Capitalisation of a Recurring Tax on Properties: Evidence from a Local Property Tax Reform (Please do not cite)

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Abstract

The housing market is an enticing source of tax revenue for local and national governments. But how does a recurring property tax affect house prices? This paper utilises rich micro data to study the introduction of a local property tax in the Norwegian capital of Oslo. The analysis suggests that the new tax at most had a minuscule effect on house prices in the treated area. The reform was introduced in only one half of the densely populated, homogeneous areas along the municipality border. This variation in tax burden is used to identify the effect on house prices, which can be measured thanks to detailed transaction-level data.

Keywords: Property tax, Capitalisation
JEL Codes: H31, H71, R20

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1 Introduction

Property taxes are actively considered around the world. Both national and local governments seek additional revenue sources in the wake of the covid-19 pandemic. Some proponents has also raised the prospects of a tax on high-worth houses only, a mansion tax, to counteract rising inequality in income, wealth, and housing (Minasi-Smith (2020); Piketty (2014)). Assumptions made about the capitalisation of property taxes will affect their decisions. The extent of capitalisation affect revenue, has implications for welfare and economic incidence, and may also tell us something about the popular reception. But the empirical evidence on how a property tax 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. The main finding is that the property tax at most had a minuscule impact on house prices when it was introduced in the Norwegian capital Oslo. The analysis does not find the 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.

The empirical strategy makes use of detailed micro data on housing transactions[1] and geographical information. The transaction data and the geographical data are combined in an event study framework, where the area of investigation is the wealthy, 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 zip codes in the neighbouring municipality, that did not introduce the tax. The effects of the tax change events are estimated using a standard difference-in-difference approach.

The empirical results are compelling: They 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 six, twelve, 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. For 11 out of 15 specifications, the full capitalisation result of

[1]The transactions data contain details on time of sale, price, common debt, the listing price, size, number of rooms and bedrooms, the size of the lot, the zip code and more.

a 3 percent price fall is outside the 95 percent confidence interval of the point estimate. Only one out of 15 specifications yield a sizeable negative point estimate. This outlier implies less than 30 percent capitalisation, although with marked confidence intervals. The quarterly difference-in-difference estimates, shown graphically, display a stable relative trend between the treatment and control area both in the pre-treatment period and the post-treatment period. And there are no sizeable negative effect on housing market activity, either when measured in transactions volume of distance between sales and list prices.

The current paper studies a question that has been subject to theoretical and empirical investigations since the 1950s (Tiebout (1956); Oates (1969); Brueckner (1982)). Still, the empirical evidence is relatively sparse and inconclusive. The availability of better data and new methods has spurred new and more reliable empirical results on the capitalisation of the tax. 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) look at the property tax in Michigan, where new home buyers 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. They 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 this project a unique contribution to this literature. 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)).

Several possible mechanisms may explain the absence of a notable capitalisation of the property tax. The current paper discusses four of them. Firstly, that the property tax

finance local public goods and services that outweigh the negative effect of the property tax. If so, this would be rational behaviour. The way Oslo designed the property tax and spent the proceeds make this less likely. The home buyers may also be inattentive or misled due to behavioural biases. One of these could be the low salience of the property tax combined with bounded rationality. Home buyers may also be present bias, 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 home buyers to ignore the property tax in the purchasing process.

The results leave a mixed message for policy makers and others. At face value, the analysis suggests that a moderate property tax 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 does not put as much weight on the tax in their electoral choices. The flip side of this is that 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 in 2016, after a close election in late 2015. The tax reform included a tax rate of 0.3 percent on housing, but with a sizeable standard deduction for every unit and a valuation discount. [2] The nominal standard deduction was set to 4 million NOK,[3] which excluded the majority of properties in Oslo. 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 design means that the effective tax rate does not reach 0.05 percent before a home is worth 6.3 million. This is used as the minimum threshold for homes to be included in the analysis.

[2]The 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 in the fall of 2015.

[3]1,000 NOK exchanged to 119 USD in 2016.

Timeline:

- **September 2014:** The Labour party elects a well-known figure as their main candidate for the September 2015 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 agree 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 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 681 thousand 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 127 thousand inhabitants in 2019. Still, it is a relatively homogeneous municipality, with a profile similar to those of the western boroughs of the municipality of Oslo.

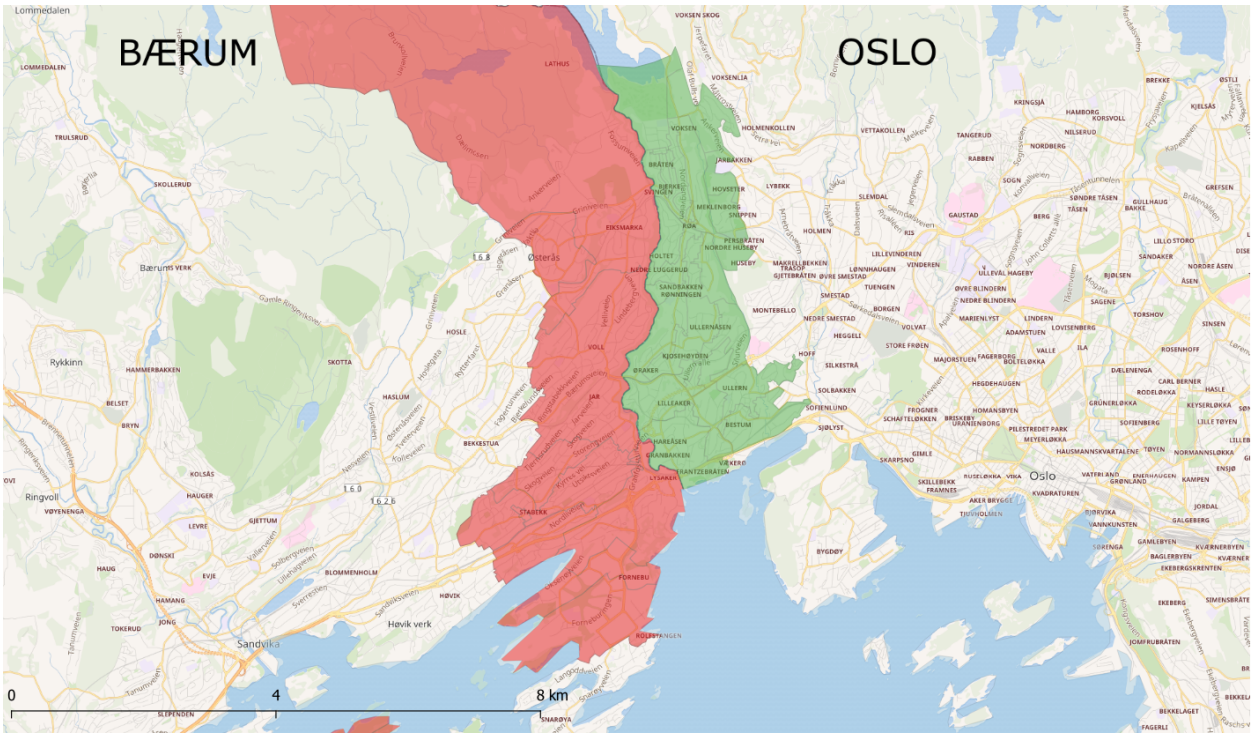


Figure 1: Map showing treatment and control group zip codes.
Source: Norwegian Mapping Authority/Wikimedia

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 is included.[4] These are presented in figure 1. The shaded area to the right is the treatment area. The shaded area to the left 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 neighbourhoods had a median household income of 945 thousand and 882 thousand respectively in 2019. Bærum had an average income of 877 thousand in 2019. The comparable number was 648 thousand for Oslo as a whole and 686 thousand 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,

[4]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.

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 about the size, floor, 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 relative pre-treatment trends and the effect of the tax reform are estimated using a standard difference-in-difference event study specification with quarterly time periods (results in figure 3), described by the following equation:

$$ln(P_{imt}) = \alpha + \sum_{j \neq -1} \beta_j (Treat_{mt} \cdot Time_{j=t}) + \gamma_t + \mathbf{C}_{it} + \epsilon_{it} \tag{1}$$

where $ln(P_{imt})$ is the sales price including stamp duty on log form, which is the dependent variable. The series of β_ts are the trend coefficients of interest. $Treat_{mt}$ is an indicator variable that is 1 for homes sold in the treatment area at the time t. $Time_{j=t}$ is an indicator variable that take the value of 1 when the period (3-months) equals t. γ_t is a period fixed effect. $\mathbf{C}_{it}$ is a vector of hedonic control variables. $\beta_{j=-1}$ is omitted, such that all estimated effects are relative to the period prior to the first treatment event date.

The quarterly estimates are supplemented with point estimates for the effect of the tax reform (results in figure 4), given cut-off windows[5] and a treatment event date. A simple difference-in-difference model is used for the estimation procedure. The model can be represented by the following equation:

$$ln(P_{imt}) = \alpha + \beta(Area_m \cdot Reform_t) + Area_m + Reform_t + \mathbf{c}'\mathbf{C}_{it} + \epsilon_{it} \tag{2}$$

The sales price including stamp duty on log form, $ln(P_{imt})$, are also here the dependent variable. β, the coefficient of the interaction variable $(Area_m \cdot Reform_t)$, is the coefficient of interest. $Area_m$ is an indicator variable for treatment area, being 1 for observations in the treatment area and 0 for the control area. An area fixed effects variable, in other words. $Reform_t$ is an indicator variable for the treatment period, and is 0 before the reform and 1 after the reform. In other words a time fixed effects variable. $\mathbf{C}_{it}$ is a vector of hedonic control variables.

5 Robustness of identification

The current paper tries to identify and measure the capitalisation of the Oslo property tax. Economic theory states that property prices should fall equal to the net present value of the expected increase in future tax payments (Oates 1969) in the short run in the event of an unexpected tax hike, everything else equal.

But this assumes a set of conditions to hold. One of these are that the supply of land and housing is fixed. It is thus central to know the price elasticity of the housing supply. 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. 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

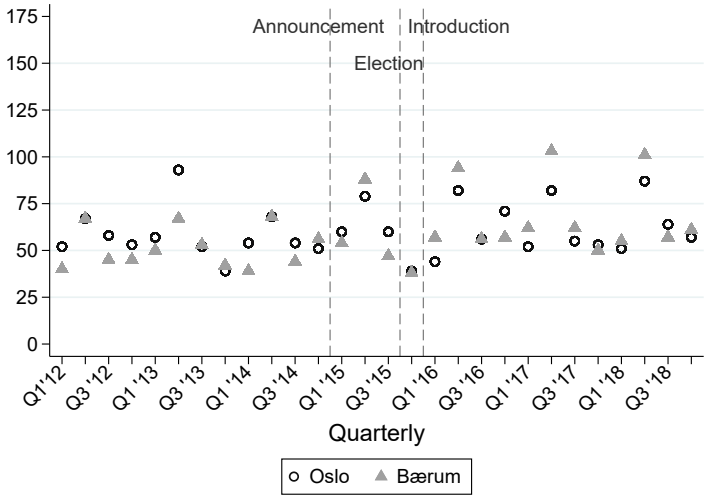
[5]The length of the cut-off windows is set to 6, 12, 18, 24 and 36 months.

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.

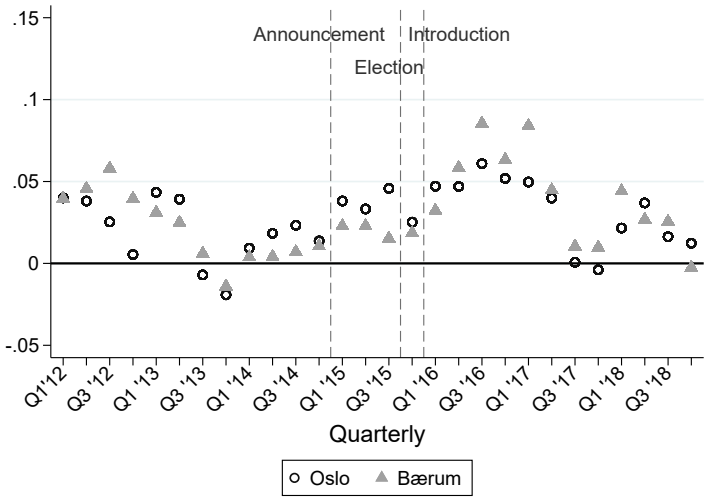
Identification also relies on establishing the most relevant event timing precisely. If home buyers expect the treatment in advance and adjust to it, this will bias the measured effect in an event study framework. The probability of this is reduced by the closeness of the election that led to the introduction 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 also a 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 2: Transaction volume and price exuberance, Oslo vs. Bærum



(a) Transactions volume, above 6.3 million (threshold)



(b) Price in excess of listing price, above 6.3 million (threshold)

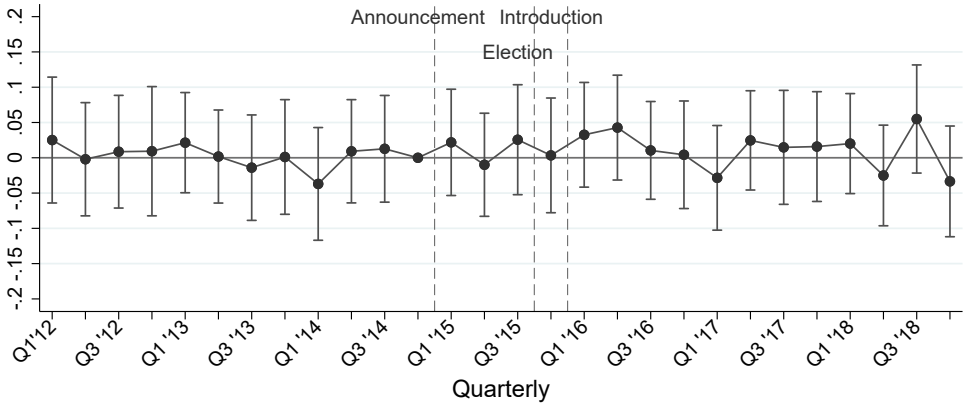
Figure 2 explore this problem in detail. Panel (a) show the development in transaction volumes before and after treatment. Panels (b) show the mean difference between the sales prices and the posted list prices. This works as a proxy for short-term imbalances in the market. It depends on the assumption that list prices are adjusted more slowly and are not adjusted for the tax increase. The graphs do not suggest that there is selection bias. The relationships are instead remarkably stable through the pre-treatment and post-treatment period. Most notably, Bærum (control area) seems to have elevated transactions volumes in Q2 every year from 2015, which is not fully matched by the Oslo sample. Selection bias is also

evaluated in a regression setting. These estimates show a small but statistically significant negative effect on the overvaluation in Oslo (treatment area) compared to Bærum (control area), but no significant effect on transaction volume. Detailed results are provided in the online appendix.

6 Capitalisation results

The property tax introduced in Oslo was moderate in general, but substantial for those who were targeted. Due to the standard deduction, the effective tax rate was zero for homes worth up to 5 million, and then gradually increasing. This analysis only includes the segment of homes worth more than 6.3 million. This is where the effective tax rate exceeds 0.05 percent.[6] A simple capitalisation model, building on Palmon and Smith (1998), implies an average price fall of 3 percent for this segment. [7] Figure 3 graphically presents the relative trend between the treatment and control areas. The graphs depicts β_t from the estimation of the event study specification, where the $\beta_{Q4,2014}$ is set to zero. 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.

Figure 3: Quarterly difference-in-differences estimates



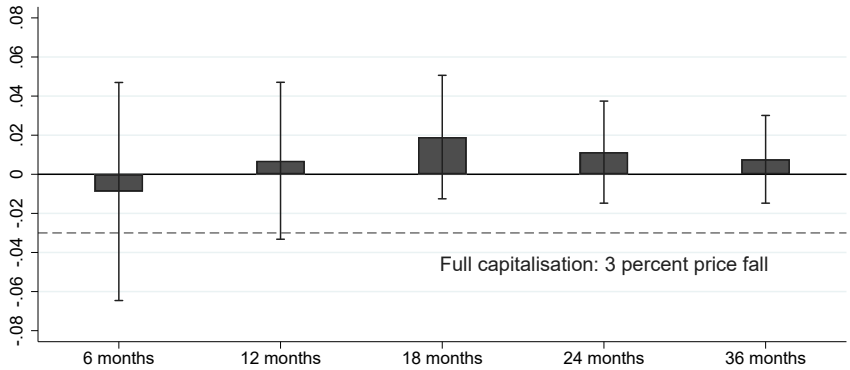
Notes: The figure shows quarterly estimates of the relative price level in the treatment area compared to the control area. Dependent variable is log sales prices incl. stamp duty. Hedonic controls included are: Type, size, bedrooms, decade built, seasonal dummies, sub-areas in treatment or control area. 95 percent confidence intervals displayed. Transactions below 6,300,000 NOK are excluded, as this is threshold were the effective tax rate exceeds 0.5 percent. Treatment and control areas as described in 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.

[6]The selection to this segment is inherently noisy, as the cut-off is unavoidably hard to set. It has a yearly adjustment of 5 percent price growth before and after.

[7]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 A5.

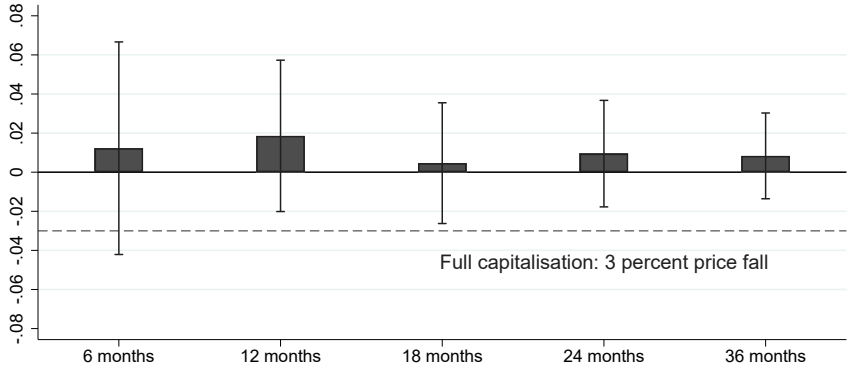
Figure 3 shows two things: There is a stable common trend in the treatment and control area. And there is no indication of a marked and consistent fall in relative prices. The price levels in the treatment area and control areas move together from the second quarter of 2012 and until the last quarter of 2014, the quarter before the first event date. The exception is an outlier movement from Q4 of 2013 to Q1 of 2014, that is reversed in the next quarter. The trend remains stable through the post-treatment period. There are outlier movements, but these are consistently reversed. There is a small increase after the Labour party pledge, and some volatility around the election and the introduction of the tax. The results are not suggestive of a sustained, negative effect after neither of the treatment events. This is confirmed by the following results.

Figure 4: Difference-in-difference estimates, point estimates



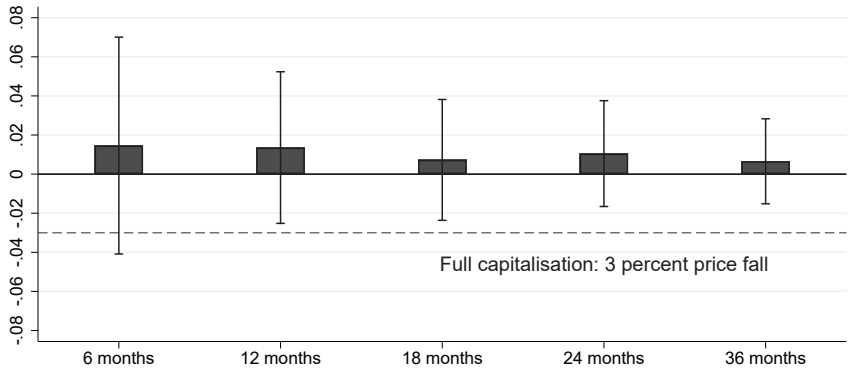
Notes: Dependent variable is log sales prices incl. stamp duty. Hedonic controls included are: Type, size, bedrooms, decade built, seasonal dummies, sub-areas in treatment or control area. 95 percent confidence intervals displayed. Transactions below 6,300,000 NOK are excluded, as this is threshold were the effective tax rate exceeds 0.5 percent. Treatment and control areas as described in 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.

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



Notes: Dependent variable is log sales prices incl. stamp duty. Hedonic controls included are: Type, size, bedrooms, decade built, seasonal dummies, sub-areas in treatment or control area. 95 percent confidence intervals displayed. Transactions below 6,300,000 NOK are excluded, as this is threshold were the effective tax rate exceeds 0.5 percent. Treatment and control areas as described in 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.

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



Notes: Dependent variable is log sales prices incl. stamp duty. Hedonic controls included are: Type, size, bedrooms, decade built, seasonal dummies, sub-areas in treatment or control area. 95 percent confidence intervals displayed. Transactions below 6,300,000 NOK are excluded, as this is threshold were the effective tax rate exceeds 0.5 percent. Treatment and control areas as described in 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.

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

Figure 4 reports the point estimates of the difference-in-difference estimates. These compare time windows before and after the three different treatment events.[8] The estimates confirm the impression from figure 3: 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. For 11 out of 15 specifications, the full capitalisation result of a 3 percent price fall is outside the 95 percent confidence interval. The remaining four are the three 6-month estimates, where the sample sizes are small and standard errors the largest, and the 12-month estimate around the Labour pledge event. There is one specification that yields a sizeable negative point estimate among these. This is the estimate for the 6 months before and after the Labour party's tax pledge. But also this estimate only implies less than 30 percent capitalisation, and with marked confidence intervals. [9]

7 Possible mechanisms

The main finding of this paper is that the introduction of the property tax in Oslo at most had a minuscule impact on house prices. This challenges the expectation of full capitalisation, and potentially the illusion of the fully rational home buyer. This section discusses possible reasons behind homebuyers deviating from the expected decision making. The four factors discussed is the value of local public goods, the combination of low salience and bounded rationality, possible present bias, and possible imperfect information and information asymmetries.

Value of local public goods. The value of new local public goods and services financed by the property tax may explain the missing capitalisation of the property tax.[10] Brueckner (1982) even proposes that when local governments adjust local taxes and spending to 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. Thus, there should not be any net capitalisation effect on house prices. But there are some factors that

[8] The precise estimates, standard errors and sample sizes are reported in the online appendix A1.

[9] Similar results for alternative specifications with extended treatment and control areas are reported in online appendix A6. This sensitivity analysis yield mostly the same results as the main analysis, but with the point estimates skewing negative.

[10] In countries like the US, there is often a close connection between property taxes and funding of the local school. Due to the large number of school districts situated in each municipality, this is not a relevant channel in Norway.

points towards this being of minor importance in the case of Oslo. Most specifically the very significant standard deduction. Only a minority of homeowners in the municipality pay the property tax, only those in the top three deciles of the distribution. [11] This creates a free-rider effect, where the benefit from the additional funding for public services is not proportional to the property tax paid by the treated households. This free-rider effect is enhanced by the way the left-wing local government has chosen to prioritise spending. A key effort is to make the after-school program free for the youngest children. This was rolled out gradually, borough by borough and school year by school year, meaning that the program was free for children in the prioritised boroughs. The boroughs in the treatment area, 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. Other policy choices point in the same direction. Another key policy change was to redistribute teachers from the wealthier parts of town to less fortunate neighbourhoods. This means that the tax revenue did not go to strengthen school quality in the treated boroughs either.

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 installments 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 why the property tax seems to be such an unpopular and much discussed tax.[12]

[11] In 2017, approximately 28 percent of Oslo households paid the property tax at all.

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

The present bias of home buyers. We say that a home buyer 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 in 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 home buyers, 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 policy making. 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 responses to local property taxes in Norway is found. The Norwegian capital Oslo introduced a property tax 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 control areas are constructed of the zip codes closest to the municipality border. The areas under investigation are some of the most densely populated in Norway. This reduces the chance that a price elastic housing supply explains the absent effect, and points towards full or near-full capitalisation. 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, world 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 some uncertainty concerning the results. Still, the lower bound of the confidence intervals of the main estimates seem to exclude full capitalisation with 95 percent certainty. Another weakness is that houses are heterogeneous, which is reflected in the standard errors. Every hedonic model will be subject to uncertainty and unobserved characteristics. In this case, it is the general standard of the house and smaller things like sun exposure that is missing, while the other characteristics are covered well. 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 likely explanation. Another possible reason for no capitalisation is that the tax finance valuable local goods and services. But this is not as likely, as there is a marked discrepancy between those who enjoy the fruits of the tax revenue and those who pay the tax. The study should reassure policy makers in that a moderate property tax may be introduced without leaving marks 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.

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A Online Appendix (Not For Publication)

A.1 Supplementary material: The Oslo tax reform

Oslo introduced the property tax 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.

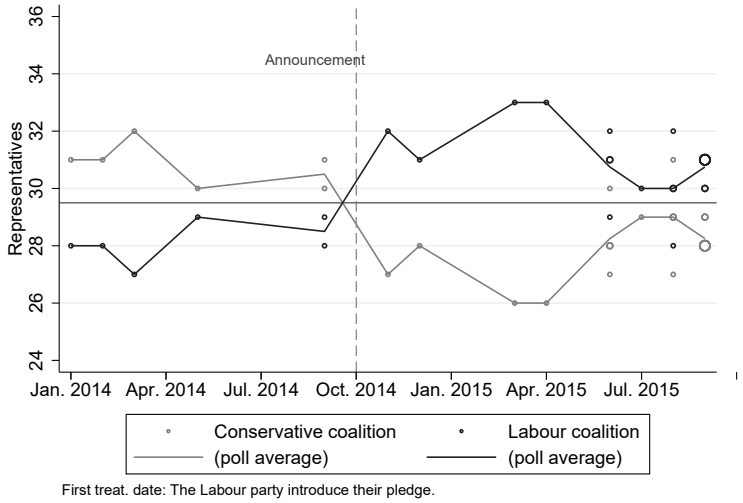


Figure 5: Opinion polls in the period before the election

Two notable things happened leading to up to this outcome. In September 2014, one year before the election, the Labour party elected a popular main candidate. 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 4. The polls remained close thereafter, but the Labour party's coalition won a slim majority in the fall of 2015.

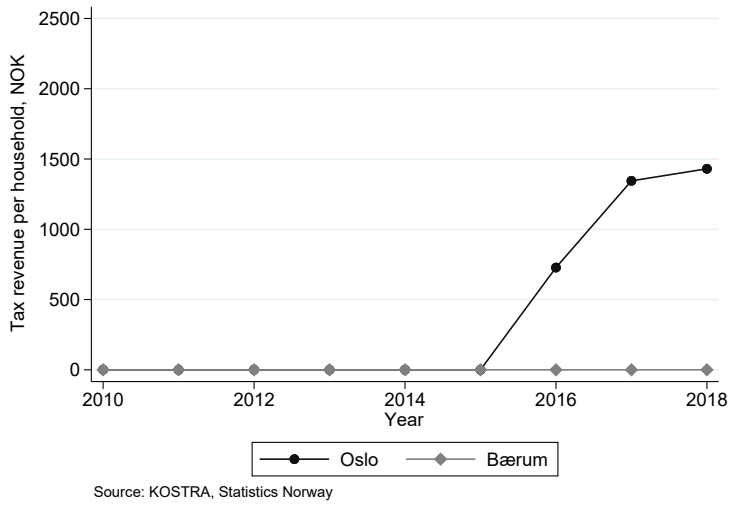


Figure 6: Tax income per household over the years (1,000 NOK exchanged to 119 USD in 2016.)

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 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 4 million NOK. 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 utilise 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	8,255,548	163	53,984	230
	2016	Oslo	9,385,108	160	62,142	244
	2015	Bærum	8,796,446	185	51,671	223
	2016	Bærum	9,342,105	170	60,334	257
Detached	2015	Oslo	10,184,058	207	52,422	69
House	2016	Oslo	11,959,063	211	59,031	64
	2015	Bærum	9,808,518	222	46,001	113
	2016	Bærum	10,903,981	218	53,312	103
Flat	2015	Oslo	7,330,696	135	57,707	51
	2016	Oslo	8,152,704	127	67,590	98
	2015	Bærum	7,679,140	120	67,446	51
	2016	Bærum	7,976,510	110	75,314	77
Rowhouse	2015	Oslo	7,024,109	140	52,820	60
	2016	Oslo	8,048,810	149	56,897	41
	2015	Bærum	7,621,557	166	47,748	8
	2016	Bærum	7,609,792	137	57,290	25
Semi-detached	2015	Oslo	8,015,279	157	53,737	50
House	2016	Oslo	9,649,273	171	59,220	41
	2015	Bærum	7,855,614	172	49,076	51
	2016	Bærum	9,103,365	179	53,526	52

Treatment area zip codes: 0280, 0281, 0282, 0283, 0284, 0380, 0381, 0382, 0383, 0750, 0751, 0752, 0753, 0754, 0755, 0756, 0757, 0760, 0766, 0767, 0768.
Control area zip codes: 1358, 1359, 1366, 1368, 1369, 1361, 1360, 1364

Table 2 presents the summary statistics of the homes sold in the main treatment and main control area for more than 6.3 million NOK. The samples are fairly similar and balanced. The Oslo neighbourhoods have fewer detached houses sold and more rowhouse flats sold than

the Bærum neighbourhoods, but there is a comparable number of observations in the two areas for the two other types and in total. Detached and semi-detached houses are smaller and have a higher square meter price in Oslo than Bærum on average, while flats are smaller and more expensive per square meter in Bærum. On average, homes in Bærum are larger and more expensive, but have marginally lower square meter prices. This is also as expected, as the Oslo neighbourhoods are relatively closer to the Oslo city centre.

A.3 Supplementary material: Selection bias

The framework compares different samples of homes, adjusting for hedonic factors. A possible weakness in this setting is that there is a selection bias, with the treatment affecting the selection of the transactions that are enacted post treatment. If an increase in the property tax lowers the activity in the housing market, this can lead to a situation where only the high quality houses with are sold, while lower quality houses are not. This may mimic an unchanged price effect, if the hedonic controls do not pick up these quality differences, although the buyers are accounting for the tax change. The counter point against this mechanism is that there are both sellers and buyers in the transaction. The sellers are able to reject the highest offer in the auction if they do not find it good enough. In a rational world, sellers would lower their willingness to accept and buyers would lower their willingness to purchase uniformly following a property tax increase.

Table 2: Selection bias regressions

	Overvaluation			Transactions		
Cut-off period	12 months	24 months	36 months	12 months	24 months	36 months
1st January 2015	-0.0010	-0.0076	-0.0025	-0.6667	-2.0000	-3.1111
	(0.0084)	(0.0066)	(0.0056)	(5.3435)	(3.6755)	(3.0058)
Observations	882	1,830	2,748	48	96	143
1st October 2015	-0.0080	-0.0143**	-0.0091	-2.1667	-2.6667	-2.8333
	(0.0092)	(0.0066)	(0.0056)	(5.2672)	(3.7509)	(3.0958)
Observations	944	1,873	2,844	48	96	144
1st January 2016	-0.0144	-0.0167**	-0.0115**	-1.6667	-2.7917	-2.9722
	(0.0092)	(0.0066)	(0.0055)	(5.6240)	(3.9062)	(3.0803)
Observations	966	1,896	2,863	48	96	144

Notes, overvaluation column: Dependent variable is sales price over list price. Hedonic controls included are: Type, size, bedrooms, decade built, seasonal dummies, sub-areas in treatment or control area. Transactions below are 6,300,000 NOK excluded, as this is threshold were the effective tax rate exceeds 0.5 percent. Treatment and control areas as described in paper. *p < 0.10 **p < 0.05 ***p < 0.01

Notes, transactions column: Dependent variable is number of transactions for each quarter worth 6,300,000 NOK or more. Seasonal controls are included. Treatment and control areas as described in paper. *p < 0.10 **p < 0.05 ***p < 0.01

This potential selection bias is evaluated in section 4 in the main body, and is further explored here. The graphs presented in section 4 shows how there is no indications of selection bias. The relationships are remarkably stable through the pre-treatment and post-treatment period. This is confirmed when evaluating this more formally. The regression analysis finds that there is a marginal effect on the transaction volume and only small, negative effect on the undervaluation of properties in the prospects compared to the final sales price.

A.4 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 home buyers 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 home buyers 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, and that the supply of land and housing is fixed.

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):

$$P_j = \frac{S(Z_{ij})}{\phi_n + \beta_\tau \tau_j} \tag{3}$$

$$\frac{\partial ln(P_j)}{\partial \tau} = \frac{\partial}{\partial \tau}\left(ln(S(Z_{ij})) - ln(\phi_n + \beta_\tau \tau_j)\right) \tag{4}$$

$$\frac{\partial ln(P_j)}{\partial \tau} = -\left(\frac{\beta}{\phi_n + \beta_\tau \tau_j}\right) \tag{5}$$

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 per cent to 0.1 per cent. 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. [13]

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

Table 3: 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 %

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

Table 5 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.5 Supplementary material: Results

Table 4: Difference-in-differences estimates, point estimates

	Baseline treatment and control area				
	6 months	12 months	18 months	24 months	36 months
1st January 2015	-0.0088	0.0069	0.0190	0.0113	0.0077
	(0.0284)	(0.0205)	(0.0161)	(0.0133)	(0.0114)
Observations	455	847	1,284	1,766	2,655
1st October 2015	0.0123	0.0186	0.0046	0.0095	0.0083
	(0.0277)	(0.0197)	(0.0157)	(0.0139)	(0.0112)
Observations	435	912	1,361	1,809	2,744
1st January 2016	0.0146	0.0136	0.0073	0.0105	0.0066
	(0.0282)	(0.0198)	(0.0158)	(0.0138)	(0.0111)
Observations	438	939	1,411	1,829	2,760

Notes: Dependent variable is log sales prices incl. stamp duty. Hedonic controls included are: Type, size, bedrooms, decade built, seasonal dummies, sub-areas in treatment or control area. Transactions below 6,300,000 NOK are excluded, as this is threshold were the effective tax rate exceeds 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. The table shows how the increase in number of observations lower the standard errors significantly when expanding from a 6-month cut-off window to a 12-month cut-off window, and lower them further as the cut-off windows are expanded further.

A.6 Sensitivity analysis: Expanded Treatment and Control Areas

The treatment and control areas are manually constructed using GIS software and detailed geographical data on Norwegian zip codes. Expanded treatment and control areas are also analysed, to check whether the results are sensitive to how these are constructed.

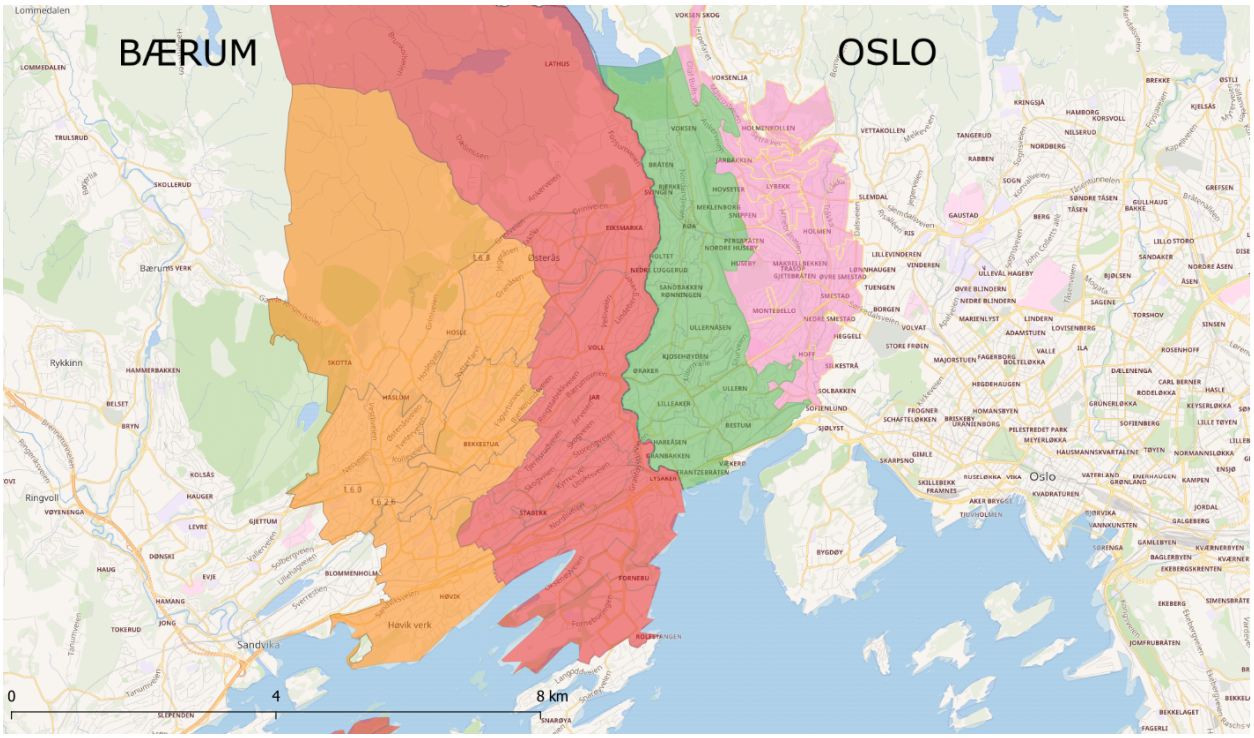


Figure 7: Map showing treatment and control group zip codes.
Source: Norwegian Mapping Authority/Wikimedia

Figure 8 shows how the treatment and control areas are expanded to cover more areas. The treatment area is expanded with neighbourhoods closer to the city centre and the central areas like Majorstuen and Frogner. The control area is expanded with neighbourhoods that are even further away from the city centre, like Høvik and Haslum. This expansion do on the one hand lead to more observations and less uncertainty around the point estimates. But the treatment and control groups also become less comparable, due to the centrality issue pointed to above.

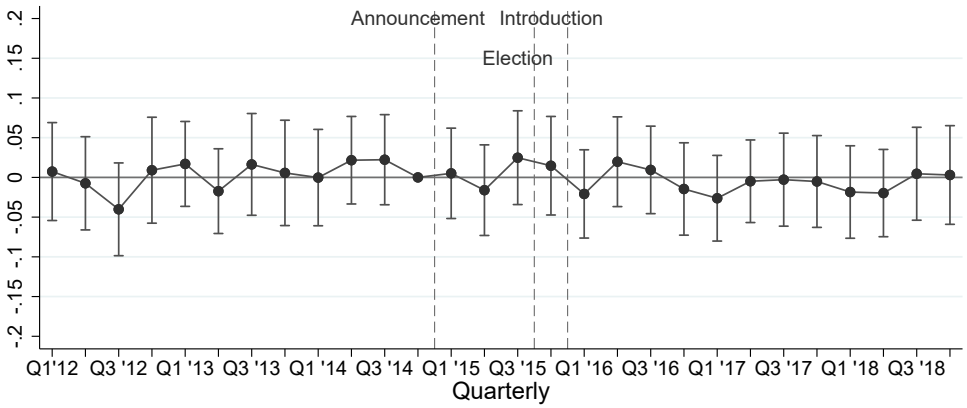
Table 5: Descriptive statistics, main treatment and control area

	Year	Municipality	Mean price (NOK)	Mean m^2	Mean price/m^2	Obs
All	2015	Oslo	9,711,463	183	55,790	182
	2016	Oslo	9,948,430	167	63,467	183
	2015	Bærum	8,276,429	183	48,766	191
	2016	Bærum	9,078,131	180	53,591	221
Detached	2015	Oslo	12,141038	231	54,710	76
House	2016	Oslo	12,302132	217	59,626	68
	2015	Bærum	8,758042	203	45,487	120
	2016	Bærum	10,194432	211	50,575	111
Flat	2015	Oslo	8,063124	137	61,199	30
	2016	Oslo	8,057391	123	69,422	59
	2015	Bærum	7,656427	108	73,444	19
	2016	Bærum	7,793842	113	72,256	21
Rowhouse	2015	Oslo	7,694417	138	58,027	36
	2016	Oslo	8,172565	131	64,222	24
	2015	Bærum	6,852592	149	48,021	10
	2016	Bærum	7,011120	139	52,644	35
Semi-detached	2015	Oslo	8,146869	168	51,773	40
House	2016	Oslo	9,765313	171	60,082	32
	2015	Bærum	7,519881	168	47,147	42
	2016	Bærum	8,622685	170	53,146	54

Expanded treatment area zip codes: 0378, 0379, 0770, 0771, 0772, 0783, 0784, 0785, 0786, 0783, 0787, 0773, 0275, 0377, 0376, 0774, 0765, 0763 Expanded control area zip codes: 1356, 1357, 1362, 1363, 1344.

Table 5 compares the housing transactions that are added to construct the expanded treatment and control areas. These summary statistics show how the homogeneity assumption concerning the treatment and control groups are challenged when they are expanded. It is evident from the table that the groups are more different than the main treatment and control areas. Homes are markedly more expensive in Oslo than Bærum for the expanded treatment and control groups. This is evident in both sales prices and the prices per square meter. This is partly the inverse of what is seen for the main treatment and control groups, where homes were marginally more expensive per square meter in Oslo and had somewhat higher total sales prices in Bærum due to larger homes.

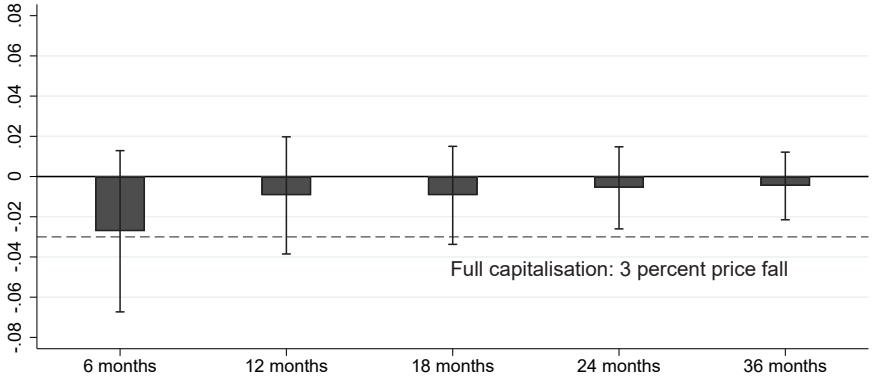
Figure 8: Quarterly difference-in-differences estimates



Notes: The figure shows quarterly estimates of the relative price level in the treatment area compared to the control area. Dependent variable is log sales prices incl. stamp duty. Hedonic controls included are: Type, size, bedrooms, decade built, seasonal dummies, sub-areas in treatment or control area. 95 percent confidence intervals displayed. Transactions below 6,300,000 NOK are excluded, as this is threshold were the effective tax rate exceeds 0.5 percent. Treatment and control areas as described in 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.

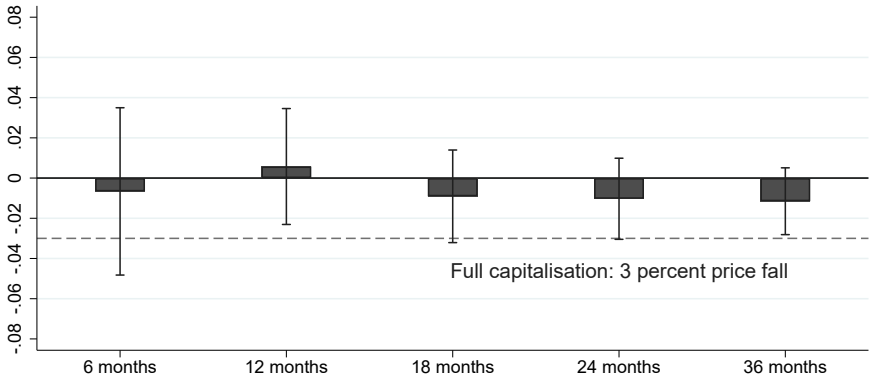
Figure 9 shows the quarterly difference-in-difference estimates, corresponding to figure 3 in the main body of the paper. The figure suggests that the common trend assumption still holds, even though the treatment and control groups now are less homogeneous. It also does not suggest a sustained, negative effect on house prices in Oslo compared to Bærum following the tax reform. There are no substantial movements around the Labour party's pledge, but there are some short-term movements around the election and the introduction of the tax, driven by elevated prices in Oslo compared to Bærum in the third quarter of 2015.

Figure 9: Difference-in-difference estimates, point estimates



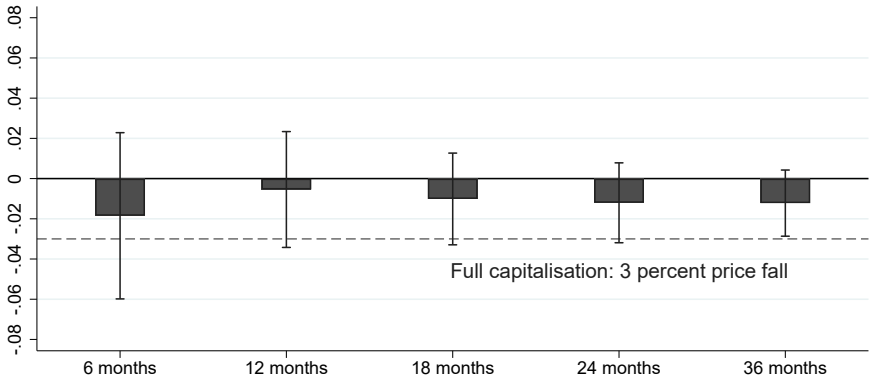
Notes: Dependent variable is log sales prices incl. stamp duty. Hedonic controls included are: Type, size, bedrooms, decade built, seasonal dummies, sub-areas in treatment or control area. 95 percent confidence intervals displayed. Transactions below 6,300,000 NOK are excluded, as this is threshold were the effective tax rate exceeds 0.5 percent. Treatment and control areas as described in 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.

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



Notes: Dependent variable is log sales prices incl. stamp duty. Hedonic controls included are: Type, size, bedrooms, decade built, seasonal dummies, sub-areas in treatment or control area. 95 percent confidence intervals displayed. Transactions below 6,300,000 NOK are excluded, as this is threshold were the effective tax rate exceeds 0.5 percent. Treatment and control areas as described in 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.

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



Notes: Dependent variable is log sales prices incl. stamp duty. Hedonic controls included are: Type, size, bedrooms, decade built, seasonal dummies, sub-areas in treatment or control area. 95 percent confidence intervals displayed. Transactions below 6,300,000 NOK are excluded, as this is threshold were the effective tax rate exceeds 0.5 percent. Treatment and control areas as described in 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.

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

Figure 10 reports the point estimates comparing the time periods before and after the event timings, corresponding to figure 4 in the main body. Like figure 9, it shows the same pattern as the corresponding analysis on the main treatment and control areas. Point estimates skew more negative than in the main analysis, but are still suggestive of no or little capitalisation. Only the most short-term point estimates are close to indicating full capitalisation. Full capitalisation is either just outside or just within the 95 percent confidence interval for 11 out of 15 specifications.

Table 6: Difference-in-differences estimates, point estimates

	Expanded treatment and control area				
	6 months	12 months	18 months	24 months	36 months
1st January 2015	-0.0272	-0.0094	-0.0094	-0.0056	-0.0047
	(0.0204)	(0.0148)	(0.0124)	(0.0104)	(0.0086)
Observations	822	1,543	2,336	3,206	4,844
1st October 2015	-0.0066	0.0057	-0.0091	-0.0103	-0.0115
	(0.0212)	(0.0147)	(0.0117)	(0.0103)	(0.0085)
Observations	770	1,651	2,479	3,300	4,961
1st January 2016	-0.0185	-0.0054	-0.0101	-0.0120	-0.0122
	(0.0211)	(0.0147)	(0.0116)	(0.0101)	(0.0084)
Observations	800	1,698	2,576	3,328	4,995

Notes: Dependent variable is log sales prices incl. stamp duty. Hedonic controls included are: Type, size, bedrooms, decade built, seasonal dummies, sub-areas in treatment or control area. 95 percent confidence intervals displayed. Transactions below 6,300,000 NOK are excluded, as this is threshold were the effective tax rate exceeds 0.5 percent. Treatment and control areas are the expanded treatment and control areas, as described in paper.

Table 6 reports the precise point estimates, the standard errors and sample sizes for the estimates presented in figure 10. Most point estimates suggest that there is little or no capitalisation, as also seen in figure 10. The number of observations are almost twice the sample sizes in the main estimates. This lowers the standard errors markedly. This is especially evident for the specifications with the shortest time horizons, where the absolute reduction is largest. This contribute to full capitalisation being either outside or just within the 95 percent confidence interval for most specification, although the point estimates in general skew more negative than in the main specification.