the event, a price fall of 3 percent. No point estimates are close to indicate such capitalisation. The estimates are almost uniformly small in magnitude, and skew positively. The full capitalisation result of a 3 percent price fall is outside the 95 percent confidence interval for 9 out of 12 specifications. There is no specification that yields a sizeable negative point estimate among the remaining three.

7 Discussion

The main findings of this paper suggest that the introduction of the property tax on high-value homes in Oslo at most had a small impact on house prices. This challenges the expectation of full capitalisation, and potentially the illusion of the fully rational homebuyer. This section discusses possible reasons behind homebuyers deviating from the expected decision making. The three factors discussed are the combination of low salience and bounded rationality, possible present bias, and possible imperfect information and information asymmetries.

The combination of salience and bounded rationality. The property tax is one of many factors homebuyers has to consider when deciding what to pay for a house. And in most places, like in Norway, the tax is relatively small compared to the full value of the house. This makes the capitalisation vulnerable to inattention, bounded rationality, or other behavioural anomalies. These may lead agents to ignore the least substantial factors or factors with low salience (Chetty, Looney, and Kroft (2009); Finkelstein (2009)). This vulnerability is further reinforced by the fact that it is paid in smaller instalments during the year. In a bidding round or a purchasing process, large lump sums and future cash flows may be considered side by side, where the "sticker cost" only represents a small fraction of the actual present value of the future recurring costs. Also, it is not paid at the time of purchase, in contrast to transaction taxes, for which the established literature concludes on a much clearer negative effect on housing market activity and prices (Besley, Meads, and Surico (2014); Best and Kleven (2017); Kopczuk and Munroe (2015); Slemrod, Weber, and Shan (2017)). What speaks against this is that the property tax is not a withholding tax, like the income tax is in most places, but paid visibly through an invoice. This is also partly

[12]The precise estimates, standard errors and sample sizes are reported in the online appendix A3.

why the property tax seems to be such an unpopular and much discussed tax.[13]

The present bias of homebuyers. We say that a homebuyer is present biased when long-run costs and benefits are valued relatively lower than short-run costs and benefits. This is also known as hyperbolic discounting, as this behaviour is formalised in models by assigning lower discount rates to short-term outcomes than in the longer-run outcomes (Frederick, Loewenstein, and O'Donoghue 2002). This may partly explain the under-capitalisation of the property tax. The literature showing clear effects on house prices from the transaction taxes indirectly support this thesis. This would also be consistent with how Bradley (2017) find over-capitalisation in Michigan. Bradley considers a setting where some homebuyers inherit a tax rebate from the previous owner, meaning the property tax is much lower in the first year than in the years that follow. He shows that the first-year effect of this rebate is sufficiently accounted for by homebuyers, but the future, higher payments are not. A related behavioural explanation is what is known as the Magnitude Effect, a phenomenon where small sums are discounted more than large ones (Frederick, Loewenstein, and O'Donoghue 2002).

Imperfect information and information asymmetries about the future tax policy. A last possible explanation considers the potential information asymmetries that arise when future tax policy is set in a messy political setting. There are great variations in the general interest concerning politics among the public, especially at the local level. The same goes for access to news and for the level of understanding of political considerations and policymaking. Imperfect information may also lead to uncertainty around future political decisions and tax policy. This may again lead to a higher discount rate for the future costs from the property tax.

8 Concluding remarks

Economic theory predicts that the cost of taxes should be reflected in house prices. The current paper poses the question whether this holds true in reality. To answer this question, quasi-experimental evidence on house price response to a tax on high-value homes in Norway is found. The Norwegian capital Oslo introduced a property tax on high-value houses in 2016. Detailed transaction data including the zip code and hedonic properties is used in a difference-in-difference event study framework. The framework compares the price development in Oslo and in one of the neighbouring municipalities. The treatment and

[13] Cabral and Hoxby (2012) calls it the most salient taxes in the U.S. for this reason.

control areas are constructed of the zip codes closest to the municipality border. But the results from the analysis suggest that the capitalisation theory does not hold true in the Norwegian setting. The analysis is not able to find any solid estimates pointing towards full capitalisation. Instead, the tax seems to have had a minuscule impact on house prices, at most. The lack of observable effects is the result despite a clean-cut quasi-experiment, leading data quality and a well-functioning regulatory and institutional setting. The results thus underline how more high-quality research is needed to inform this question, and add nuances to the detached parts of the literature that point to either full capitalisation (Oliviero and Scognamiglio 2019) or over-capitalisation (Bradley 2017).

The estimates also produce relatively large standard errors, which induce uncertainty concerning the results. Still, the lower bound of the confidence intervals of the main estimates mostly exclude full capitalisation with 95 percent certainty. There was also a marked increase in homes sold in the control area compared to the treatment area during the first half of 2016, which warrants some cautiousness when interpreting the results. The external validity of this Norwegian experience, with its Norwegian context and moderate magnitude, should also be mentioned in this regard.

The low salience of the property tax together with inattention and other behavioural irregularities are discussed as possible explanations. The study should reassure policymakers in that a moderate property tax may be introduced without creating a ruckus in the housing market. On the other hand, they should be more sceptical to the virtue the tax will have in reducing house price growth.

References

Anundsen, A. K. and E. Røed Larsen (2018). Testing for micro-efficiency in the housing market. *International Economic Review, 59*(4), 2133–2162.

Besley, T., N. Meads, and P. Surico (2014). The incidence of transaction taxes: Evidence from a stamp duty holiday. *Journal of Public Economics 119*(C), 61–70.

Best, M. C. and H. J. Kleven (2017). Housing Market Responses to Transaction Taxes: Evidence From Notches and Stimulus in the U.K. *The Review of Economic Studies 85*(1), 157–193.

Black, S. (1999). Do better schools matter? parental valuation of elementary education. *Quarterly Journal of Economics 114*, 577–599.

Borusyak, K., X. Jaravel, and J. Spiess (2021, August). Revisiting Event Study Designs: Robust and Efficient Estimation. Papers 2108.12419, arXiv.org.

Bradley, S. (2017). Inattention to Deferred Increases in Tax Bases: How Michigan Home Buyers Are Paying for Assessment Limits. *The Review of Economics and Statistics 99*(1), 53–66.

Brueckner, J. (1982). A test for allocative efficiency in the local public sector. *Journal of Public Economics 19*(3), 311–331.

Bétin, M. and V. Ziemann (2019). How responsive are housing markets in the OECD? regional level estimates. (1590).

Cabral, M. and C. Hoxby (2012). The hated property tax: Salience, tax rates, and tax revolts. Working Paper 18514, National Bureau of Economic Research.

Caldera, A. and Johansson (2013). The price responsiveness of housing supply in OECD countries. *Journal of Housing Economics 22*(3), 231 – 249.

Callaway, B. and P. H. Sant'Anna (2021). Difference-in-differences with multiple time periods. *Journal of Econometrics 225*(2), 200–230. Themed Issue: Treatment Effect 1.

Cavalleri, M. C., B. Cournède, and E. Özsöğüt (2019). How responsive are housing markets in the OECD? national level estimates. (1589).

Chetty, R., A. Looney, and K. Kroft (2009). Salience and Taxation: Theory and Evidence. *American Economic Review 99*(4), 1145–1177.

Cushing, B. J. (1984). Capitalization of interjurisdictional fiscal differentials: An alternative approach. *Journal of Urban Economics 15*(3), 317–326.

de Chaisemartin, C. and X. D'Haultfœuille (2020). Two-way fixed effects estimators with heterogeneous treatment effects. *American Economic Review 110*(9), 2964–96.

Elinder, M. and L. Persson (2017). House price responses to a national property tax reform. *Journal of Economic Behavior & Organization 144*(C), 18–39.

Fack, G. and J. Grenet (2010). When do better schools raise housing prices? evidence from paris public and private schools. *Journal of Public Economics 94*(1-2), 59–77.

Finkelstein, A. (2009). E-ztax: Tax salience and tax rates. *The Quarterly Journal of Economics 124*(3), 969 – 1010.

Frederick, S., G. Loewenstein, and T. O'Donoghue (2002). Time discounting and time preference: A critical review. *Journal of Economic Literature 40*(2), 351–401.

Gibbons, S., S. Machin, and O. Silva (2013). Valuing school quality using boundary discontinuities. *Journal of Urban Economics 75*, 15–28.

Goldsmith-Pinkham, P., P. Hull, and M. Kolesár (2022). Contamination bias in linear regressions.

Goodman-Bacon, A. (2021). Difference-in-differences with variation in treatment timing. *Journal of Econometrics 225*(2), 254–277. Themed Issue: Treatment Effect 1.

Kopczuk, W. and D. Munroe (2015). Mansion tax: The effect of transfer taxes on the residential real estate market. *American Economic Journal: Economic Policy 7*(2), 214–57.

Minasi-Smith, M. (2020). A mansion tax is an idea whose time has come. Technical report, FT Schools/Royal Economic Society 2020 Young Economist of the Year Winning Essay.

Oates, W. E. (1969). The effects of property taxes and local public spending on property values: An empirical study of tax capitalization and the tiebout hypothesis. *The Journal of Political Economy 77*(6), 957–971.

Oliviero, T. and A. Scognamiglio (2019, 06). Property tax and property values: Evidence from the 2012 italian tax reform. *European Economic Review 118*.

Palmon, O. and B. A. Smith (1998). New evidence on property tax capitalization. *Journal of Political Economy 106*(5), 1099–1111.

Piketty, T. (2014). *Capital in the Twenty-First Century*. Harvard University Press.

Sant'Anna, P. H. and J. Zhao (2020). Doubly robust difference-in-differences estimators. *Journal of Econometrics 219*(1), 101–122.

Slemrod, J., C. Weber, and H. Shan (2017). The behavioral response to housing transfer taxes: Evidence from a notched change in D.C. policy. *Journal of Urban Economics 100*(C), 137–153.

Sun, L. and S. Abraham (2021). Estimating dynamic treatment effects in event studies with heterogeneous treatment effects. *Journal of Econometrics 225*(2), 175–199. Themed Issue: Treatment Effect 1.

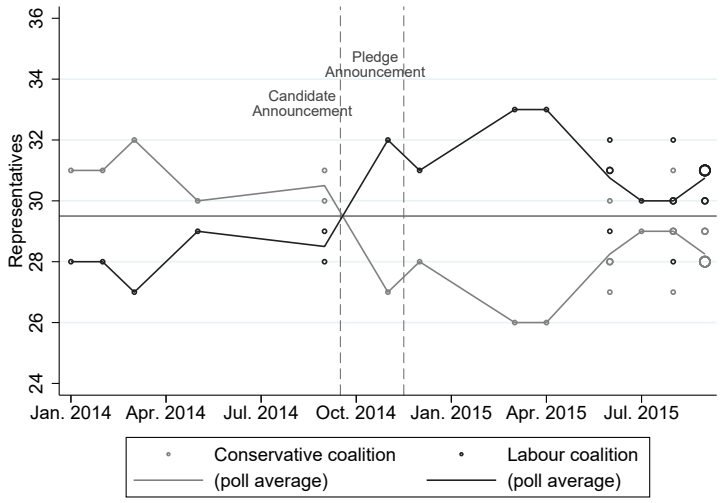
Tiebout, C. (1956). A pure theory of local expenditures. *Journal of Political Economy*.

A Appendix

A.1 Supplementary material: The Oslo tax reform

Oslo introduced the property tax on high-value homes in 2016. The reform was controversial, as Oslo is traditionally a conservative city, where city governments have abstained from levying a property tax. The last time the tax was levied was in 1998. This changed when the Labour party replaced the Conservatives as the ruling party in 2015, after the local elections resulted in a city council with a socialist majority. Oslo had seen 18 years of Conservative government by then. The goal of the tax was to tax the richest households through a tax on high-value properties and spend the money on public goods and services, with a focus on the least well off boroughs. The municipality was in no financial difficulties that indicated that a property tax would be imminent.

Figure 6: Opinion polls in the period before the election

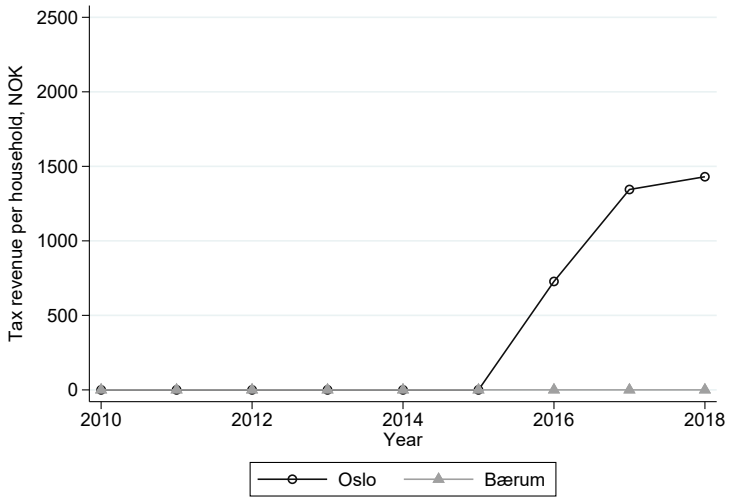


Notes: First line on x-axis marks the announcement of the well known Raymond Johansen as the main Labour candidate. Second line on x-axis marks the announcement of the property tax pledge.

Two notable things happened leading to up to this outcome. The Labour party elected a popular main candidate in September 2014, one year before the election. This was followed by the party pledging to introduce a property tax if elected, in November. This gained considerable attention in the media when the party pledged that they would introduce the tax if they won the 2015 election. Four years earlier the party had promised that they would never introduce such a tax. During this period, the polls also changed, from showing a conservative majority to showing a socialist majority, as shown in figure 5. The polls remained close thereafter, but the Labour party's coalition won a slim majority in the fall

of 2015.

Figure 7: Tax income per household over the years



Notes: NOK 1,000 exchanged to USD 119 in 2016. Source: KOSTRA, Statistics Norway

The property tax was introduced almost immediately after the election, starting in the budget year of 2016. It was announced that the tax rate should be 0.3 percent of the value of the property. The tax rate was 0.2 percent in 2016, which is the maximum increase for one year, according to the property tax law. It was then hiked by another 0.1 percentage point, to 0.3 percent, in 2017. The nominal standard deduction was set to NOK 4 million. The tax base was set to 80 percent of the estimated market value, reducing the effective tax rate, and lifting the effective standard deduction. This excluded the majority of properties in Oslo from the property tax base, leaving only approximately 30 percent. The estimated market value is calculated by the national tax authorities, who use the same valuations as basis for the national wealth tax calculation. These estimated market values are adjusted annually to account for movements in house prices. This means that more and more homes will be subject to the tax, assuming that prices increase over time. The city government has pledged to increase the standard deduction frequently, to keep the share of households that pay the property tax stable around the initial share of approximately 30 percent. The tax rules for the coming year are decided in the budget process of the municipalities. In December every year, the budget for the coming year is passed by the city council.

A.2 Supplementary material: Treatment and control areas

The paper utilises similar neighbourhoods divided by the Oslo and Bærum municipality border as treatment and control areas. The treatment and control areas are constructed by collecting similar zip codes on each side of the border. This appendix section briefly discusses the summary statistics of the transactions made in these treatment and control areas and how they compare on each side of the border.

Table 1: Descriptive statistics, main treatment and control area

	Year	Municipality	Mean price (NOK)	Mean m^2	Mean price/m^2	Obs
All	2015	Oslo	8,790,845	177	51,574	402
	2016	Oslo	9,955,268	177	58,489	362
	2015	Bærum	8,272,649	187	46,211	426
	2016	Bærum	9,248,027	185	52,383	437
Detached House	2015	Oslo	11,263,513	222	52,903	142
	2016	Oslo	12,126,894	214	59,130	132
	2015	Bærum	9,156,783	213	44,684	237
	2016	Bærum	10,484,379	215	50,910	214
Flat	2015	Oslo	6,895,258	143	49,586	93
	2016	Oslo	8,323,078	144	59,593	104
	2015	Bærum	7,848,268	140	57,594	38
	2016	Bærum	9,065,406	135	69,365	37
Rowhouse or Semi-detached	2015	Oslo	7,743,962	156	51,550	167
	2016	Oslo	9,027,436	164	56,906	126
	2015	Bærum	6,991,766	160	45,742	151
	2016	Bærum	7,861,887	161	50,700	186

Treatment area zip codes: 0275, 0280, 0281, 0282, 0283, 0284, 0376, 0377, 0378, 0379, 0380, 0381, 0382, 0383, 0750, 0751, 0752, 0753, 0754, 0755, 0756, 0757, 0760, 0763, 0765, 0766, 0767, 0768, 0770, 0771, 0772, 0773, 0774, 0783, 0784, 0785, 0786, 0787.
Control area zip codes: 1344, 1356, 1357, 1358, 1359, 1360, 1361, 1362, 1363, 1364, 1366, 1368, 1369.

Table 1 presents the summary statistics of the homes sold in the treatment and control areas that has a size above the threshold that imply a valuation exceeding NOK 6.3 million in the treatment area in 2015. The samples are fairly similar and balanced, but it is noticeable that the number of homes sold grew in Bærum and fell in Oslo from 2015 to 2016. The Oslo neighbourhoods have fewer detached houses sold and more flats sold than the Bærum neighbourhoods. On average, homes in Bærum are less expensive, both in terms of total value and square meter price. This is also as expected, as the Oslo neighbourhoods are

relatively closer to the Oslo city centre.

A.3 Supplementary material: Capitalisation Model

The theory of capitalisation describes how house prices are affected by changes in public goods and services, policies and infrastructure. It depicts how rational homebuyers and sellers consider every aspect of a house and set a value. The property tax is one of these aspects. The higher the tax is, the poorer the homeowner paying it will be, everything else equal. Thus, potential homebuyers and sellers should adjust their valuations accordingly. In the short run, full capitalisation of a tax increase implies that the market price should fall, corresponding to the net present value of the expected increase in future tax payments (Oates 1969). This is given an efficient housing market, that buyers and sellers use all available information, that the supply of land and housing is fixed, and that there are not counteracting forces like new spending on public goods and services.

The partial semi-elasticity of house prices to property taxes can be derived by building on this generalised version of the capitalisation model from Palmon and Smith (1998):

$$P_j = \frac{S(Z_{ij})}{\phi_n + \beta_\tau \tau_j} \tag{1}$$

$$\frac{\partial ln(P_j)}{\partial \tau} = \frac{\partial}{\partial \tau}\left(ln(S(Z_{ij})) - ln(\phi_n + \beta_\tau \tau_j)\right) \tag{2}$$

$$\frac{\partial ln(P_j)}{\partial \tau} = -\left(\frac{\beta}{\phi_n + \beta_\tau \tau_j}\right) \tag{3}$$

where P_j is the price of the house, $S(Z_{ij})$ is a hedonic function of the value of owning the house for one period, and ϕ is the net user cost, τ the tax rate for owning the house for the same period and β the degree of capitalisation.

The partial semi-elasticity of house prices to property taxes should thus be negative when some degree of capitalisation holds, and zero when there is no capitalisation. Based on this simple model, there should be a fall in house prices of 3.0 percent, given that $\beta = 1$ and that the tax rate is increased from 0 percent to 0.1 percent. This assumes annual user costs to be 3 percent and the tax rate expectations to be constant. The average interest rate for new mortgages in Norway was 2.86 percent in 2015 and 2.43 in 2016. These averages were 2.67 percent and 2.42 percent respectively for those with a fixed rate period between three and five years, and 3.17 percent and 2.96 percent for those with a fixed rate period of more than five years.[14]

[14] More than 90 percent of outstanding credit to Norwegian households are subject to floating interest rates, which is an international anomaly.

Table 2: Tax burden and capitalisation rates (Oslo 2017 tax rate scheme)

Property value (NOK)	Annual tax burden (NOK)	Effective tax rate	NPV of tax burden (NOK)	Capitalisation rate (expected)
6.3 million	3,120	0.050 %	104,000	1.33 %
8.6 million	8,640	0.100 %	288,000	3.00 %
10 million	12,000	0.120 %	400,000	4.00 %
12 million	16,800	0.140 %	560,000	4.67 %
14 million	21,600	0.154 %	720,000	5.14 %
16 million	26,400	0.165 %	880,000	5.50 %
18 million	31,200	0.173 %	1,040,000	5.78 %
20 million	36,000	0.180 %	1,200,000	6.00 %
22 million	40,800	0.185 %	1,360,000	6.18 %

Notes: The table reports the tax burden and theoretical outcomes for properties in different prices ranges, given the tax rate scheme for Oslo in 2017. NOK 1,000 exchanged to USD 119 in 2016.
Tax scheme: Nominal tax rate: 0.3 percent; Nominal standard deduction: 4.0 million; Valuation Discount: 20 percent.

Table 3 reports how property values, the above capitalisation model and the Oslo property tax scheme interacts. The calculations assume the Oslo 2017 tax scheme, which was communicated as the long term tax level from October 2015.

A.4 Supplementary material: Results

Table 3: Difference-in-differences estimates, point estimates

	Baseline treatment and control area			
	12 months	18 months	24 months	36 months
1st January 2015	0.0211	0.0143	-0.0072	0.0057
	(0.0191)	(0.0153)	(0.0131)	(0.0106)
Observations	1641	2448	3235	4736
1st October 2015	-0.0050	0.0328**	0.0212	0.0174*
	(0.0178)	(0.0148)	(0.0132)	(0.0106)
Observations	1650	2427	3188	4698
1st January 2016	-0.0085	0.0003	0.0155	0.0084
	(0.0181)	(0.0145)	(0.0129)	(0.0106)
Observations	1627	2433	3169	4706

Notes: Estimates are produced using the Doubly robust difference-in-differences methodology developed by Sant'Anna and Zhao (2020) and Callaway and Sant'Anna (2021). Dependent variable is log sales prices including stamp duty. Hedonic controls include size, dummy for the decade built and a time trend. 95 percent confidence intervals displayed. The sample only include homes that based on their size and type are estimated to be worth more than NOK 6,300,000 NOK in 2015, as this is threshold were the effective tax rate is expected to exceed 0.5 percent. Treatment and control areas as described in paper. *p < 0.10 **p < 0.05 ***p < 0.01

Table 4 reports the point estimates, standard errors and number of observations for the estimates underlying figure 4 in the main body.