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Does residential property taxation affect the quality of municipal welfare services? Evidence from the Norwegian school system

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Content

Abstract

This master thesis explores the incentive effect of residential property taxation on the quality of welfare services provided by the Norwegian municipalities, where the quality of welfare services are measured by school results. Norway is a well-suited case to investigate this effect, as it is possible to compare municipalities with and without residential property taxation. We build our analysis on the theoretical framework of Brennan and Buchanan (1978), Glaeser (1996) and Hoxby (1999), and follow the empirical method of Fiva and Rønning (2008). We use a two stage least squares approach in order to estimate the causal effect of residential property taxation on school results. In contrast to the findings in previous studies, our main results suggest that there are no effect of residential property taxation on school results. This implies that the findings of Fiva and Rønning (2008) are not robust to a number of factors that is implemented in the analysis of this master thesis. The underlying hypothesis of the analysis is that when residential property tax is levied, the inhabitants will demand more from their elected local representatives in the form of a higher voter participation rate. Hence, the representatives have an incentive to improve the quality of the welfare services provided in their municipality. Thus, we perform a supplementary analysis that investigate this relationship. Our findings suggest that there are no effect of residential property taxation on the voter participation rate in the local election. We find that these results adds to the robustness of our main findings, that residential property taxation does not affect school results in Norway.

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1. Introduction

This master thesis is motivated by the need to understand how different sources of financing in the public sector will affect the quality of welfare services provided in the Norwegian municipalities. Previous literature has indicated that the chosen tax structure can influence government behaviour, which influences the quality and resource use in the local governments through an incentive effect (Brennan and Buchanan, 1978). This incentive effect might be useful in explaining the prevalence of residential property taxation as a form of local government financing. While residential property tax increases the municipalities' income, property taxation has also been linked to higher quality of welfare services and higher cost efficiency (Glaeser, 1996; Hoxby, 1999; Borge and Rattsø, 2006). The idea is that if a municipality levies residential property taxation, the inhabitants will demand more from their elected local representatives in the form of higher voter turnout. Hence, the representatives have an incentive to improve the quality of the welfare services provided in their municipality in order to be (re)elected.

In Norway, it is voluntary to levy property taxation for each municipality. This makes Norway a well-suited case to study the effect of property taxation on the quality of welfare services provided, as we can compare municipalities that have chosen to levy property taxation and those who have not. Although property taxation is a highly controversial tax and one of the most unpopular taxes in Norway, an increasing number of municipalities are choosing to levy property taxation. The number of municipalities that have chosen to levy property taxation has increased by almost 100 over the last ten years (Eide, 2017). This may imply that the additional income is so valuable that the local policymakers are willing to disregard the potential negative backlash from introducing it. In fact, 9.4 percent of the municipalities total tax income came from property taxation for the municipalities that levy property taxation (Eide, 2017). Hence, this is a significant source of income for the local government.

In this thesis, we focus on the quality of public schooling as a measure of welfare services provided by the municipalities. The public school system is a significant expense for the local governments, equal to 23.4 percent of the municipalities' net expenses in 2016 (Statistics Norway, 2018), making it a relevant measure of the

quality of welfare services provided by the municipalities. Public schooling is large in Norway, compared to other countries, as only 3.5 percent of all students attend private schools (Union of Education Norway, 2016). Although all welfare services are possible to measure in theory, we are empirically restricted to analyse sectors where data is available, which is the case with school results. We use the municipality-level test performance indicator as a measure of school results, which is a value-added indicator.

Thus, we would like to answer the following research question in this master thesis: *What are the effect of residential property taxation on school results?*

Our primary objective is to study how the choice of residential property taxation affects the achievement level of the students in Norwegian municipalities. However, in order to provide insight into the robustness and validity of our results, we additionally provide an analysis of the underlying hypothesis of the incentive effect of residential property taxation. Fiva and Rønning (2008) state that, "the object of the current paper is to investigate whether property taxation works as a disciplining device on local school leaders and bureaucrats". As property taxation is a highly visible tax, since it is both voluntary and contribute directly to the municipal budget, the inhabitants will demand higher quality of the public sector services provided as the municipal budget has increased. This heightened demand is expected to materialize in a higher voter participation rate in the local election. Hence, this will provide an incentive for local decision-makers to improve the quality of the welfare services provided and control costs. Thus the supplementary analysis will investigate the effect of residential property taxation on the voter participation rate in the local election.

The empirical strategy of this thesis takes a two-stage least squares (2SLS) approach, based on Fiva and Rønning's (2008) study, in order to detect the effect of residential property taxation on school results. We instrument residential property taxation by using the two instruments introduced by Fiva and Rønning, 'Town' and 'Rural', which are derived from the tax law of 1911 and the property tax law of 1975. Further, we introduce a third instrument 'Vacation homes' in our analysis, in order to deal with a potential problem of endogeneity. The

supplementary analysis will take a similar form by employing a two-stage least squares approach. However, we will instrument residential property taxation with two instruments only, 'Town' and 'Vacation homes', in addition to a different set of control variables.

We believe that using the new and more accurate measure of school performance, the municipality-level test performance indicator, will give insight into the effect of residential property taxation on school results. The use of this measure should give more precise results than what has previously been found when using cross-sectional data. Further, introducing 'Vacation homes' in the analysis has, to the best of our knowledge, not been done in related studies. Hence, by adding this variable we believe that we are able to find the effect of residential property taxation on school results. By including the supplementary analysis of the effect of residential property taxation on the voter participation rate in the local election, we aim to add to the robustness of our results.

The structure of the thesis will be as follows; in section 2, we will provide a review of related studies regarding voter turnout and the effect of property taxation on the performance of local government welfare services. Next, we will present the institutional setting of the Norwegian political system, property taxation and school system in section 3. In section 4, we will present the data used, including the key variables of interest and descriptive statistics, and in section 5 we will line out the empirical strategy that forms the basis of our analysis. Section 6 presents our findings and discuss the results. We check the robustness of our analysis in a series of sensitivity checks in section 7, followed by our concluding remarks in section 8.

2. Literature review

This section will provide an overview of previous studies that have been conducted on topics related to our field of study. Morlan (1984) compare the voter turnout in municipal and national elections in the United States and some Western European countries. He found that the voter participation rate was higher in the national election than in the local. Morlan's results support earlier studies by Lee (1963), Alford and Lee (1968), Karnig and Walter (1977) that the voter turnout in the United States was significantly higher if the municipal and national elections were conducted simultaneously. However, his results showed that in the Western European countries, with the exception of Switzerland, the voter turnout was considerably higher when the elections were conducted separately compared to the turnout in the United States (Morlan, 1984). Karnig and Walter's (1977) analysis showed that the voter turnout was persistently higher in the cities in the United States using partisan local election compared to those that had nonpartisan elections. In the Western European countries, all the elections are partisan, and usually the same parties run for election in both national and local elections. Because the local elections are considered an indication for the following national elections, the politicians usually invest a considerable amount of time and energy in the local campaigns. This may lead to a higher turnout as the voters might feel that their vote will make an impact in the local policy decision making (Morlan, 1984).

The local and regional governments councils in Norway are elected through open-list proportional representation every fourth year. By voting for a party list and additionally casting preferential votes for particular candidates, the voters can affect the election outcome and thereby influence how high the tax rates should be as the different political parties have different views on taxation. The revenues from commercial property taxation consist mostly of taxation of hydropower producers. Andersen, Fiva and Natvik (2014) found that municipalities with high hydropower income had higher participation in local and regional elections than those with lower income. In addition, municipalities with high hydropower income had more inhabitants who cast preferential votes in their elections. Their study showed that inhabitants in municipalities with high wealth had more incentives to vote in order to influence how the municipalities spent their revenues. Further, they found that

hydropower income was positively related to higher participation in the local election and that the inhabitants of municipalities with hydropower income were more motivated to increase their knowledge about the local politics.

Fiva, Folke and Sørensen (2018) studied how the change in representation can affect the municipalities' policy and decision-making. Their analysis suggests that the voters can influence the municipality's policy by changing the composition of the municipal council through elections. They studied the local election in 2007 in the Norwegian municipality Gjøvik, which was a close race, where the left wing got majority. They analysed how the outcome would have been if the right wing got majority, and as the right wing are not in favour of property taxation compared to the left wing, this would likely lead to an abolishment of the property taxation. However, it is expected that there would not be a significant difference in how the two blocs distributed the budget. Borge and Rattsø (2006) study whether the residential property taxation gives the local governments in Norway an incentive to control costs, and found that municipalities with property taxation had lower waste costs than those without property taxation and thereby property taxation gave incentives to control costs.

There has been conducted several studies on government financing and how it affects welfare services, mainly conducted in the USA. Tiebout (1956); Glaeser (1996); Jimenez and Paqueo (1996); Hoxby (1999) use school results as a measure of the quality of welfare services. Glaeser (1996) and Hoxby (1999) found indications in their studies that local property taxation gives the local governments the incentive of investing and maintaining a well-functioning public sector by making a strong connection between the quality of the public sector to its financing. By creating an agency model, Hoxby (1996) examines the effects of the public sector from local property taxation and centralized finance have on producers' effort. If the municipality has property taxation, Glaeser (1996) argues that the local government can be considered part owners of the local properties, which creates an incentive to invest in the local community in order to raise the value of the residents' properties.

Fiva and Rønning (2008) examine the effect of property taxation in Norway on welfare services, measured by the results of the Norwegian tenth-grade examination. They argue that Norway is well suited for empirical analysis of the incentive effect of property taxation as the Norwegian municipalities with and without property taxation are comparable. They have used instrument variables techniques, and like Glaeser (1996) and Hoxby (1999), they have focused on the quality of the public sector wealth services rather than the costs associated with these services. Fiva and Rønning have constructed their measure of school quality on the national written exam, and the sample they analyse consists of the end of tenth-grade exam results of 118.178 students in the school years of 2001/2002 and 2002/2003. Fiva and Rønning's results showed that students' family background had the expected effects on student performance. The students had a higher probability of getting greater school results if their parents had higher education and jobs with high income than if the parents had little or no education. The school district fixed effects were highly jointly statistically significant at the 1 % level and were equal to 4.72. Using Oslo as the benchmark, the student performances in the 'worst' and 'best' school district were about one grade lower and one grade higher, respectively compared to the benchmark. The results showed that property taxation had a positive effect on motivating the bureaucrats and school administrators to provide efficient and high-quality schooling. From their results, Fiva and Rønning concluded that students in municipalities with property taxation performed better on the national end of tenth-grade exam than students living in municipalities without property taxation.

There have been conducted studies in the USA on how different types of taxes and federal funding can influence school results. Lin and Couch (2014) tested if funding had any impact on public schools in 286 school districts in Indiana, USA, and if the state fiscal funding had a greater impact on the school results than federal and local fiscal funding. Their results showed that fiscal funding had a positive effect on student performance in public schools, and state taxes have a greater impact on the students' school performance than local taxes as the weight on state taxes were higher, which support Fiva and Rønning's (2008) results.

Mensah, Schoderbek and Sahay (2013) studied student results in public primary, lower and upper secondary school in New Jersey, USA. They investigate whether the school results were positively related to the percentage of revenues raised from the local taxes and the school officials' salary level. To create fixed effects models they used panel data and instrument variable techniques, and their results showed that the school officials' salary seemed to have no effect or in one model, a weak, positive effect on the students' test score. When using all three fixed effects models and the two-way generalized method-of moments model, they found that local property taxation was positively related to the students' test scores, which is consistent with Kenyon's (2007) observation that the federal and state grants should be focused on school districts and schools with low student test score (Mensah et al., 2013).

Other studies have focused on the relationship between school quality and housing prices. One hypothesis is that in order to increase the chance of their children performing well in high school, parents move to a school district with a good reputation of the public schools. Fiva and Kirkebøen (2011) found a robust short-term effect in the housing-market in Oslo, Norway when the information of school-quality was published, which supports the hypothesis. Their results suggest that households did not have access to this information prior to the publishing date and that households are willing to move to areas with better schools to invest in better school results for their children. Because of this, the housing prices in the areas around the schools with better quality increased shortly after the publishing date. However, after two to three months the prices were reduced. This is connected to the effect of property taxation, as an increase in housing prices will lead to an increase in revenues from property taxation, thereby making it more attractive for the municipalities to introduce property taxation.

3. Institutional setting

In this section, we introduce the Norwegian institutional system that provides the foundation for our analysis of the effect of residential property taxation on school results in the municipalities and on the voter participation rate in the local election. Section 3.1 describes the Norwegian political system, including the electoral system and the local governments' authority in their jurisdiction. Section 3.2 presents the legal framework regarding property taxation in Norway, as well as how the development of property taxation over the past several years. Finally, section 3.3 describes the Norwegian school system, inclusive of the grading system and the measure of student achievement.

3.1.1 The Norwegian political system

The Norwegian political system is divided into the state, 19 counties ('fylker') and 428 municipalities ('kommuner') in 2015 (Hansen, 2018; Statistics Norway, 2015a). Norway is a unitary state, which means that the municipalities and counties have political authority only to the degree that it is granted by the state. Local elections are held every fourth year where the inhabitants elect their local (municipal) and regional (county) representatives (Berg & Sterri, 2017). Annually, the municipal council negotiates and adopt the municipal budget (Ministry of Local Government and Modernisation, 2013). For the budget to be adopted, more than half of the municipal council have to have been a part of the negotiations and approve it, cf. § 33 of The Local Government Act of September 25th, 1992. As the inhabitants of the municipalities can influence the politicians through voting in the local election, the inhabitants indirectly decide which issues the municipal council should prioritize.

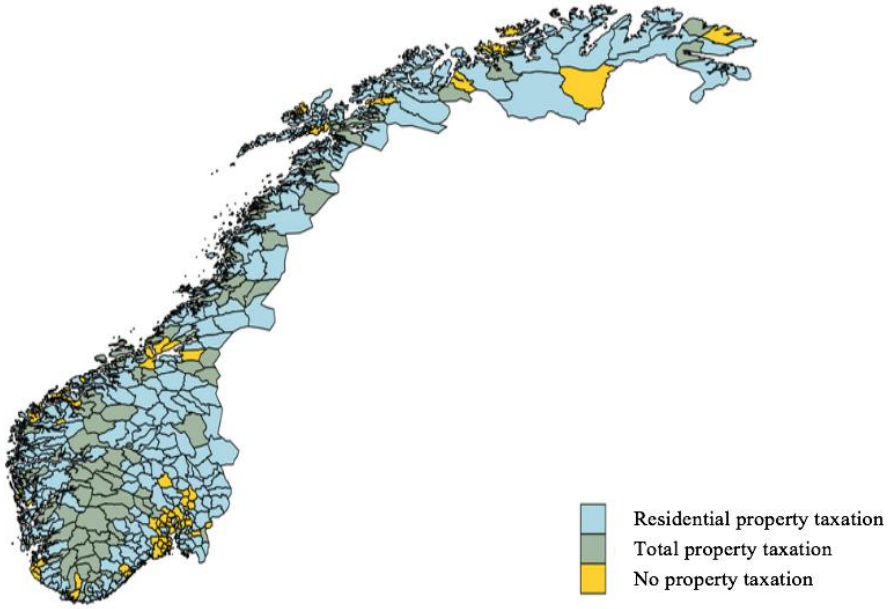
The municipalities' income consists of three main sources of income: tax revenues, government grants and user payments. These sources of income are partly general and partly predetermined in their use by the state. The municipalities' income is subject to welfare smoothing across municipalities in order to reach the main goal of the Norwegian welfare state, that the entire population should have access to welfare services of the same quality (Kjellberg, 1991). Tax income (excluding property taxation) and the general government grants are free revenues and account

for about 70% of the municipalities' income (Borge, 2003; Regjeringen.no, 2018). Free revenues are funds that the municipalities can predispose as they please within the bounds of the law. Municipalities are responsible for providing the population with national welfare services such as schools, healthcare and kindergartens, several of which are statutory. Hence, these revenues facilitate local adjustments, and the local government decides what welfare services to prioritize. This implies that one municipality may prioritize the school system, while another prioritizes elderly care.

3.1.2 Property taxation

In Norway, municipalities can freely choose whether to levy property tax or not, cf. The property tax law of June 6th, 1975. In 2015, 355 out of the 428 municipalities in Norway chose to levy property taxation (Statistics Norway, 2015b). In addition, the municipalities have the opportunity to decide on what type of property to tax, i.e. residential or commercial, and what level of tax to be introduced (between 2 and 7 permille) (Refling, 2015). Figure 1 shows the distribution of municipalities based on property taxation status, where property taxation is divided into municipalities that levy residential property taxation and municipalities that levy any type of property taxation.

Figure 1. Norwegian municipalities according to property tax status

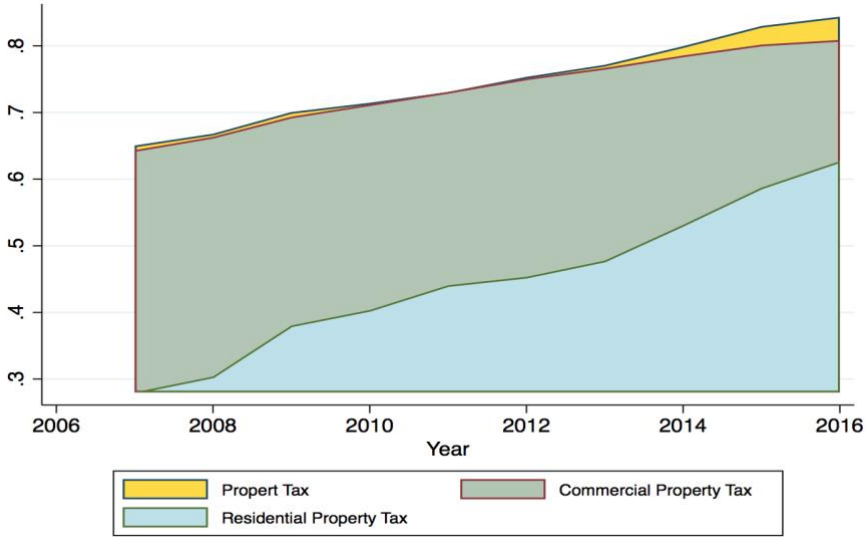


Source: Based on data from Statistics Norway

The municipalities that have chosen not to levy property taxation seem to have some common characteristics. Firstly, most of these municipalities are located around the Oslofjord and are densely populated municipalities. They get more of their revenues from income and wealth taxes and have less debt than the municipalities with property taxation. Finally, the municipalities' inhabitants have relatively high income and wealth compared to other municipalities (Bredeli, 2017). Due to this fact and as the municipalities are quite similar, the municipal councils might be hesitant to introduce property taxation, as they may be concerned this could lead to inhabitants with high income and wealth moving to a neighbouring municipality without property taxation. This is in line with Fiva and Rattsø (2007) regarding yardstick competition.

In 2009, The Norwegian National Federation of House Owners conducted a study that investigated the popularity of property taxation amongst the population. The results showed that 24% of the asked found the current property tax to be a fair system, while 59% found it unfair, making property taxation one of the most unpopular taxes in Norway (Pedersen, 2009). Nonetheless, a rapidly increasing number of municipalities has levied property taxation over the last several years. Figure 2 presents the development in the share of municipalities with residential, commercial and total property taxation from 2007 until 2016.

Figure 2: Total, Commercial and Residential property taxation (2007-2016)



Source: Based on data from Statistics Norway

We find that there has been an increase in both residential and commercial property taxation over the period, although residential property taxation has had a steeper increase compared to commercial. In addition, only a small number of municipalities have chosen to levy residential property taxation without levying commercial property taxation, while a considerable number have chosen only to levy commercial property taxation. This implies that there is a positive effect of residential property taxation on commercial property taxation.

In this thesis, we will focus on the effect of residential property taxation on the quality of welfare services in the municipalities. This implies that we will disregard the effect of both commercial property taxation and the level of the property tax rate.

3.1.3 School system

In Norway, each school district corresponds to a specific municipality. Hence, these two terms will be used interchangeably throughout the thesis. The Norwegian school system consists of primary school, lower and upper secondary school. Primary and lower secondary school is mandatory, making up the first ten years of schooling, where primary school makes up for the first seven years, followed by three years of lower secondary school. Upper secondary school is voluntary and consist of three years. During the first ten years, the students are assigned a school in their school district without the possibility of influencing which school they are assigned to, cf. The education act of July 17th, 1998. The goal of the public school system is to ensure that students have the necessary skills to be a productive member of society. This includes social norms and values, as well as sufficient academic skills in a variety of subjects (The Norwegian Directorate for Education and Training, 2015). Further, the school sector is subject to a number of requirements from the central government, concerning class size and the number of students per teacher, remedial teaching and course curriculums. This ensures that all students receive a minimum level of school quality regardless of school district affiliation.

Nationwide, all students in the fifth and eighth year of schooling undertake a test in order to analyse the students' knowledge level in Norwegian reading, Mathematics and English (The Norwegian Directorate for Education and Training, 2017), called the National tests. Participation is generally high, with a participation rate of 93-94% at the fifth-grade level and 2-3% lower at the eighth-grade level (The Norwegian Directorate for Education and Training, 2016). This high rate of participation gives a strong measure of the knowledge level of the nations' youth. The results are measured in three categories: Knowledge level 1, 2, and 3, where the level 3 is the highest knowledge level.

Further, at the end of year ten, all students undertake a written exam in either English, Mathematics or Norwegian in order to graduate from lower secondary school. The exam results are graded with numbers from one to six, where six represents the best grade and one is fail. The exams are the same for all students across the country and the grading takes place externally (Regulation concerning the Education Act, 2006). The national test and the final exams are good measures for comparing results and academic level of Norwegian students.

4. Data

The main units of our analysis are the 428 Norwegian municipalities (Statistics Norway, 2015a). We have used five sources of data in our research. The first dataset consists of municipality-level school results for three periods in time, 2010-2011, 2012-2013 and 2014-2015 (Steffensen, Ekren, Zachrisen & Kirkebøen, 2017). The dataset contains both unadjusted results and the municipality-level test performance (MLTP) indicator for students at three levels of schooling. The second dataset used is the 'Local Government Dataset' (Fiva, Halse & Natvik, 2017), which contains local government data from 1972 to 2016. In addition, we have utilized several tables from Statistics Norway's Statbank Norway and the Norwegian Social Science Services (NSD) database. An exhaustive list of the data sources used to retrieve each variable used in this thesis is presented in appendix 1.

In section 4.1, we describe the method of data compilation and quality of data. Section 4.2 presents the key variables of interest to both the main analysis, i.e. the investigation of the effect of residential property taxation on school results, and the supplementary analysis of the effect of residential property taxation on the voter participation rate in the local election. Finally, we present descriptive statistics in section 4.3.

4.1 Data compilation

The starting point in the process of compiling data for our analysis is the dataset that contains the MLTP-indicator. We use the MLTP-indicator for the tenth grade from the school year 2014-2015, which gives us a sample of 407 municipalities. This implies that we drop 21 school district from our sample, as there is no data available for these municipalities. The reason is that these school districts have less than 20 students in the tenth grade during the school year of 2014-2015, which implies a high degree of uncertainty when estimating the indicator. Further, we include data from the 'Local Government Dataset', Statistics Norway's Statbank Norway and the NSD database. We drop four municipalities from our sample as they have merged in the period between 2010 and 2015, and we exclude Oslo from our sample, as it is both a municipality and a county. A full list of all municipalities excluded from our sample is described in Appendix 2. This gives us a sample of

402 municipalities. Included in the dataset we have variables measured at different time periods according to what analysis the variable is used. In our main analysis, we include residential property taxation, instruments and a set of control variables, all measured in 2012. The second stage analysis measures the voter participation rate in the local election of 2011, while residential property taxation, instruments and control variables are mainly measured in 2010.

The MLTP-indicator was created on behalf of Statistics Norway and financed by the Norwegian Ministry of Education and Research. Specifically it was created in order to be able to compare how much individual schools and municipalities contribute to student achievement. The theoretical framework created and the data obtained has been used by several municipalities in their work to improve student achievement. Hence, we believe that this data is of sufficient quality to perform our analysis. The 'Local Government Dataset' contains municipality specific variables that have been updated in 2017. The dataset is based on data from Statistics Norway's Statbank and the NSD database. Both of these sources are deemed reliable as they are developed on behalf of the Norwegian government. Hence, we conclude that our data is reliable and of good quality.

4.2 Key variables of interest

4.2.1 Dependent variable: Municipality-level test performance (MLTP) indicator

We use MLTP-indicator as a measure of student achievement in our analysis. This indicator measures the students' results at the primary school level and lower secondary school level, by using the national test and tenth-grade final exams results. The indicator only takes into account public schools, as private schools are not owned by the municipalities (Zachrisen & Steffensen, 2016). The results are adjusted for students' family characteristics, including parents' education level, household income and student immigrant background, as student achievement is strongly dependent on family characteristics and can explain about 30% of the variation in student achievement in Norway (Hægeland, Kirkebøen, Raaum & Salvanes, 2004). In addition, the results are adjusted for students' previous achievements. The indicator can be interpreted as the result the schools in the municipality would have received if the student base were average. The MLTP-

indicator is measured on a scale of 1-6 where 6 is the highest and 1 is the lowest achievement level.

The MLTP-indicator is a value-added indicator in the sense that it takes into account students' previous results, in addition to other student characteristics. A value-added indicator should be more accurate in measuring school quality than other measurements currently existing (Hægeland, Kirkebøen, Bratsberg & Raaum, 2011) such as the cross-sectional indicator created by Fiva and Rønning (2008). OECD (2008) gives the following definition of value-added models: "a class of statistical models that estimate the contributions of schools to student progress in stated or prescribed education objectives (e.g. cognitive achievement) measured at at least two points in time".

The MLTP-indicator measures school results at three points in time: in the fifth, eighth and tenth grade. Both the eighth and tenth grade adjusted results are value-added indicators, while the fifth-grade indicator is based on cross-sectional data. The tenth-grade final exam results are adjusted for the eighth-grade national test scores, while the eighth-grade national test scores are adjusted for the students' fifth-grade national test scores. In our analysis, we will use the MLTP-indicator results from the tenth grade. This differs from the measure used by Fiva and Rønning (2008) who used cross-sectional data from one period in time. The difference between value-added models and cross-sectional models is that the estimated effects that the value-added estimator gives, provides a more precise interpretation of the municipalities' contribution to the students' knowledge acquirement between the different time periods of measurement, as one condition on the knowledge level at the start of the period (Hægeland et al., 2011). When using cross-sectional data, it is more unclear what one conditions on when controlling for family background and where differences in results will reflect possible quality differences between schools at different years of schooling.

4.2.1.1 Measuring the quality of the school sector

The MLTP-indicator is a good measure of municipalities' contribution to student performance in the subject they are chosen to undertake the exam. However, it does not measure student performance in courses that are not tested on the exam, nor

does it capture the municipality's and individual school's contribution to developing students' social skills and general attitude. It is difficult to account for these factors, as student achievement is not evaluated at the national level in any other courses. In addition, it is challenging to measure student social skills and ability to be a productive member of society after the end of the tenth grade. However, we do believe that student achievement in the exam courses is correlated with achievement in courses that are not tested in the exam. Thus, we find that the MLTP-indicator is a good measure of municipalities' contribution to student achievement and therefore a good measure of the quality of public schools.

While the MLTP-indicator is a good measure of municipalities' contribution to student achievement, it does not give any indication of what characterises a municipality that contributes largely, nor does it indicate what effect different factors have on school results (Steffensen et al., 2017). However, this will not be investigated further in this master thesis.

4.2.2 Dependent variable: Voter participation

We measure the incentive effect of residential property taxation on local elected representatives by measuring the voter participation rate in the local election in 2011, Turnout. This variable is collected from the 'Local Government Dataset' (Fiva et al., 2017). Additionally, we use a second dependent variable, Difference turnout, which is the difference between the local and regional voter participation rate where the latter is collected from the NSD database. These variables are raw election data from the 2011 election in Norwegian municipalities and counties and work as the measure of voter turnout in our sample.

4.2.3 Independent variable: Residential property taxation

Our measure of residential property taxation, DPTAX, is a binary variable that equals one if the municipality levy residential property taxation and zero otherwise. The variable is created based on data from the 'Local Government Dataset' (Fiva et al., 2017). As we use a dummy variable for property taxation, we do not take into account the level of property taxation that the local government decides on, and only distinguish between municipalities that levy property tax and those that do not

levy property taxation. Further, we find that the timing of measuring residential property status important for our analysis, hence we use property taxation from 2012 in our main analysis as the MLTP-indicator from 2014/2015 takes into account results from students dating two years back in time. In our supplementary analysis, we use residential property tax status from 2010 as an independent variable, as residential property taxation has to be levied before the local election in 2011.

4.2.4 Instrument variables

We instrument DPTAX by three instruments in total. The first two instruments used are 'Town' and 'Rural' as proposed by Fiva and Rønning (2008). These instruments take advantage of historical property tax regulations. Next, we introduce a third instrument, 'Vacation homes'. In this section, we will present the instruments used in the analysis, however, the investigation of the validity of each instrument will be discussed in section 5.

'Town' is a dummy variable, that equals one if the municipality had town status from 1911 until 1995, and zero otherwise. This draws on the tax law of 1911 that states that property taxation was mandatory for municipalities with town status. This variable was retrieved from the replication dataset of Fiva and Rønning (2008). The next instrument is 'Rural'. The property tax law of 1975 restricted the use of residential property taxation to urban areas, which means that it was not possible to levy property taxation in rural areas. Hence, 'Rural' captures the settlement pattern of the inhabitants in the municipality, and is the share of the population living in rural areas. The instrument is based on data from Statistics Norway's Statbank Norway. The third instrument used in our analysis is 'Vacation homes', which represents the logged number of vacation homes in the municipality. A vacation home is defined as a home other than the owners' primary residence that is used for recreational purposes, i.e. a home without permanent domicile. The data of the number of vacation homes is collected from Statistics Norway's Statbank Norway.

4.2.5 Control variables

Student achievement is determined by a number of factors that the school district cannot or can only partially influence. This includes factors such as socioeconomic background (Easen & Bolden, 2005), students' previous achievement (Ray, 2006), parental contribution (Harris & Goodall, 2008), student motivation (Stankow & Lee, 2014) and other unobserved factors. The MLTP-indicator is a robust measure of school results, which implies that it takes into account students' family characteristics, including parents' education level, household income and students' immigrant background. In addition, it should take into account other unobservable student specific characteristics by measuring school results at two points in time; hence we do not need to control for such factors. However, we do need to control for factors that may be correlated with our independent variable, DPTAX. We include control variables for demographic factors and school district resource use. In addition, we include county fixed effects. These controls are included in order to account for a potential endogeneity problem in connection with the independent variable, DPTAX. Not including these controls may give an estimation bias towards the unadjusted school results. A full list of controls used in our analysis is presented in appendix 1.

When analysing the effect of residential property taxation on the voter participation rate in the local election, we include a number of the same control variables as in our main analysis. As we use the same independent variable, it is expected that similar endogeneity issues need to be accounted for. However, the measure of the participation rate consists of raw data from the local election in 2011, which implies that the measure is not as robust as the MLTP-indicator. Hence, we include control variables such as the municipality education level, the share of immigrants and we include the share of eligible voters in the 2011 election, and exclude school specific controls. An exhaustive list of control variables used in this analysis is presented in appendix 1.

4.3 Descriptive statistics

In this section, we will present descriptive statistics of the variables used in our analysis. We will focus on our main analysis, but will also include the key variables from our analysis of voter participation. Table 1 present the mean, standard deviation and minimum and maximum values of our key variables. Firstly, we investigate our dependent variable, the MLTP-indicator. We see that the difference between the highest performing municipality (3.9) and the lowest performance municipality (2.9) is 1. This implies that school results have a small spread when adjusting for students' previous results, compared to unadjusted results (Steffensen et al., 2017). Hence, there are relatively small differences in Norwegian municipalities' contribution to the public school sector. Next, we consider the dependent variables for our analysis of the effect of residential property taxation on voter participation rates. The variable 'Turnout' represents the voter participation rate in the local election of 2011. We find that the mean is 0.658, which implies that the average participation rate in Norway as a whole was just below 66%. In addition, we find that the maximum participation rate was 0.802 and the minimum was 0.542, which is quite a large difference between the municipality with the highest and lowest participation rate. When considering the variable that captures the difference between voter participation rates in the local and regional election, we find a mean of 0.086 and a large spread between the municipalities' maximum and minimum values.

We measure residential property taxation in 2012 in our main analysis and 2010 for the supplementary analysis. We find that while just above 40% of the municipalities in our sample levied residential property taxation in 2010, this share has increased by 6 percentage points over the two-year period. This gives a mean of 0.478 in 2012 and 0.418 in 2010. The standard deviations are quite large as the two variables of residential property tax are binary variables. The mean of 'Town' (0.102) implies that about 10 percent of the municipalities in our sample had town status from 1911 until 1995. Further, we see that the average share of the population living in rural areas is 0.451, which means that almost half of the population historically could not be subject to residential property taxation. We find that there is a large spread of the number of vacation homes in the municipalities, ranging from 12 to 6363 vacation homes in the municipalities. A number of factors, such as municipality

size, geographic factors and property taxation considerations, can explain this variation. However, the mean is 982.401, which implies that there are more municipalities with few vacation homes than municipalities with many vacation homes. Hence, we adjust for large outliers by using the logged number of vacation homes.

Table 1. Descriptive statistics of dependent and independent variables

Variable	Mean	Standard Deviation	Min	Max
Dependent variable				
MLTP-indicator	3.382	0.160	2.90	3.90
Turnout	0.658	0.048	0.542	0.802
Turnout local - regional	0.086	0.040	0.020	0.273
Independent variables				
DPTAX (2012)	0.478	0.50	0	1
DPTAX (2010)	0.418	0.494	0	1
Instruments				
Town	0.102	0.303	0	1
Rural	0.451	0.262	0.011	1
Vacation homes	982.40	949.37	12	6363.00
Log Vacation homes	6.475	0.980	2.565	8.758
Control variables - Main analysis				
Teacher hours per student	121.429	43.41	55.52	463.60
Number of students	255.523	460.39	20	5332
Number of students^2/1000	276.71	1723.9	0.40	28430
Control variables - Main and supplementary analysis				
lnpop	8.542	1.078	6.417	12.455
Divorce	0.071	0.022	0.002	0.189
Unemployment	0.021	0.007	0.007	0.058
Share women	0.495	0.010	0.432	0.529
age 21-40	0.233	0.027	0.159	0.316
age 41-60	0.274	0.014	0.239	0.323
age 61-80	0.171	0.028	0.088	0.258
age 81	0.050	0.014	0.017	0.093
Control variables - Supplementary analysis				
Eligible Voters	0.776	0.022	0.702	0.842
Lower secondary	0.337	0.065	0.174	0.611
Upper secondary	0.459	0.044	0.277	0.568
Recent immigration	0.047	0.025	0.009	0.159
Median income	413.340	45.223	311.00	546.00

Note: Control variables reported for the main analysis and control variables used in both analyses are measured in 2012. Control variables used in the supplementary analysis is measured in 2010 (Eligible voters in 2011).

5. Empirical Strategy

The empirical strategy of this master thesis addresses the research question of the effect of residential property taxation has on school results. Hence, we investigate two hypothesis in this thesis. Firstly, our main hypothesis is that residential property taxation has a positive effect on school results in Norwegian school districts. Secondly, the supplementary hypothesis indicates that residential property taxation has an incentive effect on local bureaucrats, which manifest as an increase in the voter participation rate at the municipal level in Norway. The identification strategy is affected by endogeneity issues connected to the independent variable, DPTAX, which has been described by Fiva and Rønning (2008). In section 5.1, we present the empirical strategy used in order to estimate the causal relationship between residential property taxation on school results. We employ instrument variable techniques by using the two-stage least squares (2SLS) approach, as performed by Fiva and Rønning (2008). Firstly, we instrument DPTAX by the two instruments suggested by Fiva and Rønning (2008), and secondly we introduce a third instrument, 'Vacation homes'. In section 5.2, we present the 2SLS framework used to conduct our supplementary analysis, the effect of residential property taxation on the voter participation rate. This analysis is provided in order to test the underlying hypothesis of our main model and hence can be interpreted as a robustness check of our main analysis.

5.1 Main analysis – Student achievement

We start our empirical analysis by running a simple ordinary least square (OLS) regression, linking the dependent variable, school results, to the independent variable, residential property tax. This regression will give us an idea as to what extent residential property tax affects school results in the municipalities, through essentially looking at the correlation between the two variables, and will be used as a benchmark for our 2SLS estimation. The OLS estimation takes the following form:

$$MLTP_i = \sigma + \theta DPTAX_i + Controls_i + \varepsilon_i \quad (1)$$

Where MLTP is the municipality-level test performance indicator and the parameter θ is the effect of residential property taxation on the MLTP-indicator. The term Controls represents the combined effect of the control variables included

in our analysis and ε is the error term. However, the OLS estimation will be inconsistent if the independent variable, DPTAX, is correlated with the error term (Stock &Watson, 2015). As the municipalities are free to decide whether they should levy residential property taxation or not, it is clear that we cannot causally ascribe the differences in school results to the differences in choice of residential property taxation in the municipalities. In essence, this means that our independent variable, residential property taxation, is correlated with the error term. We use control variables in order to account for this issue, however there is reason to believe that we have not been able to capture all noise related to our independent variable. This implies that the OLS regression might be upward or downward biased. For instance, it is possible that school districts with low school results will be more inclined to levy property taxation if they believe in a positive incentive effect of property taxation. In order to manage this endogeneity problem, we need to find some variation in residential property taxation that is not dependent on school district choice of this tax (Angrist & Pischke, 2009).

In order to isolate the effect of residential property taxation on school results and manage the endogeneity problem, we would ideally conduct an experiment where residential property tax status would be allocated at random. However, as this is not possible, we find that the best option is to use a method that retains only the variation in our variable for residential property taxation, DPTAX, which is generated by quasi-linear variation (Angrist & Pischke, 2009). We do so by employing instrumental variable techniques in a 2SLS approach. 2SLS is a two-stage process where the first stage involves using instruments to find an estimation of the independent variable such that the problem of endogeneity is solved. Further, the estimation of the independent variables is used in the second stage regression that describes the relationship between the independent and the dependent variable (Wooldridge, 2008).

Our starting point is to use the two instruments, 'Town' and 'Rural', that was introduced by Fiva and Rønning (2008), before introducing 'Vacation homes' as an instrument. However, in order for an instrument variable to be valid, it has to satisfy two conditions, relevance and exogeneity. Instrument relevance implies that the instrument has to be correlated with the regressor so that there is an effect of the

instrument on the explanatory variable (Wooldridge, 2008). Further, an instrument is exogenous if it only affects the dependent variable through the regressor and is not correlated with the error term. The first condition is empirically testable, by testing whether the instruments have a significant correlation with the independent endogenous variable, while we rely on theory to argue why our instruments satisfy the exclusion condition.

The historic tax regulations in Norway give a strong foundation to find valid instruments for property taxation. The tax law of 1911 states that residential property taxation was mandatory in towns and optional in countryside municipalities. The first instrument we use is 'Town', which was introduced by Fiva and Rønning (2008). 'Town' equals one if the municipality had town status from 1911 until 1995, and zero otherwise. Traditionally, towns in Norway are municipalities that had formal town status granted by the national government and where the local government had no ability to affect the status decision. Further, it seems that the number of inhabitants and size of the municipality from the 1960s until 1996 did not affect the granting of formal town status; hence, it can be argued that town status was randomly assigned (Thorsnæs, 2017). Thus, we argue that this instrument does not affect school results in any other way than through property taxation.

A new tax law was imposed in 1975, where it was decided that it was no longer mandatory for towns to have property taxation, hence it is possible that town status does not determine residential property tax status. Table 4 includes the distribution of residential property taxation for municipalities with and without town status. We find that 90.2 percent of the municipalities that had town status from 1911 to 1995 still levy residential property taxation in 2015. Further, we find that 'Town' has a positive and statistically significant correlation of 0.219 with DPTAX (Appendix 3a). Hence, we argue that residential property taxation is historically determined by town status and is a relevant instrument.

Table 4. Settlement pattern, town status (1911-1995) and residential property tax status

Share of the population living in rural areas	School districts with residential property taxation	Total number of school districts	Share of school districts with residential property taxation
Below 10%	17	37	0,459
Between 10% and 20%	28	49	0,571
Between 20% and 30%	21	42	0,500
Between 30% and 40%	31	56	0,554
Between 40% and 50%	24	47	0,511
Between 50% and 60%	20	45	0,444
Between 60% and 70%	25	54	0,463
Between 70% and 80%	16	39	0,410
Between 80% and 90%	1	8	0,125
Between 90% and 100%	8	25	0,320
Town status 1911-1995			
Town	37	41	0,902
No Town	155	361	0,429
Overall	192	402	0,478

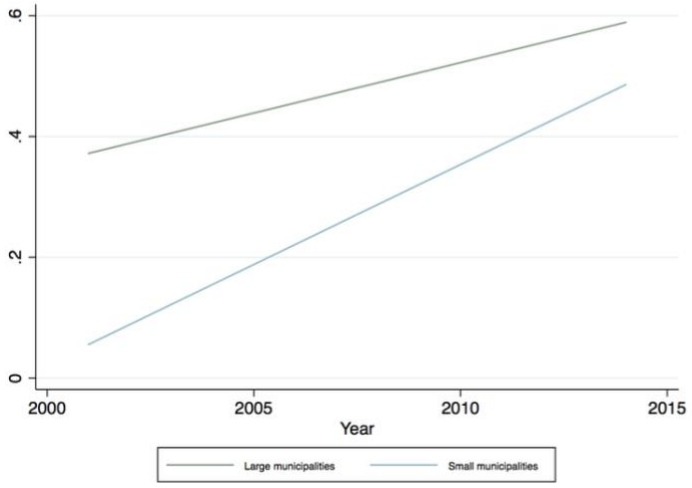
Note: The settlement pattern described is measured in 2012.

The property tax law of 1975 restricted the use of residential property taxation to urban areas, so that it was not possible to employ property taxation in rural areas. The second instrument, 'Rural', captures the share of the population living in rural areas in the municipality. This is related to school results as the higher the number of inhabitants that lives in rural areas, the higher the number of students lives in the rural areas. The MLTP-indicator adjusts for both observed and unobserved student characteristics through testing at two points in time, hence factors such as small classes and travel distance should not affect the adjusted results. However, we cannot rule out that there are still factors concerning the rural-urban dimension that can affect school results. We investigate this further in the sensitivity analysis in section 7.

Fiva and Rønning (2008) find a strong relationship between residential taxation and the settlement patterns in the municipality; however, we do not find such strong relationship in our sample. Table 4 includes the share of municipalities that levy residential property taxation for different levels of the share of inhabitants living in rural areas. While there seem to be a lower number of municipalities that levy

residential property taxation when a large share of the inhabitants live in rural areas than if a small share lives in rural areas, there is a somewhat weaker relationship between settlement pattern and residential property taxation compared to Fiva and Rønning's findings. The reason might be that in 2007 municipalities was no longer prohibited from levying residential property taxation in rural areas, cf. §3 of The property tax law (2006). Hence, it might be the case that an increasing number of municipalities with a large share of the population living in rural areas have levied residential property taxation since 2007. Figure 3 shows the development from 2001 to 2014 of the share of small municipalities (less than 3000 inhabitants) and the share of large municipalities (more than 3000 inhabitants) levying residential property taxation. We find that the share of small municipalities levying residential property tax has been increasing at a faster rate than the share of large municipalities in this period. This implies that there is a weaker relationship between 'Rural' and residential property taxation in our analysis than in the analysis by Fiva and Rønning (2008). Further, the correlation between DPTAX and 'Rural' is -0.114, which is significant at the 10% level (Appendix 3a). Hence, we find that 'Rural' is a relevant instrument and we believe that the effect, if any, is negative on residential property taxation.

Figure 3. The share of municipalities that levy residential property taxation



Source: Based on data from Statistics Norway

Next, we introduce a third instrument in our analysis, namely the logged number of vacation homes in each municipality. We use the logged number of vacation homes in order to deal with the issue of large outliers in our sample. Borge et al. (2015) show that there is a positive effect of the number of vacation homes on revenues from residential tax and vacation homes per inhabitant. As the external vacation

homeowners are not allowed to vote in other municipalities than where their primary homes are, we argue that this gives the local government an incentive to impose property tax on external vacation homeowners. Table 5 displays the share of municipalities that levy residential property taxation based on the logged number of vacation homes in the municipality. There seems to be a considerable relationship between the number of vacation homes and residential property taxation. When considering the correlation between 'Vacation homes' and DPTAX we find a positive relationship of 0.176 (Appendix 3a). Hence, we expect the local government's incentive to impose residential property tax to be increasing in the number of vacation homes in the municipality compared to population size.

Table 5. Number of vacation homes and residential property tax status

Log number of vacation homes	Municipalities with property taxation	Total number of municipalities	Share of municipalities with property taxation
Under 4	0	8	0,000
Between 4 and 5	5	23	0,217
Between 5 and 6	35	86	0,407
Between 6 and 7	93	167	0,557
Between 7 and 8	48	98	0,490
Between 8 and 9	11	20	0,550

Note: The logged number of vacation homes is measured in 2012.

Municipalities have higher expenses than income connected to vacation homes when the income from residential property taxation is not included. The expenses consist of higher costs in the health, technical, water and waste sectors. Each municipality is responsible for providing health care to anyone visiting, including external vacation homeowners. The Norwegian Directorate of eHealth (NDE) and the vacation homeowners' home municipality cover parts of these expenses. However, the municipalities are dependent on user payments and/or tax income from the owners of the vacation homes to cover the rest, so they do not have to reduce spending in other sectors. However, income adjustments between the government and the municipalities will help reduce the difference between costs and income. Hence, we believe that the costs associated with having external vacation homeowners are small, and will not have a significant effect on the welfare services provided by the municipality. Similarly, Borge et al. (2015) find that the

costs associated with external vacation homes make up 6% (on average) of healthcare costs. This is arguably quite low relative to the municipality's budget as a whole, and these costs should not affect the welfare services provided in a considerable way. Hence, we believe that vacation homes only affect school results through property taxation.

Next, we consider the first stage of our main analysis of the effect of residential property taxation on school results. As DPTAX is a dummy variable it might be tempting to use a probit model for the first stage estimation, however this may give inaccurate results and is simply not necessary (Angrist and Krueger, 2001). As Kelejian (1971) explains, the consistency of the second stage is not dependent on getting the functional form of the first stage right. In addition, using a non-linear first stage will not generate consistent estimates, unless the model is exactly right. Hence, we use an OLS estimation in our first stage regression, as this should generate consistent results. Thus, the first stage in the 2SLS approach is given by equation 2, which is the regression of our instruments, 'Town', 'Rural' and 'Vacation homes' (and control variables) on DPTAX. The parameters γ_1, γ_2 and γ_3 captures the effect of our instruments on residential property taxation respectively. From our investigation into the effect of each instrument we expect 'Rural' to have a negative effect ($\gamma_2 < 0$) on residential property taxation, while we expect 'Town' and 'Vacation homes' to have a positive effect ($\gamma_1 > 0$, $\gamma_3 > 0$).

$$\widehat{DPTAX}_i = \delta + \gamma_1 Town_i + \gamma_2 Rural_i + \gamma_3 VacationHomes_i + Controls_i + v_i \quad (2)$$

$$MLTP_i = \alpha + \beta \widehat{DPTAX}_i + Controls_i + u_i \quad (3)$$

The second stage is similar to our original OLS regression. However, the dummy variable for residential property taxation is replaced by its fitted value, rather than the observed value. Hence, our second stage is given by equation 3. Where MLTP is school results, DPTAX is residential property taxation, Controls represents the combined effect of the control variables and u is the error term. The parameter β is the key coefficient, which captures the effect of residential property taxation on school results (MLTP-indicator). Previous literature has found property taxation to have a positive effect on school results (Fiva & Rønning, 2008; Mensah et al., 2013). Hence, our hypothesis is that there will be a positive effect of residential property taxation on school results ($\beta > 0$).

5.2 Supplementary analysis - Voter participation

Fiva and Rønning's (2008) primary objective is to determine if "property taxation works as a disciplining device on local school leaders and bureaucrats". Hence, residential property taxation is expected to influence the quality of welfare services through an incentive effect, which arises as the residential property tax is a visible and voluntary tax in the municipalities. The income from residential property taxation directly contribute to the municipal budget, and hence, inhabitants are expected to demand more from the local decision-makers in terms of the quality of the welfare services provided. Due to this fact it is expected that the local decision-makers have an incentive to meet the expectations. The heightened public pressure can be captured through the participation rate in the local election, as this is one way the inhabitants may affect the decision-makers in the municipality. Through conversations with the inhabitants, the politicians have to justify their political decisions to the voters who have the opportunity to punish them (no re-election) or reward them (re-election) (Sandbu, Winsvold & Blåka, 2016). Accordingly, residential property taxation should have a positive impact on the local election participation rate. In this section, we describe the theoretical framework used to estimate the effect of residential property taxation on the voter participation rate in the local election.

Similarly to our main analysis, we use a dummy variable of residential property tax status as the independent variable. Hence, we expect that we have the same endogeneity issues connected to DPTAX. However, as a benchmark for the 2SLS estimations we do employ an OLS approach, which is presented in equation 4, where PR is the voter participation rate, χ is the coefficient of interest, Controls represents the combined effect of control variables presented in section 4.2.5, and ϖ is the error term.

$$PR_i = \varphi + \chi DPTAX_i + Controls + \varpi_i \tag{4}$$

However, the OLS estimation does not take into account the endogeneity issue connected to DPTAX. In order to isolate the effect of residential property taxation on the voter participation rate in the local election, we use a two-stage least squares approach, with two instrument of property taxation, due to the endogeneity issue related to residential property taxation. The instruments 'Town' and 'Vacation

homes' are included based on the same argumentation as in our main analysis. We do not include 'Rural' as an instrument as the rural-urban dimension is expected to have an effect on several municipal and individual voter characteristics that are difficult to control for fully. This differs from the main analysis as we now use a dependent variable that is not robust to unobservable factors connected to the urban-rural dimension. Hence, the exclusion restriction does not hold for 'Rural' as an instrument. Additionally, we expect the explanatory power of 'Rural' on residential property tax to be weak.

The first stage is presented in equation 5, where DPTAX is the fitted value of residential property taxation, 'Town' and 'Vacation homes' are our instruments, the term Controls represents the combined effect of the control variables used in the analysis and ϵ is the error term. Further, we expect the effect of 'Town' and 'Vacation homes' on residential property taxation to be positive ($\mu_1>0$, $\mu_2>0$).

$$\widehat{DPTAX}_i = \lambda + \mu_1 Town_i + \mu_2 VacationHomes_i + Controls_i + \omega_i \quad (5)$$

$$PR_i = \rho + \pi \widehat{DPTAX}_i + Controls + \xi_i \quad (6)$$

The control variables are added in order to correct the problem of omitted variable bias. However, it is likely that we still have not cleared out all omitted variables. Hence, in our second stage, we will additionally measure the voter participation rate as the difference between local and regional election turnout, as suggested by Andersen et al. (2014). As the local and regional elections are conducted at the same time, the difference between the two will clear out any common factors. Hence, we get the second stage presented in equation 6, where PR represents the participation rate in the local election, Turnout, or the difference between the participation rate in the local and regional election, Difference turnout. We expect the effect of DPTAX on voter turnout to be positive (π >0) based on theory and previous literature.

6. Results

In this section, we present the results of the regression analysis presented in the last section and provide a discussion of the main findings. We support our results with empirical evidence from previous studies. Section 6.1 investigate the first stage results from our analysis, and section 6.2 presents our findings from the second stage analysis. In both sections, we compare our results with those of Fiva and Rønning (2008), and provide a discussion of the main findings. In section 6.3, we investigate the results of our analysis of the effect of residential property taxation on the voter participation rate in Norwegian municipalities.

6.1 Main analysis – Student achievement

6.1.1 First stage

Table 6 presents the results from the first stage regression for eleven specifications of our main analysis. Specification (1), (2) and (3) follows the main specifications of Fiva and Rønning (2008), where we investigate the effect of 'Town' and 'Rural' on residential property taxation separately and when used together. In specification (4), we include municipality fixed effects in our analysis. 'Vacation homes' is introduced and used as a single instrument in specification (5) and (6), while specification (7) and (8) presents the first stage regression when instruments 'Town' and 'Vacation homes' are used simultaneously.

We start by considering the specifications based on Fiva and Rønning's (2008) analysis. We find that 'Town' has a substantial positive effect of 0.275 on residential property taxation, which is significant at the 1% level. This result is consistent with our expectations that residential property taxation is historically determined by town status, as well as the findings of Fiva and Rønning (2008). When we use 'Rural' as a single instrument, we find that there is no significant effect on residential property taxation, which is not consistent with the findings of Fiva and Rønning (2008) who found a negative and significant effect. This implies that there might be an issue of relevance connected to this instrument, which can be explained by the rapidly increasing number of small municipalities levying residential property taxation over the last years since Fiva and Rønning's study was conducted. Additionally, this may be due to that the exclusion restriction does not hold, as it is difficult to completely control for the rural-urban dimension. The

effects found when using 'Town' and 'Rural' separately holds when we include both instruments simultaneously in the regression. This suggests that while 'Town' is a valid instrument, we might have issues related to 'Rural' as an instrument in our analysis.

We find it useful to evaluate the explanatory power of 'Town' and 'Rural', as including a weak instrument can give a poor approximation of the 2SLS estimator. If this is the case, then 2SLS is not the appropriate approach to solve the endogeneity problem of the OLS estimation, as the 2SLS estimator can be biased towards the OLS estimate. Hence, 2SLS is no longer reliable if one uses weak instruments (Stock and Watson, 2015). We test for weak instruments using an F-test of the first stage. According to Stock, Wright & Yogo (2002), the critical value of weak instruments is between 9.08 and 11.52. Hence, as a rule of thumb, an F-value of less than 10 is a good estimation for a weak instrument (Stock and Watson, 2015). When considering the F-test of the joint significance of the instruments included, we find that both specifications that include 'Rural' as instrument shows signs of issues with weak instruments. When 'Rural' is included as an instrument in our analysis, we find a p-value of 1.35 and 8.34, which indicates that we have a problem with weak instruments when including 'Rural' in the analysis. Further, we find a p-value between 14.16 and 19.27 when 'Town' is included in the specifications (excluding specification (3)). This implies that the low p-value found when including both 'Town' and 'Rural' in the analysis is due to the low explanatory power of 'Rural' as an instrument, and does not affect 'Town' as an instrument. Hence, we need to be careful to interpret the second stage results as consistent when 'Rural' is included as an instrument.

As an additional control, we include county fixed effects in our analysis in order to adjust for systematic differences between counties that have not been captured by our other control variables or the MLTP-indicator. Such systematic differences could lead to omitted variable bias if they are not accounted for. Specification (4) presents the effect of 'Town' on residential property tax when we include county fixed effects. The effect is slightly lower (0.250) than what we found when county fixed effects were not included. However, the effect is still sizable and statistically significant, which implies that the instrument is robust.

The third instrument, 'Vacation homes' is introduced in specification (5) and (6), where county fixed effects are included in the latter. In both specifications, we find a positive effect on residential property taxation, of 0.085 and 0.095 respectively. The instrument does not seem to have issues related to week instruments, as the p-value of the joint significance test is above 10 for all specifications containing 'Vacation homes' as an instrument. Finally, we present the coefficient estimations when both 'Town' and 'Vacation homes' are included as instruments simultaneously. These results are consistent with what we find when the two instruments are used as single instruments. This strengthens our conviction of the validity of 'Town' and Vacation homes' as instruments in our analysis.

We find it useful to consider the magnitude of which our instruments affect residential property taxation. We find that historical town status increases the probability of levying residential property taxation by an average of about 26% (between 23.6%-27.5%). We find this effect to be large and hence that 'Town' is a highly relevant instrument in our analysis. Further, we find that a 50% increase in the logged number of vacation homes gives an increase in the probability of levying residential property taxation of around 4.30% (between 3.95%-4.75%). We find this to be a sizable effect of the instrument, as we expect vacation homes to account for only a relatively small part of residential property tax income.

Table 6. First stage estimations: Historical town status (1911-1995), current settlement pattern, the logged number of vacation homes and the probability of levying residential property taxation

Specification	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Town	0.275***		0.266***	0.250**			0.261***	0.236**
	(0.101)		(0.102)	(0.104)			(0.101)	(0.103)
Rural		-0.199	-0.157					
		(0.172)	(0.171)					
Vacation homes					0.085**	0.095**	0.079**	0.089**
					(0.035)	(0.037)	(0.035)	(0.038)
Teacher hours per student	0.002***	0.002***	0.002***	0.001	0.002***	0.002*	0.002***	0.001*
	(0.001)	(0.001)	(0.001)	(0.007)	(0.001)	(0.001)	(0.001)	(0.001)
Lnpop	0.211***	0.212***	0.185***	0.203***	0.224***	0.206***	0.192***	0.172***
	(0.059)	(0.065)	(0.065)	(0.059)	(0.058)	(0.058)	(0.059)	(0.060)
Number of students	0.091	0.109	0.099	0.149**	-0.235	-0.036	-0.248*	-0.053
	(0.071)	(0.071)	(0.071)	(0.076)	(0.148)	(0.148)	(0.147)	(0.147)
Number of students ^2/1000	-0.018	-0.022	-0.019	-0.028*	0.022	-0.005	0.026	-0.002
	(0.015)	(0.015)	(0.015)	(0.016)	(0.023)	(0.022)	(0.022)	(0.022)
Share women	-3.479**	-3.752**	-3.789**	-2.891*	-3.091*	-2.319	-3.229**	-2.530
	(1.623)	(1.673)	(1.659)	(1.597)	(1.631)	(1.600)	(1.618)	(1.592)
Unemployment	-0.116	-0.113	-0.127	-0.076	-0.072	-0.025	-0.090	-0.034
	(0.100)	(0.102)	(0.101)	(0.101)	(0.101)	(0.103)	(0.100)	(0.102)
Divorce	-0.198**	-0.176**	-0.198**	-0.138*	-0.172**	-0.106	-0.194**	-0.126
	(0.078)	(0.078)	(0.078)	(0.078)	(0.078)	(0.078)	(0.077)	(0.058)
	(0.056)	(0.057)	(0.057)	(0.058)	(0.056)	(0.058)	(0.056)	(0.057)
Age 21-40	-2.846	-2.317	-3.037	-0.368	-2.019	0.973	2.785	0.052
	(2.660)	(2.677)	(2.669)	(2.785)	(2.649)	(2.759)	(2.644)	(2.771)
Age 41-60	-3.155	-3.609	-3.728*	-0.533	-3.715*	-0.418	-3.858*	-0.994
	(2.251)	(2.277)	(2.258)	(2.545)	(2.259)	(2.539)	(2.241)	(2.771)

Age 61-80	-3.156	-3.158	-3.163	-1.094	-2.935	-0.309	-2.955	-0.909
	(2.256)	(2.276)	(2.257)	(2.389)	(2.264)	(2.375)	(2.245)	(2.374)
Age 81	-4.167	-2.493	-3.591	-1.157	-4.047	-1.249	-4.922	-2.135
	(3.579)	(3.641)	(3.635)	(3.899)	(3.587)	(3.899)	(3.574)	(3.894)
R-squared	0.176	0.161	0.178	0.300	0.172	0.301	0.188	0.312
Observations	402	402	402	402	402	402	402	402
County fixed effect	NO	NO	NO	YES	NO	YES	NO	YES
Joint significance of instruments, F-test (p-value)	18.28	1.35	8.34	19.27	13.44	13.12	14.76	14.16
Estimation method	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS

The dependent variable is a dummy for residential property taxation, DPTAX.
Note: Included in the regression, but not reported, is a constant term.
*Significance level is shown by *** p<0.01, ** p<0.05, * p<0.1.*

6.1.2 Second stage

Table 7 presents the second stage results of our analysis of the effect of residential property taxation on school results. Specification (i) presents the standard OLS regression, ignoring the potential endogeneity problem related to residential property taxation. Specification (1)-(8) corresponds to the specifications described in our first stage analysis. The simple OLS model provides a positive coefficient of residential property taxation (0.025). However, this effect is not statistically significant at any traditional level of significance. This may be the first indication that the effect of residential property taxation on school results is not present, which is not in line with previous literature such as Fiva and Rønning's (2008) study. However, as the OLS estimation does not take into account the potential endogeneity issue connected to our key explanatory variable, residential property taxation, we need to investigate the results from the 2SLS approach.

First, we consider the estimates that correspond to the estimation design of Fiva and Rønning (2008). When 'Town' is used as a single instrument, we find that there is a positive effect of residential property taxation on school results of 0.226, which is significant at the 5% level. An increase of 0.226 corresponds to about a two standard deviation increase in residential property taxation. We find that the incentive effect of residential property taxation leads to an increase of one grading point for about one out of nine students, compared to about one out of five students in Fiva and Rønning's (2008) study. This implies that we find a weaker effect of residential property taxation on school results. Further, when we use both 'Town' and 'Rural' as instruments we find a positive effect of residential property taxation, which is in line with Fiva and Rønning's findings and support the theoretical framework considered in this thesis. When 'Rural' is included as a single instrument, we find that there is no effect of residential property taxation on school results. However, the first stage estimations revealed that 'Rural' is a weak instrument in our analysis, and hence that the second stage results we find when including this instrument should be interpreted with caution. Thus, we exclude it from the rest of our analysis.

Further, we investigate if Fiva and Rønning's results hold when we include county fixed effects in our analysis where residential property taxation is instrumented by 'Town'. We find that there is no effect on school results in this case, which implies that the results of Fiva and Rønning are not robust to controlling for systematic differences between counties. We find this to be a weakness of their study. The robustness of Fiva and Rønning's results are also tested when we introduce the instrument 'Vacation homes' in our analysis. In all specifications where 'Vacation homes' is included, we find that there is no effect of residential property taxation on school results. We believe these results increase the uncertainty of the validity of Fiva and Rønning's main finding of a positive effect of residential property taxation on school results.

When considering the second stage findings in our main analysis, we believe that the difference in our findings compared to Fiva and Rønning's is not caused by the use of a more accurate measure of school results, i.e., the MLTP-indicator. In fact, Fiva and Rønning's results hold when we use the same setup and 'Town' as a single instrument. However, we find that 'Rural' is a weak instrument that should not be included in the analysis. Further, we find evidence that their analysis is not robust to changes in the regression design. This is apparent when we include county fixed effects and add 'Vacation homes' as a new and valid instrument. Hence, we believe that these results indicate that there is no effect of residential property taxation on school results in our sample.

Although we find no effect of residential property taxation on school results in most specifications, the point estimates of DPTAX does have quite large standard errors. Hence, we cannot completely rule out a positive effect of residential property taxation on school results, as found by Fiva and Rønning (2008). However, we cannot rule out a negative effect either. Thus, in the next section, we will test the underlying hypothesis of residential property taxation working as a disciplining device, through a higher participation rate in the local election. We believe this will provide insight into the robustness of the findings in our main analysis.

Table 7. Second stage estimations: The effect of residential property taxation on school results

Specification	(i)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
DPTAX	0.025	0.226**	0.459	0.259*	0.203	-0.101	-0.009	0.082	0.094
	(0.018)	(0.111)	(0.477)	(0.123)	(0.125)	(0.133)	(0.117)	(0.093)	(0.084)
Teacher hours per student	-0.003	-0.007*	-0.001	-0.008*	-0.002	-0.007	-0.001	-0.004	-0.001
	(0.003)	(0.004)	(0.001)	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)
lnpop	-0.032	-0.084**	-0.143	-0.092**	-0.084**	-0.004	-0.033	-0.047	-0.058*
	(0.019)	(0.039)	(0.128)	(0.043)	(0.042)	(0.036)	(0.032)	(0.030)	(0.029)
Number of students	-0.027	-0.057	-0.052	-0.055*	-0.066	-0.027	-0.035	-0.040	-0.054
	(0.023)	(0.036)	(0.042)	(0.033)	(0.041)	(0.024)	(0.035)	(0.026)	(0.037)
Number of students ^2/1000	0.007	0.013*	0.012	0.013*	0.014*	0.007	0.009	0.010*	0.012
	(0.005)	(0.007)	(0.009)	(0.007)	(0.008)	(0.005)	(0.007)	(0.006)	(0.007)
Share women	0.519	1.208	2.004	1.321	1.056	0.088	0.462	0.715	0.751
	(0.546)	(0.832)	(1.023)	(0.868)	(0.742)	(0.732)	(0.610)	(0.626)	(0.615)
Unemployment	-0.005	1.208	0.042	0.021	0.039	-0.018	0.024	0.001	0.031
	(0.034)	(0.832)	(0.068)	(0.043)	(0.045)	(0.044)	(0.044)	(0.035)	(0.042)
Divorce	-0.008	0.031	0.077	0.038	0.014	-0.033	-0.016	0.003	-0.001
	(0.026)	(0.037)	(0.099)	(0.039)	(0.033)	(0.038)	(0.031)	(0.032)	(0.028)
	(0.019)	(0.024)	(0.052)	(0.025)	(0.023)	(0.025)	(0.023)	(0.021)	(0.022)
Age 21-40	0.366	0.738	1.167	0.798	0.589	0.132	0.814	0.471	0.705
	(0.896)	(1.007)	(1.669)	(1.059)	(1.051)	(0.957)	(0.944)	(0.906)	(0.963)
Age 41-60	0.657	1.306	2.056	1.412	0.560	0.250	0.691	0.841	0.627
	(0.764)	(0.927)	(1.950)	(0.981)	(0.957)	(0.997)	(0.891)	(0.813)	(0.891)
Age 61-80	0.113	0.775	1.539	0.883	0.566	-0.302	0.455	0.299	0.509
	(0.758)	(0.914)	(1.989)	(0.956)	(0.928)	(0.971)	(0.823)	(0.810)	(0.842)
Age 81	1.109	1.433	1.809	1.487	0.531	0.905	0.794	1.201	0.666
	(1.218)	(1.419)	(2.098)	(1.483)	(1.453)	(1.424)	(1.345)	(1.218)	(1.335)

Observations	402	402	402	402	402	402	402	402	402
Instrument(s) for DPTAX		Town	Rural	Town, Rural	Town	Vacation homes	Vacation homes	Town, Vacation homes	Town, Vacation homes
County fixed effect	NO	NO	NO	NO	YES	NO	YES	NO	YES
Sargan's test (p-value)				0.199				0.363	0.544
Estimation method	OLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS

The dependent variable is the municipality-level test performance (MLTP) indicator.
Note: Included in the regression, but not reported, is a constant term.
*Significance level is shown by *** p<0.01, ** p<0.05, * p<0.1.*

6.2 Supplementary analysis - Voter participation

In this section, we present the results of the analysis of the effect of residential property taxation on the voter participation rate. The first stage regressions are reported in appendix 4, where specification (1) and (2) presents the analysis when Town is used as a single instrument, specifications (3) and (4) when 'Vacation homes' is used as a single instrument and the last two specifications where we have used both instruments. We find the results to be quite similar to the first stage in our main analysis, as is expected due to the stability over time of the variables included and the fact that we include several of the same instruments. Overall, we find a positive effect of our two instruments in all specifications, which are statistically significant. Furthermore, we find that we have no issues related to weak instruments, as the specifications containing 'Town' as an instrument has a p-value ranging from 14.07 to 20.62, which clearly is well above the threshold of weak instruments. Further, specifications containing 'Vacation homes' has a p-value ranging from 12.33 and 15.93, which is above all critical values of weak instruments as well. Hence, we believe that the instruments are valid and have a high degree of explanatory power on our dependent variable, DPTAX. We find a slightly stronger effect of 'Town' in this analysis compared to the main analysis, while the effect of 'Vacation homes' is somewhat lower. Town status increases the probability of having residential property taxation by about 28% on average (between 26.5%-29.5%) compared to an average of about 26% in our main analysis. Hence, we find the effect of 'Town' on residential property tax to be strong. Further, we find that a 50% increase in the logged number of vacation homes increases the probability of levying residential property taxation by around 2.60% (between 2.45%-2.80%) compared to around 4.30% in our main analysis. This change is a relatively large change and may be caused by the fact that there were fewer vacation homes on average in 2010 than in 2012, as well as the use of a different set of control variables.

The second stage analysis is presented in table 8, where specification (i) and (ii) represents the OLS estimation of residential property taxation on the voter participation rate in the local election, and the difference between the voter participation rate in the local and regional election respectively. The OLS

estimations are used as a benchmark for the 2SLS results. Specification (1)-(6) presents the second stage results corresponding to the specifications in our first stage when Turnout is used as the dependent variable. Specification (7)-(16) corresponds to the same first stage results; however, the dependent variable used in this case is Difference turnout. We start by considering the results found when using Turnout as the dependent variable. The OLS estimation gives a negative coefficient of -0.001 on the voter participation rate in the local election. However, the effect is not statistically significant. This is the first indication that there is no effect of residential property taxation on the voter participation rate. When instrumenting DPTAX by either instrument or both, we find a small positive coefficient of residential property taxation on Turnout; however, the effect is not significant. This is also the case when we include county fixed effects in our analysis. However, when Turnout is used as the dependent variable, we cannot rule out that we have an endogeneity problem, due to omitted variable bias, and hence we should be careful when interpreting the results. We hope to account for this bias by employing Difference turnout as our dependent variable. The measure of the difference between the participation rate in the local and regional election should clear out any common factors in the two elections. The OLS estimation gives a (close to zero) negative coefficient of DPTAX, which is not statistically significant. When we use 'Town' and 'Vacation homes' both as single instruments and together, we again find no effect of residential property taxation. These results hold when we include county fixed effects in the analysis.

These findings suggest that there is no effect of residential property taxation on the voter participation rate in the local election, which implies that the underlying assumption of our main analysis does not hold. Hence, we find that this result adds to the robustness of our main finding, that residential property taxation does not affect student achievement and further questions the validity of Fiva and Rønning's (2008) result. Although the point estimates have such standard errors that we cannot completely exclude the possibility of either a positive or negative effect of residential property taxation on the voter participation rate. However, if this is the case, the magnitude of our estimates are so small that we would not expect them to be sufficient to create an incentive effect for local bureaucrats to improve the quality of the public sector.

Table 8. Second stage: The effect of residential property taxation on the voter participation rate

Specification	(i)	(1)	(2)	(3)	(4)	(5)	(6)	(ii)	(7)	(8)	(9)	(10)	(11)	(12)
DPTAX	-0.001	0.001	0.014	0.096	0.045	0.026	0.025	-0.004	-0.008	0.016	0.035	-0.008	0.003	0.008
	(0.004)	(0.019)	(0.022)	(0.068)	(0.039)	(0.019)	(0.018)	(0.003)	(0.017)	(0.019)	(0.047)	(0.037)	(0.015)	(0.015)
lnpop	-0.025***	-0.026***	-0.031***	-0.042***	-0.037***	-0.029***	-0.032***	-0.019***	-0.019***	-0.028***	-0.027***	-0.023***	-0.021***	-0.026***
	(0.003)	(0.005)	(0.005)	(0.013)	(0.009)	(0.005)	(0.005)	(0.002)	(0.004)	(0.005)	(0.009)	(0.008)	(0.004)	(0.005)
Eligible voters	0.169*	0.171*	0.094	0.286	0.112	0.201*	0.100	0.085	0.081	0.070	0.132	0.056	0.094	0.065
	(0.101)	(0.104)	(0.096)	(0.181)	(0.111)	(0.109)	(0.099)	(0.091)	(0.102)	(0.104)	(0.140)	(0.106)	(0.106)	(0.103)
Recent immigration	0.004	0.004	0.002	0.014	0.002	0.007	0.001	0.008**	0.008*	0.004	0.012*	0.004	0.009**	0.004
	(0.004)	(0.005)	(0.005)	(0.010)	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)	(0.004)	(0.007)	(0.004)	(0.004)	(0.004)
Share women	-0.227**	-0.223**	-0.236**	-0.099	-0.223*	-0.192*	-0.232**	0.196**	0.191	0.207	0.247	0.197	0.205	0.204
	(0.099)	(0.108)	(0.108)	(0.183)	(0.119)	(0.111)	(0.109)	(0.090)	(0.137)	(0.138)	(0.155)	(0.138)	(0.137)	(0.137)
Unemployment	-0.001	-0.001	0.001	0.002	0.001	-0.001	0.001	0.003	0.003	0.009	0.005	0.009	0.004	0.009
	(0.007)	(0.007)	(0.008)	(0.012)	(0.008)	(0.008)	(0.007)	(0.006)	(0.007)	(0.008)	(0.009)	(0.007)	(0.007)	(0.007)
Divorce	0.016***	0.017**	0.011*	0.037**	0.015**	0.022***	0.012**	0.006	0.005	0.004	0.014	0.002	0.008	0.004
	(0.005)	(0.007)	(0.006)	(0.016)	(0.007)	(0.007)	(0.006)	(0.005)	(0.006)	(0.005)	(0.011)	(0.007)	(0.006)	(0.005)
Lower secondary	-0.416***	-0.416***	-0.458***	-0.433***	-0.464***	-0.420***	-0.461***	0.161***	0.161***	0.066	0.154***	0.070*	0.159***	0.067
	(0.046)	(0.044)	(0.046)	(0.080)	(0.054)	(0.048)	(0.048)	(0.042)	(0.040	(0.042)	(0.053)	(0.042)	(0.042)	(0.042)
Upper secondary	-0.354***	-0.353***	-0.422***	-0.359***	-0.459***	-0.355***	-0.434***	0.021	(0.021	0.007	0.018	0.036	0.021	0.016
	(0.058)	(0.049)	(0.068)	(0.104)	(0.087)	(0.056)	(0.069)	(0.052)	(0.059)	(0.073)	(0.076)	(0.078)	(0.061)	(0.069)
Age 21-40	-0.354*	-0.354**	-0.384*	-0.379	-0.491**	-0.361**	-0.419**	0.362**	0.363*	0.365**	0.352	0.447**	0.361*	0.392**
	(0.185)	(0.169)	(0.198)	(0.298)	(0.239)	(0.185)	(0.194)	(0.167)	(0.191)	(0.184)	(0.217)	(0.215)	(0.193)	(0.178)
Age 41-60	-0.522***	-0.521***	-0.458**	-0.485	-0.561**	-0.512***	-0.492**	0.122	0.121	0.126	0.137	0.205	0.125	0.152
	(0.185)	(0.168)	(0.208)	(0.305)	(0.261)	(0.184)	(0.212)	(0.168)	(0.168)	(0.179)	(0.191)	(0.223)	(0.167)	(0.179)
Age 61-80	-0.023	-0.022	0.042	0.008	-0.010	-0.015	0.023	0.069	0.067	-0.021	0.082	0.018	0.071	-0.008
	(0.169)	(0.181)	(0.187)	(0.272)	(0.207)	(0.186)	(0.187)	(0.154)	(0.186)	(0.175)	(0.212)	(0.185)	(0.188)	(0.174)
Age 81	0.963***	0.964***	0.738**	1.031**	0.643*	0.981***	0.707**	0.643***	0.640***	0.470**	0.669**	0.542**	0.647***	0.494**
	(0.0254)	(0.266)	(0.187)	(0.475)	(0.377)	(0.297)	(0.321)	(0.229)	(0.222)	(0.228)	(0.272)	(0.239)	(0.225)	(0.217)
Median income	0.004***	0.004***	0.003***	0.007***	0.003***	0.005***	0.003***	0.006	0.005	-0.008	0.002	-0.009	0.009	-0.008
	(0.001)	(0.001)	(0.001)	(0.003)	(0.001)	(0.001)	(0.001)	(0.006)	(0.009)	(0.007)	(0.002)	(0.007)	(0.008)	(0.006)

Observations	402	402	402	402	402	402	402	402	402	402	402	402	402	402
Dependent variable	Turnout	Turnout	Turnout	Turnout	Turnout	Turnout	Turnout	Difference turnout	Difference turnout	Difference turnout	Difference turnout	Difference turnout	Difference turnout	Difference turnout
Instrument(s) for DPTAX		Town	Town	Vacation homes	Vacation homes	Town, Vacation homes	Town, Vacation homes		Town	Town	Vacation homes	Vacation homes	Town, Vacation homes	Town, Vacation homes
County fixed effect	NO	NO	YES	NO	YES	NO	YES	NO	NO	YES	NO	YES	NO	YES
Sargan's test (p-value)						0.525	0.567						0.315	0.551
Estimation method	OLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	OLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS

Note: Included in the regression, but not reported, is a constant term.
*Significance level is shown by *** p<0.01, ** p<0.05, * p<0.1.*

7. Sensitivity

Although we find that the two analysis provided give consistent results, which is an indication that our results are robust, we find it useful to perform several other sensitivity checks. We will investigate the exclusion restriction for the three instruments used in the analyses in section 7.1. In section 7.2, we will investigate the role of resource use, and in section 7.3, we investigate if using cross-sectional data for fifth grade student achievement as dependent variable will alter the results of our analysis.

7.1 Empirical investigation of the exclusion restriction

7.1.1 Main analysis – Student achievement

The validity of our identification strategy relies on the assumption that our instruments, 'Town', 'Rural' and 'Vacation homes', are only related to school results through residential property taxation. In order to ensure that this is the case, we use the Sargan's instrument validity test on all specifications of our main analysis that is overidentified. The test fails to reject the null hypothesis for all specifications of the main analysis (Table 7). However, as it is known that the Sargan overidentification test may have low power in some settings, we additionally perform an empirical analysis of the validity of our instruments. We divide our sample according to residential property tax status and perform the following regression:

$$MLTP_i = a + bTown_i + cRural_i + dVacationHomes_i + Controls + e_i \quad (7)$$

Where b, c and d are the coefficients of interest, Controls represents the combined effect of our control variables and e is the error term. If the exclusion restriction holds, then our instruments should not have any effect on school results when we have divided our sample according to residential property tax status. Appendix 5a presents the results from the two regressions. We find that 'Town' and 'Vacation homes' does not have an effect on school results in any of the two samples; hence the exclusion restriction holds for these two instruments. However, this is not the case for the instrument 'Rural', as we find that the instrument has a negative and significant effect on school results in the sample that levy residential property taxation. Hence, we find that the exclusion restriction does not hold for 'Rural' as

an instrument and the results found when including 'Rural' as an instrument should not be considered valid.

7.1.2 Supplementary analysis - Voter participation

We find it useful to use the same method in order to test the validity of the results found in the analysis of the effect of residential property taxation on the local voter participation rate. Table 8 displays the p-values of Sargan's instrument validity test. We find that the test does indicate that the exclusion restriction holds for our two instruments. However, we do perform the same analysis as described above in order to validify this conclusion. We divide our sample according to residential property tax status and perform the following regression:

$$PR_i = f + gTown_i + hVacationHomes_i + Controls + j_i \quad (8)$$

Where g and h are the coefficients of interest, Controls are the combined effect of the control variables included in the analysis and j is the error term. The results from this regression analysis are reported in Appendix 5b. Firstly, we consider the case where the voter participation rate in the local election is used as dependent variable. We find that 'Town' and 'Vacation homes' does not have a significant effect on the dependent variable regardless of residential property tax status. When we use the difference between the local and regional participation rate as dependent variable, we come to the same conclusion, that 'Town' and 'Vacation homes' does not have a significant effect on the voter participation rate in the local election when we condition on the choice of residential property taxation. Hence, we conclude that the exclusion restriction holds for the two instruments in the supplementary analysis of the effect of residential property taxation on the participation rate in the local election of 2011.

7.2 Investigation into the role of resource use

Based on the analysis of Fiva and Rønning (2008) we have used teacher hours per student as a measure of the resource use in the school sector, and find predominantly results that suggest no effect on school results. However, it might be so that the income from residential property taxation leads to increased spending in the public school sector that the variable teacher hours per student does not capture. Hence, we would like to investigate the robustness of our results when we use the share of total municipal cost used in the school sector as measure of resource use in the analysis, which is analogous to the use of expenditure per student used as a sensitivity check in the analysis of Fiva and Rønning (2008). Appendix 6 presents the second stage results of our main analysis when we test if the use of an alternate measure of resource use changes the results of our analysis, where we only include 'Town' and 'Vacation homes' as instruments. When we include the share of the total costs used in the school sector as a measure in our analysis, we find that the results are essentially unaltered. We find that when 'Town' is used as a single instrument the effect of residential property taxation on school results are positive (0.287) and significant. When we include 'Vacation homes' as an instrument, we find no effect of residential property taxation. These results are consistent with the results from our main analysis, which implies that the new measure of resource use does not alter our results. This is caused by the fact this measure does not have a significant effect on school results, which is expected as multiple studies have shown that resource use does not have an effect on student achievement (Hanushek, 2002; Woessmann, 2010; Hanushek & Woessmann, 2011).

However, we find that expenditure per student is an endogenous variable as the resource use is determined by the local government. Hence, it is possible that this control variable does not capture the causal effect of resource use on student performance. In an effort to solve this issue, we use a control of free income per capita as a measure, as we believe that an increase in free income will create an increase in public sector spending as a whole, including the education sector. Although the local government can choose the tax level (within the bounds of the law) in the municipality, it is fair to say that it does not determine the income of its inhabitants. In addition, government grants adjust for such differences in an effort to smooth welfare across municipalities. Hence, we believe that this variable is as

good as exogenous in our analysis. Further, we believe that free income has a negative effect on residential property taxation, as municipalities with low free income will have an incentive to levy residential property taxation. This is confirmed in our first stage analysis (not reported). When we use free income per capita as a measure, we confirm the main findings of our main analysis. However, we do not find a statistically significant effect of residential property taxation when 'Town' is used as a single instrument, as free income has a significant negative effect on residential property taxation. This may indicate that teacher hours per student does not capture resource use in the educational sector completely, which may be a weakness of Fiva and Rønning's (2008) findings. For all other specifications we reaffirm the results of our main analysis, of that there is no effect of residential property tax.

Further, we investigate if the effect of resource use is affected by the cost structure in the municipality, by interacting our two measures of student size with teacher hours per student. These measures should account for differences in the costs related to the production of the educational services. We find that the interaction term between the number of students and teacher hours per student has a positive effect in two out of three specifications. This implies that resource use is increasing in the number of students enrolled in the school district. However, we find that including these interaction terms does not alter the results presented in this thesis. Hence, we believe that our results are robust to using several measures of resource use.

7.3 Fifth grade student achievement

Steffensen et al. (2017) have shown that student achievement has a higher dependence on school quality and parental guidance the younger the student. Hence, we would like to test if our results are consistent when using a measure of student achievement at the fifth-grade level. This implies that we use a cross-sectional data MLTP-indicator, rather than a value-added indicator. The cross-sectional data indicator is strongly positively correlated with unadjusted school results of 0.90, compared to the tenth-grade value-added indicator that has a correlation with unadjusted results of 0.60 (Steffensen et al. (2017). This implies

that the value-added indicator takes into account unobservable factors such as student motivation and ability, which may give this analysis a different result compared to the main analysis as we use cross-sectional data.

We employ the same two-stage least squares approach as we did when using results from the tenth grade in our main analysis, and hence the first stage regression is the same as reported in our main analysis (Table 6). The second stage results are presented in appendix 7, where the specifications presented correspond to the specifications in the main analysis. When we include 'Town' as a single instrument, we find that there is a negative, but not significant effect of residential property taxation on school results. The fact that we do not find a significant effect of DPTAX in this specification, and that we did find a positive effect in our main analysis may be due to the fact that the measure of fifth grade school results only take into account students' family characteristics of parents' education level, household income and immigrate background. This differs from the value-added measure of tenth-grade results. Further, the cross-sectional measure of school results used by Fiva and Rønning (2008) takes into account a richer set of students' family characteristics than what is used in the fifth grade MLTP-indicator. Hence, this fifth-grade analysis may be biased towards the unadjusted results.

Further, we do not find an effect of residential property taxation on school results regardless of what instrument(s) that are used in the analysis or whether county fixed effects are included. This supports the findings of our main analysis and is a strength to our analysis. In addition, these findings make us question the robustness of Fiva and Rønning's results further. It should be noted that we do have somewhat large standard error connected to the point estimates of residential property taxation on school results; hence, it is possible that the results are either positive or negative. We find that the effect in such case would likely be negative due to that we find negative estimates in all but two specifications. However, we do not emphasize this as the results may be biased towards the unadjusted school results.

8. Conclusion

Previous studies have found that one reason for public sector inefficiency is the lack of incentives for bureaucrats to behave in an efficient manner (Burgess & Ratto, 2003; Erkoc, 2013). This introduced the need to investigate tools that create incentives in this sector. Hence, in this thesis, we investigate the relationship between residential property taxation and student achievement in the public school system in Norway, in order to understand to what degree residential property taxation can affect quality in the public sector (Fiva & Rønning, 2008). We use a well-suited dataset that is based on the Norwegian school system and municipal structure in order to estimate our main model. The measure of school results, the MLTP-indicator, is of particular interest, as a value-added measure has not been used in previous related literature. This reduces omitted variable bias caused by unobserved student characteristics, by taking into account students' previous results and thus aim to capture the causal effect of residential property taxation on school results.

Our main findings suggest that students living in a municipality that levy residential property taxation do not achieve better results at the national exam than their peers in municipalities that do not levy residential property taxation. In fact, there seems to be no difference in student achievement caused by the municipalities' residential property tax status when we consider the combined findings of this thesis. We use a two-stage least squares framework with three instruments in the analysis. We do find that there is a positive effect when we use 'Town' as a single instrument, which is in line with the findings of Fiva and Rønning (2008). This implies that the improved measure of school results, the MLTP-indicator, does not alter the results of Fiva and Rønning. However, the positive result found when using 'Town' as a single instrument does not hold in the remainder of our analysis, which implies that several aspects affect the robustness of Fiva and Rønning's findings. Firstly, we find that the instrument 'Rural' is an invalid instrument, as the exclusion restriction does not hold. This is because it is close to impossible to control for every aspect connected to the rural-urban dimension. In addition, we find that 'Rural' has low explanatory power on DPTAX, which may be due to an increasing number of small municipalities choosing to levy residential property tax over time since the study of Fiva and Rønning (2008) was conducted. Further, we find that the results of Fiva

and Rønning do not hold when we include county fixed effects or when we use free income per capita as a measure of resource use in the municipalities. Finally, when including the instrument 'Vacation homes,' we find that there is no effect of residential property taxation. Additionally, we perform the same analysis for fifth-grade student results, which is a cross-sectional indicator. We find that there is no effect of residential property taxation on school results, which is in line with the results of our main analysis and further support the findings of no effect of residential property taxation on school results.

Moreover, we test the underlying hypothesis that residential property taxation affects the quality of welfare services provided in the municipalities through an incentive effect. We use the participation rate in the local election as a measure of the public pressure induced by residential property taxation. Our results are consistent when using both the OLS and 2SLS estimation methods, and we find that there is no effect of residential property taxation on the voter participation rate in the local election of 2011. This is consistent with the results from our main analysis as we find that there is no incentive effect of residential property tax and hence no effect on student achievement. We find that these results provide a good source of robustness for both analyses. Hence, we believe that we have found evidence suggesting that there is no effect of residential property taxation on school results. We believe that this thesis has provided sufficient evidence that the results presented are robust for a number of factors.

In this thesis, we have investigated the effect of residential property taxation on the quality of the public school system in Norway and found no effect. However, our results may not be representative for the quality of welfare services provided by the municipalities as a whole. Hence, it may be worthwhile investigating if there is an effect of property taxation in other sectors of the public welfare system in order to discover the complete effect of residential property taxation on the welfare services provided by the municipalities and through what channel the potential effect works. However, this is dependent on the quality and availability of the measures. Further, an investigation into incentives of other means of public income is an important ground for further research, which might contribute to the efficiency and quality of the public sector welfare services.

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Appendices

Appendix 1. Data description and sources

Table A1: Overview of variables used in the analysis

Variable	Description	Source	Analysis
Dependent variables			
MLTP-indicator	Value-added indicator that measures the students' results at primary school level and lower secondary school level.	SSB publication Report 2017/02	M
Turnout	The voter participation rate in the local election of 2011.	FHN	S
Difference Turnout	The difference between the local and regional voter participation rate.	NSD	S
Independent variable			
DPTAX	Dummy variable for residential property taxation. Equals 1 if the municipality levy property taxation and 0 otherwise.	SSB table 12120	M, S
Instrument variables			
Town	Dummy variable for whether the municipality had town status between 1911 and 1995. Equals 1 if the municipality had town status and 0 otherwise.	FR	M, S
Vacation Homes	The logged number of vacation homes in the municipalities.	SSB table 05467	M, S
Rural	Share of the population in the municipality living in rural areas.	SSB table 05212	M
Control variables			
Teacher hours per student	The number of teacher hours per student.	SSB table 12285	M
Number of students	The number of students in the municipality.	SSB publication Reports 2017/02	M
Number of students ^2/1000	The number of students in the municipality squared and divided by 1000.	SSB publication Reports 2017/02	M
Share Expenditure education	The costs of education as share of the municipalities' total costs based on the variables Total_education and Total from FHN.	FHN	M

Free income	The municipalities' free revenues, which is income and wealth tax revenues, and government grants. In NOK per capita	SSB table 09397	M
Eligible voters	The share of the population eligible to vote in the election of 2011	NSD	S
Lower secondary	Share of the population (16 and older) whose highest education level is lower secondary school.	SSB table 09429	S
Upper secondary	Share of the population (16 and older) whose highest education level is upper secondary school.	SSB table 09429	S
Recent Immigration	Share of immigrants in 2010 relative to the size of the population in the municipality	NSD	S
Median income	Median income in the municipality for person 18 years and older. In 1000 NOK.	SSB table 06944	S
lnpop	The logged number of inhabitants in the municipality	FHN	M, S
Divorce	The share of divorces and separations in the municipalities	SSB table 09660	M, S
Unemployment	Unemployment rate (yearly average)	FHN	M, S
Share women	The female share of the municipality's population	FHN	M, S
County fixed effects	i.cnr - County identifier. Analogous to European Statistical Office NUTS 3 level.	FHN	M, S
Age 21-40	Share of population aged 21 to 40	FHN	M, S
Age 41-60	Share of population aged 41 to 60	FHN	M, S
Age 61-80	Share of population aged 61 to 80	FHN	M, S
Age 81	Share of population aged 81 and higher	FHN	M, S

Note: M and S indicates what analysis that variable has been used in, Main or Supplementary analysis respectively.
FR – Fiva and Rønning (2008)
SSB – Statistic Norway's Statbank
FHN – 'Local Government Dataset' (Fiva, Halse & Natvik, 2017)
NSD – Norwegian Social Science Services database

Appendix 2. Data sample

In 2015, there were 428 municipalities in Norway. We have dropped 26 municipalities from our sample due to three reasons. Firstly, there was missing data for the MLTP-indicator for 21 municipalities. The reason is that these municipalities had less than 20 students in the tenth grade in 2015, and hence the indicator was not created for these school districts due to too small samples. The municipalities with less than 20 students are listed below.

Table A2a. Missing value of the MLTP-indicator

0829 Kviteseid
1233 Ulvik
1412 Solund
1422 Lærdal
1424 Årdal
1613 Snillfjord
1630 Åfjord
1636 Meldal
1665 Tydal
1740 Namsskogan
1749 Flatanger
1811 Bindal
1856 Røst
1857 Værøy
1928 Torsken
1929 Berg
2011 Guovdageaidnu Kautokeino
2014 Loppa
2017 Kvalsund
2023 Gamvik
2024 Berlevåg

Next, 0301 Oslo is dropped as it is both a municipality and county. Further, it is the norm that when municipalities merge or split they get a new identifying number. In our sample, four municipalities have merged into to new municipalities during the time period 2010 to 2015. These municipalities create a gap in our sample and hence we have decided to drop these municipalities, which are listed in table A2b.

Table A2b. Municipalities that have merged between 2010 and 2015

1901 Harstad and 1915 Bjarkøy	1903 Harstad
1723 Mosvik and 1729 Inderøy	1756 Inderøy

Appendix 3. Correlations

Appendix 3a and 3b we present the correlations between the dependent, independent and instruments variables, in the main and supplementary analysis respectively.

Appendix 3.a. Main analysis – Student achievement

Table A3a. Correlation matrix of key variables in the main analysis

	MLTP-indicator	DPTAX	Town	Rural	Vacation homes
MLTP-indicator	1.000				
DPTAX	0.060*	1.000			
Town	0.101*	0.219**	1.000		
Rural	-0.026	-0.114*	-0.146***	1.000	
Vacation homes	-0.023	0.176***	0.157**	-0.036	1.000

*Note: DPTAX, Rural and Vacation homes are measured in 2012. The MLTP-indicator consist of school results from the school year 2014/2015 adjusted for students previous results in 2012/2013. Significance level is shown by *** p<0.01, ** p<0.05, * p<0.1.*

Appendix 3b. Supplementary analysis – Voter participation

Table A3b. Correlation matrix of main key variables in the supplementary analysis

	Turnout	Difference turnout	DPTAX	Town	Vacation homes
Turnout	1.000				
Difference turnout	0.350***	1.000			
DPTAX	-0.240***	-0.214***	1.000		
Town	-0.251***	-0.277***	0.281***	1.000	
Vacation homes	-0.054	-0.111*	0.213***	0.166***	1.000

*Note: DPTAX and Vacation homes are measured in 2010, Turnout and Difference turnout are measured in 2011. Significance level is shown by *** p<0.01, ** p<0.05, * p<0.1.*

Appendix 4. First stage estimation – Voter participation

Table A4. First stage estimations: Historical town status (1911-1995), number of vacation homes, control variables and the probability of levying residential property taxation

Specification	(1)	(2)	(3)	(4)	(5)	(6)
Town	0.294***	0.266**			0.295***	0.265**
	(0.103)	(0.104)			(0.103)	(0.104)
Vacation homes			0.049**	0.056**	0.049**	0.056**
			(0.024)	(0.026)	(0.024)	(0.025)
lnpop	0.138***	0.166***	0.160***	0.184***	0.199***	0.141***
	(0.042)	(0.045)	(0.042)	(0.044)	(0.044)	(0.047)
Eligible voters	-1.777	-1.005	-1.261	-0.584	-1.838	-1.016
	(1.481)	(1.427)	(1.478)	(1.423)	(1.477)	(1.422)
Recent immigration	-0.113*	-0.029	-0.099	-0.021	-0.106*	-0.028
	(0.006)	(0.062)	(0.061)	(0.062)	(0.060)	(0.062)
Share women	-0.993	-0.315	-1.141	-0.149	-0.821	-0.057
	(1.453)	(1.429)	(1.464)	(1.443)	(1.453)	(1.432)
Unemployment	-0.069	-0.021	-0.006	0.036	-0.042	0.012
	(0.103)	(0.105)	(0.104)	(0.107)	(0.104)	(0.107)
Divorce	-0.245***	-0.154**	-0.206***	-0.109	-0.240***	-0.141*
	(0.077)	(0.076)	(0.076)	(0.076)	(0.076)	(0.076)
Lower secondary	0.589	0.569	0.216	0.266	0.630	0.643
	(0.685)	(0.704)	(0.676)	(0.692)	(0.684)	(0.703)
Upper secondary	0.330	1.502	-0.267	0.920	-0.008	1.188
	(0.848)	(0.967)	(0.874)	(0.982)	(0.869)	(0.979)
Age 21-40	-0.136	2.779	0.062	3.684	-0.339	2.987
	(2.695)	(2.744)	(2.715)	(2.747)	(2.690)	(2.738)
Age 41-60	0.316	3.239	-0.964	2.933	-0.268	2.843
	(2.714)	(2.825)	(2.746)	(2.847)	(2.729)	(2.824)
Age 61-80	-0.151	1.299	-0.453	1.642	-0.283	1.266
	(2.476)	(2.507)	(2.476)	(2.515)	(2.471)	(2.478)
Age 81	-1.501	1.917	-0.692	2.821	-1.497	1.664
	(3.709)	(3.832)	(3.726)	(3.826)	(3.699)	(3.822)
Median income	-0.003***	-0.003	-0.003***	-0.003	-0.003**	0.002
	(0.001)	(0.010)	(0.001)	(0.010)	(0.001)	(0.010)
R-squared	0.162	0.299	0.149	0.292	0.169	0.306
Observations	402	402	402	402	402	402
County fixed effect	NO	YES	NO	YES	NO	YES
Joint significance of instruments, F-test (p-value)	19.23	20.62	14.56	12.33	15.93	14.07
Estimation method	OLS	OLS	OLS	OLS	OLS	OLS

The dependent variable is a dummy for residential property taxation in 2010, DPTAX.
Note: Included in the regression, but not reported, is a constant term.
*Significance level is shown by *** p<0.01, ** p<0.05, * p<0.*

Appendix 5. Empirical investigation of the exclusion restriction

Appendix 5a. Main analysis – Student achievement

Table A5a. The effect historical town status (1911-1995), settlement pattern and the number of vacation homes on school results dependent on choice of property taxation

Specification	(1)	(2)
Town	0.052	0.079
	(0.046)	(0.080)
Rural	-0.166*	0.020
	(0.088)	(0.088)
Vacation homes	-0.004	0.025
	(0.056)	(0.034)
Teacher hours per student	-0.004	-0.002
	(0.004)	(0.003)
lnpop	-0.045	-0.012
	(0.030)	(0.026)
Number of students	-0.062	-0.046
	(0.091)	(0.083)
Number of students ^2/1000	0.013	0.009
	(0.011)	(0.015)
Share women	-0.506	0.411
	(0.828)	(0.902)
Unemployment	-0.054	0.022
	(0.055)	(0.054)
Divorce	-0.015	-0.016
	(0.048)	(0.037)
Age 21-40	0.892	0.470
	(1.498)	(1.386)
Age 41-60	0.361	-0.185
	(1.443)	(1.245)
Age 61-80	0.361	0.246
	(1.215)	(1.099)
Age 81	0.334	2.293
	(2.131)	(1.969)
Median income	0.006	0.005**
	(0.007)	(0.003)
R-squared	0.247	0.171
Observations	192	210
DPTAX	YES	NO
County fixed effect	YES	YES
Estimation method	OLS	OLS

The dependent variable is the municipality-level test performance (MLTP) indicator.
Note: Included in the regression, but not reported, is a constant term.
*Significance level is shown by *** p<0.01, ** p<0.05, * p<0.1.*

Appendix 5b. Supplementary analysis – Voter participation

Table A5b. The effect of historical town status (1911-1995) and the number of vacation homes on the voter participation rate dependent on the choice of residential property taxation

Specification	(1)	(2)	(3)	(4)
Town	0.012	-0.003	0.006	0.003
	(0.009)	(0.016)	(0.007)	(0.014)
Vacation homes	0.009	0.002	0.002	-0.001
	(0.006)	(0.003)	(0.003)	(0.002)
lnpop	-0.039***	-0.025***	-0.024***	-0.026***
	(0.006)	(0.004)	(0.005)	(0.004)
Eligable voters	0.027	0.193	0.114	0.138
	(0.170)	(0.146)	(0.134)	(0.131)
Recent immigration	-0.001	0.003	-0.001	0.006
	(0.006)	(0.006)	(0.005)	(0.005)
Share women	-0.213	-0.177	-0.069	0.266**
	(0.189)	(0.139)	(0.149)	(0.125)
Unemployment	0.003	0.004	-0.005	0.015
	(0.012)	(0.011)	(0.009)	(0.010)
Divorce	0.010	0.011	-0.003	0.003
	(0.009)	(0.064)	(0.008)	(0.006)
Lower secondary	-0.525***	-0.411***	0.010	0.081
	(0.095)	(0.065)	(0.075)	(0.058)
Upper secondary	-0.549***	-0.348***	0.185**	-0.016
	(0.118)	(0.096)	(0.093)	(0.086)
Age 21-40	-0.027	-0.595**	0.644**	0.266
	(0.371)	(0.255)	(0.292)	(0.229)
Age 41-60	0.254	-0.788***	0.022	0.089
	(0.352)	(0.279)	(0.277)	(0.251)
Age 61-80	0.444	-0.174	0.436*	-0.374*
	(0.324)	(0.229)	(0.255)	(0.205)
Age 81	0.291	0.996***	0.120	0.752**
	(0.456)	(0.0356)	(0.359)	(0.319)
Median income	0.004***	0.003***	0.005	0.001
	(0.001)	(0.001)	(0.017)	(0.001)
R-squared	0.631	0.589	0.612	0.591
Observations	168	234	168	234
Dependent variable	Turnout	Turnout	Difference turnout	Difference turnout
DPTAX	YES	NO	YES	NO
County fixed effect	YES	YES	YES	YES
Estimation method	OLS	OLS	OLS	OLS

Note: Included in the regression but not reported is a constant term.
*Significance level is shown by *** p<0.01, ** p<0.05, * p<0.1.*

Appendix 6. The role of resource use in the educational sector

Table A6. Second stage: The effect of historical town status (1911-1995) and the number of vacation homes on residential property taxation. Investigating into the role of resource use

Specification	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Residential property taxation	0.287**	0.263*	0.216	0.239**	0.004	0.008	0.008	0.015	0.141	0.133	0.131	0.129
	(0.142)	(0.135)	(0.162)	(0.116)	(0.105)	(0.105)	(0.107)	(0.104)	(0.095)	(0.095)	(0.096)	(0.091)
Teacher hours per student				-0.001**				-0.001				-0.001*
				(0.001)				(0.001)				(0.001)
School expenditure	0.306				0.225				0.264			
	(0.271)				(0.255)				(0.246)			
Free income			0.002				0.001				0.01	
			(0.002)				(0.002)				(0.001)	
lnpop	-0.034	-0.028	-0.004	-0.080**	0.0131	0.013	0.018	-0.032	-0.010	-0.007	0.005	-0.056**
	(0.029)	(0.029)	(0.021)	(0.038)	(0.021)	(0.021)	(0.017)	(0.029)	(0.019)	(0.019)	(0.016)	(0.027)
Number of students	-0.523	-0.512	-0.045	-0.048	-0.029	-0.030	-0.030	-0.024	-0.041	-0.040	-0.039	-0.036
	(0.033)	(0.031)	(0.029)	(0.031)	(0.024)	(0.024)	(0.024)	(0.023)	(0.026)	(0.026)	(0.026)	(0.025)
Number of students ^2/1000	0.013*	0.012*	0.011*	0.010	0.008	0.008	0.008	-0.001	0.010*	0.010*	0.009*	0.004
	(0.007)	(0.007)	(0.006)	(0.012)	(0.005)	(0.005)	(0.005)	(0.009)	(0.005)	(0.005)	(0.005)	(0.010)
Teacher hours per student x Number of students				0.002***				0.009				0.002**
				(0.001)				(0.004)				(0.001)
Teacher hours per student x Number of students ^2/1000				0.002				0.006				0.005
				(0.006)				(0.005)				(0.005)
Share women	1.411	1.304	1.194	1.271	0.354	0.353	0.375	0.527	0.865	0.822	0.858	0.908
	(0.901)	(0.883)	(0.798)	(0.859)	(0.693)	(0.695)	(0.722)	(0.719)	(0.675)	(0.679)	(0.678)	(0.713)
Unemployment	0.002	-0.002	0.001	0.008	-0.018	-0.019	-0.017	-0.009	-0.009	-0.011	-0.006	-0.001

	(0.044)	(0.043)	(0.041)	(0.042)	(0.039)	(0.039)	(0.041)	(0.040)	(0.038)	(0.038)	(0.039)	(0.039)
Divorce	0.053	0.044	0.018	0.035	-0.011	-0.012	-0.017	-0.010	0.019	0.015	0.004	0.012
	(0.045)	(0.044)	(0.036)	(0.037)	(0.036)	(0.037)	(0.035)	(0.035)	(0.033)	(0.032)	(0.032)	(0.031)
Age 21-40	1.383	1.106	0.903	0.862	0.320	0.192	0.186	0.334	0.834	0.643	0.608	0.605
	(1.172)	(1.133)	(1.022)	(1.046)	(1.009)	(0.990)	(0.986)	(0.928)	(0.966)	(0.954)	(0.933)	(0.928)
Age 41-60	1.562	1.273	1.153	1.506	0.565	0.422	0.436	0.709	1.047	0.842	0.859	1.118
	(1.049)	(0.989)	(0.915)	(0.978)	(0.895)	(0.869)	(0.882)	(0.888)	(0.861)	(0.835)	(0.831)	(0.852)
Age 61-80	1.041	0.876	0.554	0.877	-0.032	-0.075	-0.112	0.092	0.487	0.395	0.280	0.494
	(1.049)	(0.996)	(0.873)	(0.944)	(0.891)	(0.883)	(0.860)	(0.876)	(0.829)	(0.817)	(0.792)	(0.815)
Age 81	3.053	2.574*	2.479*	1.711	1.996	1.715	1.736	1.126	2.507*	2.139*	2.174	1.426
	(1.613)	(1.518)	(1.415)	(1.483)	(1.383)	(1.331)	(1.344)	(1.355)	(1.349)	1.302)	(1.302)	(1.338)
Observations	402	402	402	402	402	402	402	402	402	402	402	402
Instrument(s) for DPTAX	Town	Town	Town	Town	Vacation homes	Vacation homes	Vacation homes	Vacation homes	Town, Vacation homes	Town, Vacation homes	Town, Vacation homes	Town, Vacation homes
County fixed effect	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Sargan's test (p-value)									0.453	0.484	0.425	0.422
Estimation method	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS

Note: The dependent variable is the municipality-level test performance (MLTP) indicator.
Included in the regression but not reported is a constant term.
*Significance level is shown by *** p<0.01, ** p<0.05, * p<0.1.*

Appendix 7. Second stage estimation – Fifth grade student achievement

Table A7. Second stage: The effect of residential property taxation of fifth grade school results

Specification	(i)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Residential property taxation	-0.004	-0.063	0.501	0.107	0.023	-0.127	-0.137	-0.100	-0.038
	(0.024)	(0.177)	(0.427)	(0.168)	(0.195)	(0.142)	(0.245)	(0.111)	(0.151)
Teacher hours per student	-0.002***	-0.002*	-0.002**	-0.002***	-0.001	-0.001	-0.001	-0.002**	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
lnpop	0.062***	0.072*	-0.023	0.043	0.059	0.083***	0.086**	0.078***	0.069**
	(0.019)	(0.038)	(0.077)	(0.034)	(0.037)	(0.029)	(0.042)	(0.027)	(0.030)
Number of students	-0.053*	-0.047	-0.109	-0.065*	-0.058	-0.039	-0.032	-0.043	-0.048
	(0.031)	(0.036)	(0.068)	(0.037)	(0.044)	(0.035)	(0.051)	(0.033)	(0.040)
Number of students ^2/1000	0.010	0.008	0.021	0.012	0.008	0.007	0.004	0.007	0.007
	(0.008)	(0.007)	(0.013)	(0.008)	(0.008)	(0.007)	(0.009)	(0.006)	(0.007)
Share women	-0.161	-0.343	1.403	0.185	-0.386	-0.544	-0.837	-0.460	-0.558
	(0.734)	(0.887)	(1.765)	(0.904)	(0.925)	(0.849)	(1.076)	(0.791)	(0.883)
Unemployment	-0.115**	-0.117**	-0.092	-0.109**	-0.072	-0.119**	-0.073	-0.118**	-0.072
	(0.045)	(0.052)	(0.073)	(0.045)	(0.052)	(0.05)	(0.054)	(0.052)	(0.053)
Divorce	0.044	0.032	0.146	0.067	0.044	0.019	0.022	0.025	0.035
	(0.035)	(0.054)	(0.100)	(0.049)	(0.047)	(0.047)	(0.051)	(0.045)	(0.044)
Age 21-40	-0.326	-0.497	1.143	-0.001	-0.844	-0.686	-0.834	-0.607	-0.841
	(1.192)	(1.188)	(2.081)	(1.298)	(1.121)	(1.203)	(1.114)	(1.147)	(1.103)
Age 41-60	-0.326	0.598	1.428	0.015	-1.095	-0.831	-1.142	-0.733	-1.113
	(1.026)	(1.169)	(2.152)	(1.197)	(1.118)	(1.064)	(1.115)	(1.034)	(1.103)
Age 61-80	-0.241	-0.408	1.187	0.075	-0.332	-0.591	-0.382	-0.515	-0.351
	(1.041)	(1.239)	(2.089)	(1.152)	(1.186)	(1.263)	(1.198)	(1.211)	(1.177)
Age 81	-0.132	-0.393	2.100	0.362	-0.380	-0.679	-0.727	-0.559	-0.512
	(1.626)	(1.776)	(2.917)	(1.800)	(1.937)	(1.784)	(1.953)	(1.701)	(1.893)
Median income	0.006	0.008	0.001	-0.001	-0.003	-0.001	-0.007	-0.009	-0.004
	(0.005)	(0.008)	(0.001)	(0.008)	(0.006)	(0.008)	(0.007)	(0.007)	(0.006)

Observations	402	402	402	402	402	402	402	402	402
Instrument(s) for DPTAX		Town	Rural	Town, Rural	Town	Vacation homes	Vacation homes	Town, Vacation homes	Town, Vacation homes
County fixed effect	NO	NO	NO	NO	YES	NO	YES	NO	YES
Sargan's test (p-value)				0.130				0.801	0.666
Estimation method	OLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS

The dependent variable is the municipality-level test performance (MLTP) indicator for the fifth grade, which is a cross-sectional data indicator.
Note: Included in the regression, but not reported, is a constant term.
*Significance level is shown by *** p<0.01, ** p<0.05, * p<0.1.*