LUND UNIVERSITY
School of Economics and Management

Master's Programme in in Economic Growth, Population, and Development

The Old, the Young and the Public Spending:

A study on the relationship between demographic change and education spending in Swedish municipalities

By

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Abstract: Many developed economies face a graying future with shrinking cohorts of young and increasing longevity. Population aging and its societal consequences have long been a topic in demographic research. Concerns have been raised in the research community that the elderly will use their growing numbers to influence public policy to benefit themselves at the expense of children. The empirical evidence for this is mixed. Some studies have found clear links between population aging and lower support for education spending whilst other have found the opposite effect or emphasized that there is no clear association between aging and education spending. This study adds to the research by exploring the relationship between demographic change and education spending in Swedish municipalities between 2000 and 2016. The results suggest that the elderly are not a threat to education spending. The younger segment of the elderly population were found to have a small positive relationship with education and only the very old had a small negative association with education spending. In line with earlier research, this study finds a negative association between education spending per student and larger student cohorts.
***Keywords**: Education spending, demographic change, population aging, municipalities, Sweden*

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1 Introduction

The Swedish Finance minister Pär Nuder famously likened the baby boomer generations of the 1940s to a 'Meat Mountain' (Rislund, 2004). The not too flattering imagery was likely the product of worries that the aforementioned cohorts, when retiring, would leave a giant hole in the government budget. Nuder was likely not the only finance minister that saw the oncoming population aging as a threat to the public finances. A similar brought up in research was how an older society would manage the shift in political equilibrium. Both children and the retired elderly rely heavily on redistributions from the working population. The children are provided with education and the old with elderly care and pensions. As the old grow in numbers relative to both the working population and children so does their political influence. This sparked an initial concern in economic research as it was feared that the elderly would use their influence to direct redistributions to themselves and away from children. If turned into reality this would have fateful consequences for economic growth. To maintain growth in the face of a shrinking working population education is vital to maintain economic productivity. Whether the elderly would use their influence to depress education spending has been studied with a resurged interest since the late 1990s and the evidence have pointed in both ways. Poterba (1997) found an increasing share of elderly was indeed a threat to education spending in the United States. Subsequent studies by Ladd and Murray (2001) and Harris, Evans and Schwab (2001) confounded the support for the thesis somewhat. They found the negative effect to be smaller and dependent on what level of public spending was studied. Studies on Europe and Scandinavia (e.g. Grob & Walter, 2007; Borge & Rattsø, 2008) have yielded results that pointed to a negative association.

The purpose of this study is to explore the relationship between demographic change and education spending with a focus on the associations of shifts in the relative size of the elderly and young in regards to spending per student. This study adds to the research by studying education spending in Swedish municipalities during a time of large changes in the population structure. Data from Sweden for the period 2000-2016 has previously not been studied. This study will capture the transition into retirement of those born in the 1940s. Thus, shedding light on the question if the baby boomers have had a negative association with spending. This study also adds to the understanding of the dynamic between elderly and education by exploring how the share of elderly politicians is associated with municipal education spending. The main question this study tries to find the answer to is: Is population aging associated with lower education spending in Sweden. This study is limited to focus mainly on compulsory school education in Sweden. It therefore cannot give answers or insights related to other forms of education. Furthermore, this paper limits itself to only study education spending per student. Qualitative aspects of education resources, grades or teaching time are not studied. Furthermore, the methodology used in this study does not allow for causal inference. Questions as to why associations do or do not exist is out of this study's scope and will only be discussed in light of previous findings.

The remainder of this paper's outline is structured as follows: First, Section 2 provides a background on relevant Swedish demographic trends and education as well as a review of the literature on demographic change and education spending. Section 3 provides an in-depth description of the data, variables and methods used in the study. In section 4 the results are presented, tested for robustness, and discussed in connection to the aims of the paper and the studies presented in Section 2. The paper is concluded by a summation of the results in section 5.

2 Background and Literature Review

2.1 Demographic Change in Sweden

Figure 1 illustrates the Swedish demographic development during the studied time-period. Beginning in the differences in composition between municipalities, as can be seen in the dispersion shown in Figure 1.

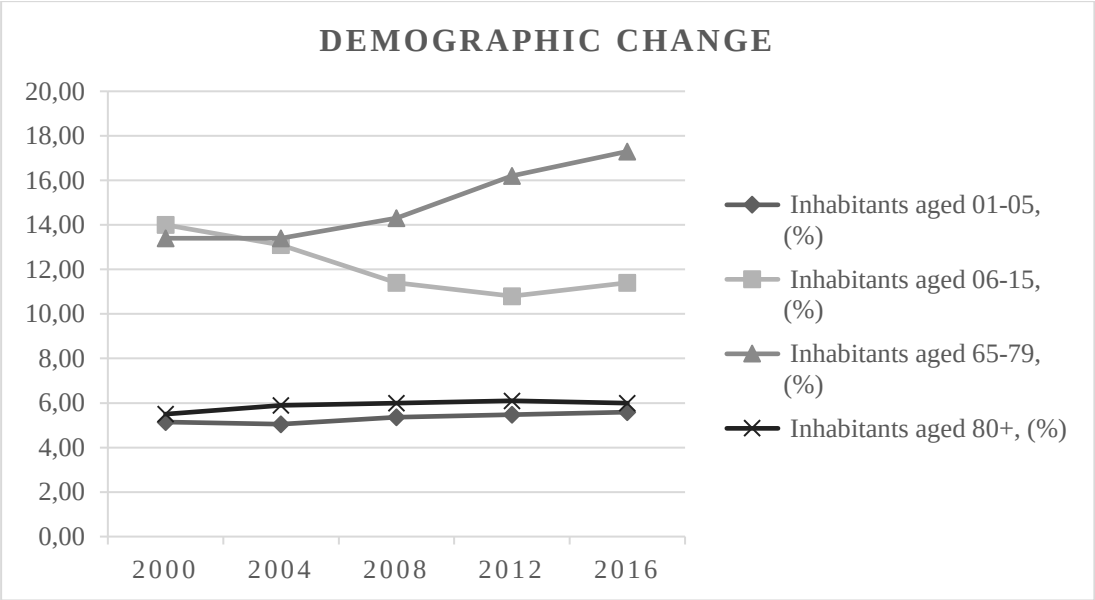

Figure 1. Demographic change in Sweden, 2000-2016. (Own calculations based on SCB (2019a) data)

On the national level, the oldest and the youngest exhibit the smallest changes measured as their share of the total population. Both groups show a small increase over time to being around the 6 percent mark. The largest changes, in opposite directions, occur in the groups of children aged 6-15, and for the group aged 65-79. Children in school age decreased from around 14 percent of the population in 2000 down to below 12 percent in 2016. The sharpest decline occurred in first decade of the millennia, then stabilizing after 2008 growing slightly between 2012 and 2016. The group of younger retirees, aged 65-79, increased substantially over the period. Growing from around 13 percent in 2000 to around 17 percent in 2016. First slowly during the first part of 00s and then rapidly after 2008. This group contains the large baby-boomer cohorts of the 1940s.

The simultaneous development of spending is illustrated in Figure 2. Both spending on the elderly and on children have increased in real terms. Education spending per student has increased more in relative terms and continued to grow as school aged children declined as a share of the population. The share of the population older than 80 has remained about the same while the spending per member of the group has increased.

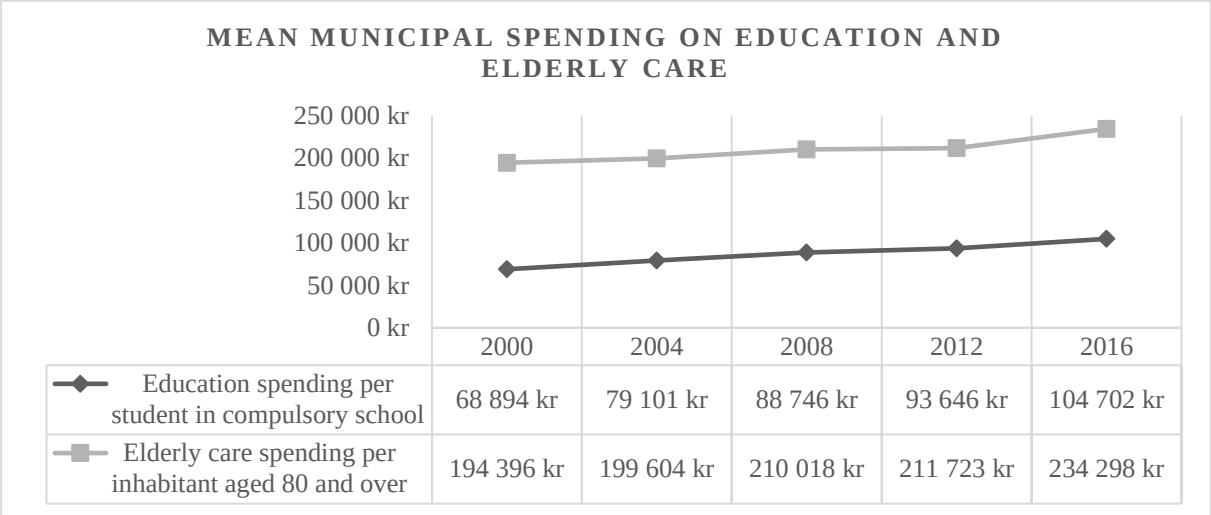

Figure 2. Mean public services spending per user. All prices are adjusted to 2015 SEK. (Own calculations based on SCB (2019a) data)

Looking at the two groups and the services they use it does not seem to matter if the relative size of the group grows or not. Spending on the group rose regardless.

2.2 Education in Sweden

The focus in this study is on Swedish compulsory education and therefore the term education refers to compulsory education, unless otherwise stated. For all children aged 6-16 education is compulsory. Education in Sweden is tuition free, this includes schools with a non-public owner. During the 1990s the Swedish education system underwent extensive political reform (v. Greiff, 2009). Among the most important changes were the handing over of responsibility for provision and financing of education from the state to the municipalities. Ahlin and Mörk (2008) studied how the decentralization affected resources and found that there were no major differences pre and post reform. The passing of responsibility to the municipalities were not found to have any profound effect on how much was spent on education. Ahlin and Mörk (2008) concluded that there where you live in the country did not become more important after, compared to before, the municipalities were made responsible for education. In 1993 education grants were changed significantly. Previously, the state provided funding to education through earmarked grant. The change meant that grants would no longer be earmarked (v. Greiff, 2009). Instead the state funding to schools would be included in the general grants that are tailored to each municipality and aimed at compensating for unequal economic conditions such as differences in median income and spatial population distribution.

The important difference is that the general grants can be allocated freely by municipalities and through the budget. Any money in the general grants intended to go to education could in theory be spent on something else. Earmarked grants to education still persist in a different form. These are now smaller and targeted directly to specific projects, special needs education and teacher career salaries (Statskontoret, 2016).

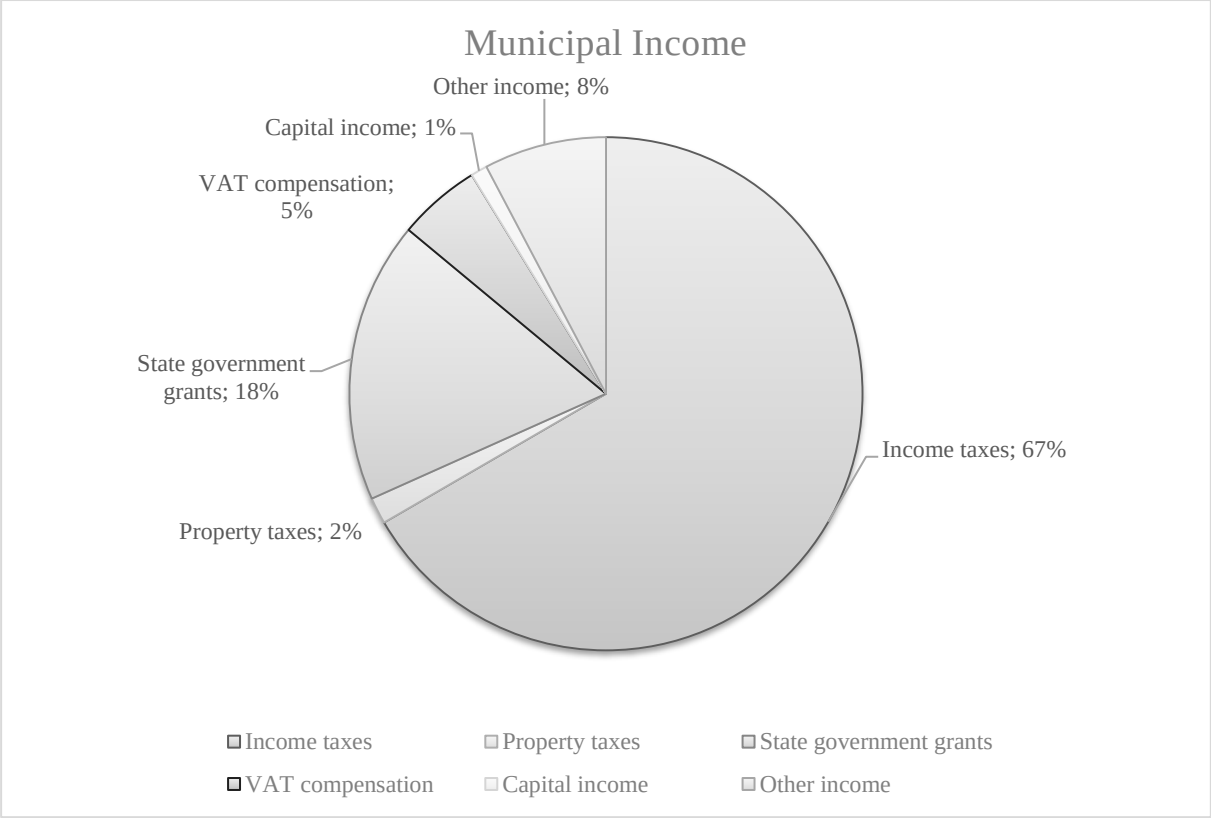

Figure 3. Municipal income by source in 2015 (Statskontoret, 2016)

Seen as one sector Swedish municipalities mainly rely on local revenue. Income taxes account for 67% of total revenues followed by state grants which constitute 18% of total incomes. Of these 18% around 50% are earmarked and 50% general grants (Statskontoret, 2016). The remaining 15% come from smaller revenue streams, see figure 1.

Even though the education reforms meant largescale decentralization and increased municipal autonomy over education the state is still are largely involved. The state government are responsible for plans, goals and initiatives that guide education of which the national curriculums are the most important. These statute the methods and aims of teaching. Skolverket, which is the government agency with primary responsible for education also have the authority to provide legally binding guidelines.

The municipalities are responsible for running and fulfilling the goals set by the state. This is done through local school committees who manage and oversee resource allocation to schools within the jurisdiction. Municipalities cannot discriminate against non-public schools but are legally required to provide equal funding to students regardless of who runs the schools they attend. In a survey on how municipalities distribute the budgeted resources to schools 86% of

municipalities used a model of resource allocation that includes sum based on student volume and an additional sum based on socioeconomic factors (Skolinspektionen, 2014).
Figure 4 shows a breakdown of total municipal expenditures by service. Elderly care, compulsory school and pre-school spending account for around 50% of annual expenditure.

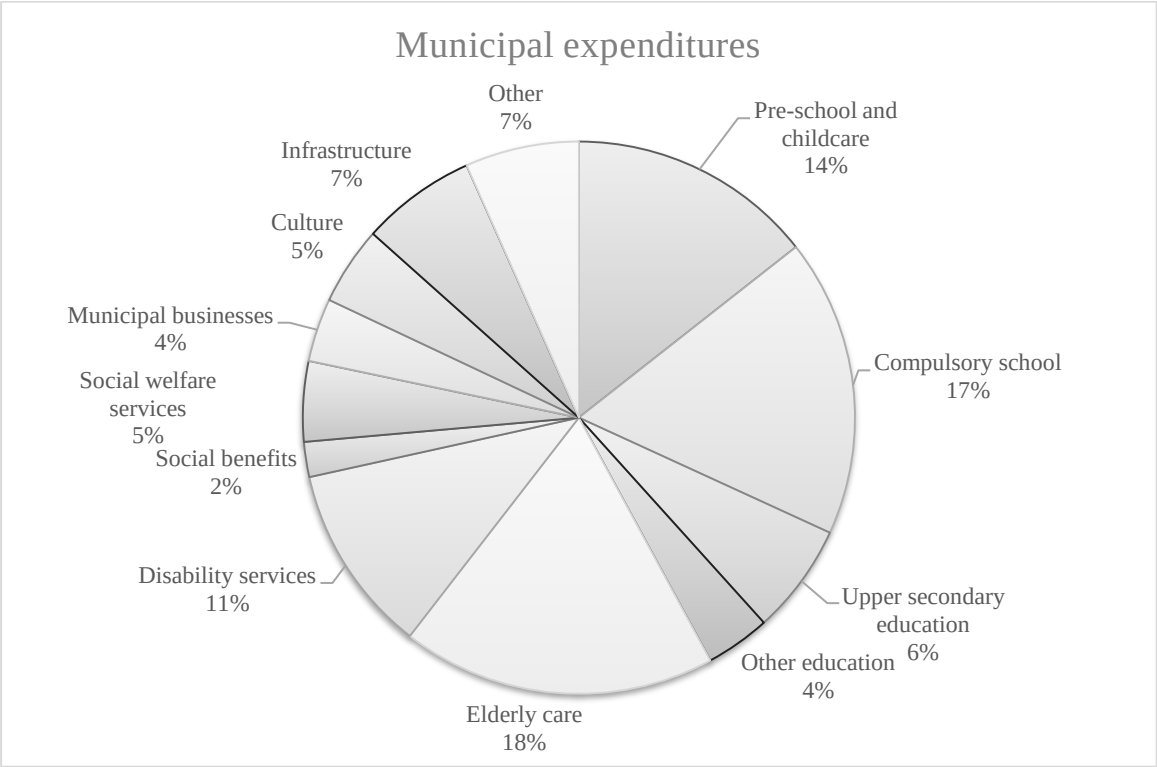

Figure 4. Municipal expenditures in 2018 (SKL, 2019)

A government report on education resources by Statskontoret (2013) found that education spending per student were highest for municipalities with low population density. In the scarcely populated municipalities, the high education spending per student was attributed to structural costs caused by geographical distance and by an inability of adjusting expenditures to shrinking student cohorts. In densely populated urban municipalities higher costs are the main driver higher expenditure. Statskontoret (2013) concluded that factors such as population density and demographic composition seemed to have increased in importance to education spending.

2.3 Theoretical perspectives on demographic change and education spending

In the simplest form of framework, the young and the old stand as opposing and competing groups. Both groups are non-working groups of the populations, and hence rely on redistributions of resources from the working population. In economics generational distribution and competition are mainly analyzed through overlapping generations model and median voter theory. In a political equilibrium model, the amount of education subsidies depends on the political support such programs have in the voting population. The young, who receive the benefits of education subsidies, rely on the political support of adults. The key to this support from older generations is the rate of returns on human capital investments. As adults and retirees benefit from education investment through future economic growth and redistributions (Casamatta & Batté, 2016).

Kemnitz (1999) argues, that in a model with more than two generations political support for education spending would be found in generations that would benefit indirectly from education in subsequent time periods. As an illustration, consider a model of three generations: children, parents and grandparents. Parents would have economic incentives to support education for the children as they would benefit in a subsequent time period (transitioning from parents to grandparents). However, for grandparents this is not the case. There is no apparent benefit to be gained from supporting education, based on self-interest, as they are not alive to receive the benefits in the subsequent time period. In essence, parents and children have an economic incentive to support spending on education, as they can enjoy the benefits in the future. However, as children have no voting rights the political support for education is dependent on the relative (political voting) strength of the parents and grandparents. Then, as a population ages, the share of elderly increases and support for education declines.

However, the proposed effects of any model depend on the assumptions and preferences underlying the model. Gradstein and Kaganovich (2004) used a two period OLG model with workers and elderly. The workers support education spending in anticipation of future higher growth caused by returns on human capital and the elderly show lower support for education as they cannot age further. An increase in life expectancy increases the political power of the elderly, providing a depressing effect on education spending, but as the workers face prospects of a longer future retirement their support increase. A proposition, as modelled by Gradstein and Kaganovich (2004), is therefore that population aging need not pose a serious threat to education spending. As Kemnitz (1999) remarks, in an aging society with smaller cohorts of children the cost of supporting education decreases as there are fewer children that need redistribution of resources. In such a scenario even a shrinking education budget could increase spending per student. An intuitive takeaway from the theoretical literature it that even though growing numbers of elderly might act in their immediate self-interest and oppose education spending this need not lead to a dramatic decline in such spending.

As revenues, expenditure and support for education and other welfare services are often decided on the local levels of government the insights from local public finance literature are also important to consider. One of the foundational economic theories on local government spending is the 'pure theory of local expenditures' (Tiebout, 1956). The theory is based on the *'consumer-voter'.* This is a person, a taxpayer and voter, who is in the market of consuming public goods (such as education) from local, municipal or community, suppliers of public goods. The demand depends on the agent and his or her personal preferences for consumption of public goods. As an example; a consumer-voter with children will value a community that spends much on education vis-à-vis a consumer-voter without children. The implication of the model is that the revenues and expenditure of local governments reflect the preferences of the inhabitants. The theory proposes that consumer-voters sort themselves into the communities that appeal to their respective preferences. The mechanism does not work in the reverse. In other words, the theory assumes that spending profiles of local providers are fixed and do not change, thereby people sort themselves after spending and not the other way around. Tiebout (1956) argues that changes in spending on the part of providers would upset and destabilize the aggregate utility.

This sorting effect would suggest that, within an aging society, sorting shifts the demographic profiles of local communities. If people act as consumer voters and elderly have different public service preferences than younger adults and children, the elderly would move to communities that provided services aimed at their needs and families with children would move to communities with good childcare. Poterba (1998) saw Tiebout sorting as a possible positive force in preventing a scramble for resources in the changing and aging demographic landscape of the United States. Rather than fighting to lower education spending the growing elderly population would relocate to communities with elderly friendly policies. Low local support for public services for children is therefore not necessarily an effect of political pressure from an aging local population. It could instead be indicative of the heterogeneity among the suppliers, who target different consumer-voters. Any cross-sectional analysis of public spending patterns and demographic composition could therefore include a Tiebout bias. Making it harder to establish whether spending is low because there are more elderly or there are more elderly because spending is low.

2.4 Previous empirical research

No single agreed upon theory on how demographic change and local public economics are linked exist in the literature. In a simplified manner the basis for many of the studies is the observation that different the elderly and children have different needs which must be satisfied by a certain level of redistribution of limited resources. The core assumptions of the well informed and self-interested agent, whose behavior is guided by marginal utility and benefit, have been used but also subjected to criticism in the empirical literature on demographic change and local public spending. Sørensen (2013) and Grob and Wolter (2007) underscored that the assumptions and expectations of the economic models have to be supplemented with perspectives that consider family altruism, human empathy and social

norms. This study uses insights from two main streaks in the empirical literature. One that primarily uses survey data to study attitudes towards public spending on education and a second that uses demographic censuses and public finance data. In the following paragraph both streaks of research will be reviewed, beginning with studies based on survey data.

2.4.1 Demographic change and attitudes towards public spending

In an American study on Californian voter attitudes in 2000 and 2002, Brunner and Balsdon (2004) found that support for public education spending declined with age. But, when questioned in the context of local, instead of state, spending support increased among older homeowners. Brunner and Baldson (2004) argued that older homeowners support local education spending as it results in higher property values, since better schools attract well off families with children that drive prices up. This suggests that a certain subset of elderly, those who own homes, might lend their support to spending aimed at children, given that supports translates to gains for themselves.

In a similar study Cattaneo and Wolter (2009) polled 2025 Swiss citizens on their opinions on social security and education spending. The respondents were asked if they would support a 10% increase in primary and lower secondary school spending, and if they would support a tax increase in order to pay for the proposed increase in spending. Respondents 50 years and older, thought that spending on social security and healthcare were more important than spending on education. A one-year increase in the respondent's age was found to decrease the probability of supporting a 10% increase in education spending by 0, 16% (Cattaneo & Wolter, 2009).

Sørensen (2013) used data from four surveys on 22 OECD countries gathered 1985-2006 to study age related preferences in public spending. The respondents were questioned whether they preferred more or less public spending on a number of public programs, such as education and health care. The results indicated a small but significant proof of a negative life-cycle effect on the support for education spending. Respondents born in the 1920s were especially negative to the prospect of increased public spending on education compared to respondents from successive generations. Having higher education, children or identifying as left wing were factors that indicated a positive correlation with support for spending. Sørensen (2013) also found that the negative life-cycle effect for the support of education spending were especially large in the United States. In contrast, in one of the oldest countries in the OECD, Japan, there were very little change in the attitudes towards education spending over the lifecycle (Sørensen, 2013). De Mello et al (2017) used data from the Life in transition II survey which includes data from 34 European countries collected in 2010, as well as Eurobarometer data, collected in 2004-2011. The respondents in the surveys were asked to prioritize between public spending. Healthcare was found to have the highest overall support followed by education and pensions. Older respondents preferred increased spending on healthcare and pensions while younger respondents preferred increased education spending. In contrast to the findings by Sørensen (2013) de Mello et al (2017) did not find any significant differences in attitudes between the countries in the study.

Svallfors (2008) studied the support for increases in spending on public programs in Sweden with data from five welfare surveys spanning 1981-2002. Svallfors (2008) did not study education or school spending in isolation. Instead he studied the evolution of a broader sentiment towards spending on families with children and the elderly. The support for both types of spending increased in the studied period. In 2002 a net of around 30% of respondents were in favor of spending more on children while a net of 70% were in support of increasing spending on elderly. The results indicated a high support for spending, regardless of age or social class. Svallfors (2008) study suggests that attitudes in Sweden have developed similarly to attitudes in Japan, and in contrast to attitudes in the United States, as found by (Sørensen, 2013). Another paper on Swedish attitudes towards public spending studied the role of ethnic diversity and found some evidence to suggest that increased ethnic diversity had a negative correlation with support for welfare services. Using a pooled cross section with Swedish survey data from 1987, 1992, 1997 and 2002, Eger (2009) found that in counties and regions with a high share of recent immigrants and foreign born, the support for welfare services was lower amongst native Swedes. The lack of panel methods and specificity in regard to what welfare services are affected, and how these attitudes might be associated with education spending, cannot be ascertained from Eger's (2009) study.

2.4.2 Empirical studies on demographic change and education spending

The papers that are reviewed in this section have studied education for pupils in between primary and upper secondary school. Exceptions to this are explicitly mentioned.

The empirical studies on demographic change and allocation of resources often rely on a mix of theoretical insights in their design as there is no one generally accepted framework or applicable theory (Poterba, 1998; Grob & Wolter, 2007). Arguing that population aging would shift the preference of the median voter away from supporting spending on children to support spending for the elderly Miller (1996) studied the relationship between demographic change and education spending in American states and counties. Using 1960-1990 decennial data Miller (1996) found that an increasing percentage of elderly had a negative effect on education spending, but the effect was only significant on the county level. Poterba (1997) argued that the demand and supply of services would be affected by age groups shifting in sizes. Belonging to a large cohort would face tougher competition for resources and jobs. Poterba's (1997) empirical contribution to the subject was to study American states using data from 1960 to 1990. The main findings indicated that jurisdictions with a growing share of elderly spent less on education per child. Poterba (1997) argued that this was a consequence of the political equilibrium having changed in favour of the elderly at the expense of children. He also found that if the racial composition was markedly different between elderly and children this was associated with decreased spending per student.

In a response to Poterba's (1997) study Ladd and Murray (2001) used a similar methodological approach to the same time period but shifted the focus from American states to counties. The rationale being that state spending ignores any Tiebout sorting happening on sub-state levels. They found a small negative association between aging and education spending per child, but only on the county level. Ladd and Murray (2001) argued that it is more likely that the mechanism through which elderly have a depressing effect on education

spending is through their localisation decisions, which can be attributable to Tiebout sorting. They also found a negative effect of differences in racial composition between elderly and children. Ladd and Murray (2001) found that a 1% increase in racial mismatch corresponded to a 0, 2% decrease in per child spending.

Harris, Evans and Schwab (2001), in reference to the studies by Poterba (1997) and Ladd and Murray (2001), continued to add to the field. They established that the effect of population aging on education spending is different depending on what level of government is studied. On the lower district level increasing the size of the elderly population was positively associated with spending, while it had the opposite relationship on the state level. The authors argued that this is because there is a connection between local spending and increases in house prices. A similar observation as made by Brunner and Balsdon (2004).
An issue with the studies that focused on state level spending (such as Poterba, 1997) was, Harris, Evans and Schwab (2001) argued, that they failed to account for the fact that elderly feel more strongly about state spending than local spending. As on the state level education competed with Medicaid, which directly benefit the elderly, for resources. Also, state education spending does not have a clear link with housing prices, thus it is less likely to be supported by elderly house owners.
A more recent study by Kurban, Gallagher and Persky (2015) reinterpreted the findings by Poterba (1997) and Harris, Evans and Schwab (2001) and concluded that population aging is not a threat to education spending. They argued that, as the previous studies used percentage shares of the population to measure demographic change the results were misleading. Kurban, Gallagher and Persky (2015) observed that the negative effect of population aging on education spending must come from increasing either elderly or children at the expense of an omitted age group, not included in the econometric model. This is because the percentage shares of elderly, children and the omitted age group(s) must be equal to 1, as in 100 percent. Using American demographic data and the regression coefficients from Poterba (1997) and Harris, Evans and Schwab (2001), Kurban, Gallagher and Persky (2015) found that the negative effect from increasing the elderly is outweighed by the effect of the decrease in share of children. Instead of decreasing, spending per child increased as a result of population aging. In a follow up paper, based on data from Chicago school districts from 1980 to 2010, Gallagher, Persky and Kurban (2018) studied the redistributive effects of population aging on education spending. They found that, by their increase in numbers, the elderly had a net positive effect on education. As more elderly increased the property tax payments used to fund schools. These findings, put in their American context, obfuscates the overall conclusion that can be drawn on whether population aging has a negative effect on education spending or not, as evidence point in both directions.

Japan provides an interesting case for the study of how population aging could impact spending on education as it has been one of the most rapidly aging countries in the world. Ohtake and Sano (2010) studied the effects of demographic change on education in Japanese Cantons between 1975 and 2005. They found that the share of elderly was positively correlated with education spending in their models up until 1990 when it changed to being negatively correlated with education spending. The authors argued that this reversal might be due to changes in fiscal structure or education funding reforms that took place during the period.

In addition to the studies on the United States and Japan there is also several European studies on demographic change and education spending. In the light of population aging in Switzerland Grob and Wolter (2007) examined how demographic change affected education spending in Swiss cantons. Their main findings were that both the share of elderly above 65 years and the share of students were negatively associated with spending whilst cantonal per capita income and ethnic heterogeneity were positively correlated with spending. Grob and Wolter (2007) argued that the results were in line with their expectations. Being a part of a large student cohort is negatively related to education resources as teachers and personnel take time to educate and facilities take time to build. A certain sluggishness of resource adaptation was therefore to be expected (Grob & Wolter, 2007). Furthermore, the authors explain, Swiss districts with a larger foreign-born population receive additional resources to help integration which explain the small positive association between spending and share of foreign born.

An important point of difference between the Swedish and American contexts is that American education is largely funded by local property taxes (Ladd & Murray, 2001). Elderly homeowners are therefore an important revenue stream for school districts. (See Harris, Evans and Schwab, 2001). In Sweden the property taxes are not earmarked to fund a specific public service. Therefore, the elderly play a different role in the funding of education in the United States compared to Sweden. The European studies are better suited for a comparison with Sweden, especially the studies on the neighboring countries of Norway and Denmark, as Scandinavian countries have similar political-institutional history and comparable welfare systems. The differences between the United States and Europe likely also applies to the associations between education spending and ethnicity. In the American context ethnicity is studied in terms of race and not in terms of place of birth or origin, as is done in the European context (see Grob & Wolter, 2007).

An early Scandinavian paper on demographic change and education spending was done in Norway. Borge and Rattsø (1995) studied how changes in demographic composition between school aged children and elderly affected resource allocation of six local government provided services in Norway between 1986-1989.They found that client age group size was negatively associated with spending per client. Borge and Rattsø (2008) studied the effects of demographic change on public services in Denmark. The study used 1989-1996 data on demographic change and spending per client in 275 Danish local governments. The main finding in the study was that an increasing share of elderly depressed spending on education, but an increasing share of children did not threaten spending on services to the elderly. In line with Ladd and Murray (2001) and Harris et al. (2001), Borge and Rattsø (2008) used past size of age groups as instruments to control for Tiebout sorting. The argument for using past size as it excludes the effect from elderly who have relocated, and thus represents the effect of exogenous (natural) aging. A similar Norwegian study by Rattsø & Sørensen (2010) explored the effects of family altruism on the competition for local government resources between the old and young. Using demographic and local government data for the period of 1992-2004. Their expectations were that adults would support spending that positively impacted close family members living in the same municipality. They found that family altruism was more helpful to children, as adults prioritized spending on education rather than care to the elderly. Rattsø & Sørensen (2010) also found that elderly had a negative association with spending on education, but the share of children in a community had no impact on spending on elderly.

Strömberg (2006) studied competition for resources between young and old in Swedish municipalities using a median voter model that included benefit gains of close family members to the utility of the median voter. Strömberg (2006) used data from 1991 in his cross-sectional model with a ratio of combined spending on services for children aged 0-19 divided by the combined spending on the elderly as dependent variable. Strömberg (2006) found that as the median voter gets older the support for more spending on the elderly increases at the cost of support for spending on the young. Because, as the population ages, there are more elderly than children to receive altruistic support from young and middle-aged adult median voters.

2.5 Expected associations

Following the findings of primarily the Scandinavian literature. Children are expected to have a negative association with education spending, but not with other spending. The share of elderly is expected to be negatively associated with education spending as most of the empirical literature in neighboring countries propose such an association. The insights from previous studies suggest that there are two main modes of association between education spending and demographic change. The first, accounted for in the studies on attitude, regards the political preference or attitude towards increased spending. If the elderly have negative preferences regarding education and express this through their political influence, education spending will likely decrease as a response. The second, as discussed by Poterba (1997) and others, relates to size and demand. If the cohorts of students grow, competition for existing resources, such as teachers and schools, will increase and the spending per student will decrease, if supplementary resources are not provided. Similarly, if the dependent elderly increase in numbers, this might also drive resources away from education as municipalities are faced with difficult choices on what group to prioritize.

3 Data and methods

3.1 Data

The data gathered to construct the dataset used in this study comes from *Statistics Sweden* (SCB) and Kolada, a database that publishes a broad range of data on Swedish municipalities and regions. Kolada is published by the non-profit organization RKA (*Rådet för främjandet av kommunala Analyser*) that is owned jointly by the Swedish government and the lobby organization for Swedish municipalities and regions *Sveriges Kommuner och Landsting* (SKL). The data in Kolada is produced by, and collected from, Swedish government agencies and published by RKA (2019).

Data was collected for 289 out of 290 municipalities for the years 2000, 2004, 2008, 2012 and 2016. Knivsta municipality was left out of the analysis as it was established in 2003 as an off branch from Uppsala municipality. This exclusion is motivated mainly by the fact that it did not exist at the beginning of the time period and that there were no reliable estimates that could serve as proxy measures for the period prior to its establishment.

The studied timespan was chosen for the following reasons. Firstly, the timeframe is reasonably current, so it provides information relevant for contemporary analysis. Secondly, no large reforms affecting spending or resources in education occurred during the time period allowing for greater comparability and less distortion in the variables. Thirdly, no comparable study on Sweden has been conducted for the period. The time period also captures the baby boomers' transition into retirement.

The gaps were chosen out of two main reasons. Firstly, by having gaps of more than one year captures more change in variables between the time periods. A one-year gap would mean minimal change in the composition and size of the age groups, discounting large yearly changes in birthrates, death rates or migration. Although Sweden did experience considerable immigration during the time between 2000 and 2016, the four-year gaps leave more room for capturing change in the demographic variables. Secondly, a four-year gap two years after parliamentary elections means that every time period captures political changes caused by changes in parliament. A time gap of less than four years would mean no change voter support and any such variables would therefore be useless in a fixed effects model. To increase the comparability between years and account for inflation, all prices are adjusted to 2015 Swedish crowns (SEK) using the Eurostat *harmonized index of consumer prices* (HICP) for Sweden published by Statistics Sweden (SCB, 2019b).

3.2 Variables

Dependent variable

Education Spending per student is compound education spending per students aged 6-15. This variable is a standard measure commonly used when studying school resources in both government reports (Statskontoret, 2013; 2016) and in previous empirical studies (Grob & Wolter, 2007; Rattsø, & Sørensen, 2010; Harris et. al, 2001; Borge & Rattsø, 2008). It takes into account all municipal spending on education, this includes teacher salaries, teaching materials and cost for classrooms and more. Other studies use a similar measure based on spending per child (for examples see Poterba, 1997; Ladd & Murray, 2001). Both are aimed at measuring resources per intended user. As education is mandatory for all children aged 6-15 the number of children and students should be the same and using either measure would provide similar results.

Demographic independent variables

Children 6-15 is the share (%) of the population between the ages of 6 and 15. The expected association with education spending is negative. As more students increase the denominator in the dependent variable, there is a mechanical link to lower per student spending, all else equal. A negative association has been found in several previous studies (e.g. Poterba, 1997; Borge & Rattsø, 1995 and Grob & Wolter, 2007).

Elderly 65-79 share (%) of population in the age-range of 65 to 79. This demographic variable is one of two elderly categories used in this study. This age group contains persons who make the transition from the working population to entering retirement and collecting pension benefits. Not all persons aged 65 are pensioners, some retire earlier due to choice or disability and some retire later than 65. However, most commonly those aged 65 and above are counted as the elderly population in earlier studies. **Elderly80+** is the share (%) of the population 80 years or older. This group represents the elderly that are in most need of elderly care and healthcare. Together with children this group of elderly rely heavily on redistribution through public services.

Foreign Born, measures the share (%) of the local population born in foreign country. The reason to include this variable in the model is twofold. Firstly, it has been found to have explanatory power in previous research. American studies (e.g Poterba, 1997) have found that ethnicity and heterogeneity in the population has a negative correlation with education spending. However, in European studies (e.g Grob & Wolter, 2007) the link between an increasing share of ethnic heterogeneity and education resources are small and positive. Secondly, in Sweden a larger share of municipal population with foreign background provides more resources in government grants and socioeconomic support. Increasing heterogeneity might mean larger grants but might also lead to less support for municipal spending (Eger, 2009). The relationship with education spending is expected to be slightly positive as it in Sweden is a source of receiving higher grants. ***Politicians 65+*** is the share (%) of elected politicians 65 years or older in the municipal council. If politicians are driven by age related self-interest, then a higher share of elderly politicians should be correlated with lower education spending

Control variables

Other variables used in the regression models in this study are variables that have been found to be important to education spending. They can be grouped into two categories. The first is socioeconomic variables. The second are political-structural variables that aim to capture political and structural associations with education spending. As municipal revenues are determined largely by local tax income, as seen in figure 3, socioeconomic variables, such as median income and unemployment will affect both revenues and expenses. The political power-balance and who sit in the elected councils have a direct impact on what and how spending is allocated to different services. Structural factors, such as population density, are important characteristics that impact economics of scale. Bellow follows a brief presentation of each of the variables used in the main regressions.

Tax power, or *skattekraft* in Swedish, is a measure to control for the effects of income. It is a measure of taxable income divided by the number of inhabitants. This indicator is one of the variables used to determine the size of government grants. Previous studies (e.g Poterba, 1997; Harris et. al, 2001; Ladd & Murray, 2001) use median income. Tax-power is highly correlated with mean income (see appendix) but is a more precise indicator income that end up as municipal tax revenues. ***Unemployment*** is the share (%) of unemployed in the workforce, this is included as an increase in unemployment might direct municipal resources to combat unemployment or to social benefit payments rather than to education. Grob and Wolter (2007) included unemployment as a control variable but found it had no significant effect on education spending. ***Higher Education*** is the share (%) of adult population with post upper secondary education. Studies by Miller (1996), Rattsø and Sørensen (2010) and Gallagher, Persky and Kurban (2018) use education level to capture preferences for education among the adult population. The assumption is that adults with higher education value education more and are thusly more willing to support spending on education for children. Education and income are strongly correlated, as higher education is the ticket to many high salary jobs. However, income arguably does not capture preference for education with the same precision, which is the reason why both are included.

Structural variables that has been found to be correlated with education spending. ***Population density*** represents the number of inhabitants per square kilometer. The expectation is that low population density is correlated with higher per student spending on because of higher costs for school transports (v. Greiff, 2009). ***Left-wing Vote*** is the share (%) of votes for the left party, green party and the Social democrats. This variable is included to control for possible partisan or ideological links to spending on welfare services. Finally, ***Grants*** is the combined sum of general grants and other equalizing grants divided by number of inhabitants.

Descriptive Statistics

Table 1 Descriptive Statistics

Variable	*Obs*	*Mean*	*Std. Dev.*	*Min*	*Max*
Education spending per student	1,436	87 052.990	15 664.620	55 254.450	161 413.900
Children 6-15	1,445	0.121	0.018	0.069	0.178
Elderly 65-79	1,445	0.149	0.030	0.067	0.248
Elderly 80+	1,445	0.059	0.014	0.015	0.107
Foreign Born	1,445	0.107	0.058	0.021	0.410
Tax Power	1,445	145 403.700	33 159.250	81 249.000	346 200.000
Unemployment	1,445	0.060	0.026	0.011	0.195
Higher Education	1,445	0.279	0.095	0.126	0.732
Population Density	1,445	135.527	469.598	0.229	5 494.822
Left-wing Vote	1,445	0.475	0.111	0.116	0.835
Politicians 65+	1,445	0.131	0.078	0.000	0.400
Grants	1,439	9 967.985	6 107.651	-16 654.310	33 273.680

Note: Prices are adjusted to 2015 SEK and measured per inhabitant. Source: own calculations using data from Kolada.

The range between the lowest and highest observation of education spending is quite astonishing, the highest being thrice as large as the lowest. As expected, the standard deviation for children and elderly older than 80 are smaller compared to the standard deviation of elderly between 65 and 79. As the latter group grew considerably as part of the population (see figure 1). The variation in the share of foreign born and elected elderly politicians are comparatively large as both standard deviations are over half of the mean value. The large range in the demographic variables together with their comparatively small standard deviations can be seen as indicative of large differences between municipalities that likely persist over time. For further details on the panel properties of the data, see Appendix (Table 5).

3.3 Model specification

The chosen empirical strategy and model specifications makes it possible to establish correlations and links between the variables in the study. Although the fixed effects approach controls for time-invariant characteristics of the data it does not provide grounds for establishing causal links. To try to establish and explain causality a different approach would have been necessary. Previous studies have employed instrumental variable techniques to provide causal explanations on how demographic change affect public spending on education. This limitation is important to keep in mind when interpreting the outcomes from the regressions. To measure elasticities in the models and make interpretation easier all variables are in natural logarithms.

In designing and developing the final model diagnostic tests were used to distinguish the appropriateness of each different model specification. Previous research studying municipalities, counties or states have relied on fixed effects to mitigate endogeneity and omitted variable bias caused by unobserved time invariant characteristics. Fixed effects models, specifically fixed effects models based on within estimates, are calculated by using an individual's (*i)* observed variation over timed, subtracted from the individual mean (Angrist & Pischke, 2008). In effect this means that the β-coefficients are calculated using changes in variables, rather than differences in (absolute) magnitude that include time-invariant characteristics. This approximation has an intuitive appeal when studying municipalities as there are many characteristics that potentially influence differences in outcomes that remain unaccounted for and would thus bias the models. The fixed effects approach puts one major challenge to the data, the within estimations depend on there being at least some variation in the variables between time periods. Otherwise the difference from the period mean would be zero and thus be time invariant and lack explanatory power in the regression. The use of fixed effects would also help to decrease the effects of any endogeneity caused by Tiebout sorting. As the models use estimates based on change over time, and thus capture aging well, it could be tempting to consider the elderly variables to be causal in relation to spending. But, the demographic change in a municipality cannot be considered entirely exogenous in relation to spending as migration between municipalities, a lá Tiebout sorting, cannot be accounted for in the models.

Modified Wald-tests for group-wise heteroscedasticity were performed using all iterations of the models presented in the empirical section below. The tests all confirmed the presence of heteroscedasticity. As a remedy all regressions use cluster-robust standard errors. These are calculated using the Huber-White estimations provided by the statistical software STATA. A set of Wooldridge tests (Drukker, 2003) confirmed that the models suffered from auto-correlated residuals. This means that the errors are correlated across time, and therefore not homoscedastic. The existence of autocorrelation further underlines the importance of using the cluster-robust standard error estimators as they also remedy problems caused by autocorrelation (Wooldridge, 2015).

An alternative specification to fixed effects models when using panel data are random effects models. The core difference between the two is that random effects assume that the independent variables are not correlated with unobserved individual characteristics. This likely not the case for the data used in this study. To test whether feasibility of this belief statistical tests designed for the choosing between random and fixed effects were performed. As there was strong presence of heteroscedasticity both a Hausman test and a modified Sargan-Hansen test was used. The latter test was included as the presence of heteroscedasticity reduces the reliance of the Hausman test (Arellano, 1993). Both tests supported the suitability of using fixed effects models, rather than random effects models, as the null hypotheses, which if supported would suggest a random effects approach, could be rejected in both cases.

The fixed effects models also include time fixed effects as municipal spending is likely affected by economic cycles. In practice the time fixed effects are period specific dummy variables that capture year specific effects. Joint F-tests supported the inclusion of the time dummies as their effects were jointly significantly different from zero.

Finally, the fixed effects models presented in the results section use within estimators. Therefore, the appendix includes LSDV regressions, which produce the same β-coefficients but a different R^2. LSDV models include dummy variables for each reported R^2 additional estimate calculated using the LSDV method to show the difference caused by changes in degrees of freedom. This is because the LSDV approach treats the individual fixed effects as dummy variables, thus removing one degree of freedom per individual.

$$Education\ spending\ per\ student_{it} = Dem_{it} + X_{it} + \alpha_i + \tau_t + u_{it}$$

The base fixed effects model is structured as follows. The dependent variable is ESP_{it} is education spending per student. The independent variables are denominated by Dem_{it} which represents a vector of demographic independent variables and X_{it} which represent vectors of control variables relevant for education spending. Individual, municipal, fixed effects are symbolized by α_i, where $\alpha_i = \alpha + A_i'\gamma$, which represents an intercept and individual dummies for each municipality. Time fixed effects,τ_t, are dummy variables for each time period, year, in the panel.
As a supplement to the fixed effects method the results will also include tables with OLS regressions, these use the same models in terms of variables but are regressed on cross-section data from a single year. These regressions also use robust standard errors estimators. As the OLS regression likely include omitted variable bias. The results should therefore be interpreted with this in mind.

4 Empirical Analysis

4.1 Results

4.1.1 OLS regressions

As the models in Table 2 only include 2016 data the time dimension properties disappears in favor of a spatial dimension. Models (1) and (2) only contain demographic variables, (3) include socioeconomic controls and (4) include political and structural controls and the full model (5) include all control variables.
In model (1) share of children has a negative elasticity of -0, 32%. Share of elderly aged 65 to 79 is positively associated with spending per student with a magnitude of 0, 21%. The share of elderly above 80 years have clear association with spending.

Municipalities with large share of elderly and a lower share of children seem to have the highest spending per student. Including share of foreign born in model (2) adds very little explanatory power. The little association it has with spending seem to be negative, although the elasticity is close to zero. Including socioeconomic control variables in model (3) alters the demographic associations. The negative coefficient of share of children increases somewhat to -0, 35%. The magnitude of share of 65-79 decreases significantly from 0, 21% to 0, and 07%. Income, in the shape of tax power, has a very small elasticity that is indistinguishable from zero. Education and unemployment both have significant explanatory power, both being negatively associated with education spending per student. The magnitude for education is considerably larger, with an elasticity of -0, 14%. This is opposite to the expected relationship, which was expected to be positive.

The variable for school aged children is significant through all regressions (1-5). Increasing the share of children by 1% is associated with decreased spending by between 0, 32% and 0, 37%. This indicates that Municipalities with a larger share of children aged 6-15 are associated with lower education spending per student. The coefficients for elderly 65-79 remains positive through iterations (1-5). The coefficient loses in magnitude when controls are introduced. In contrast, the share of elderly over 80 becomes significant and increase in magnitude first after introducing controls. Notable is that the coefficients of the two groups of elderly respond differently to the two sets of controls. Socioeconomic control removes magnitude from elderly 65-79 but does not impact the share of elderly 80+. Looking at models (4) and (5) population density has a small but significant correlation with education spending. As expected, owing to lower density being linked to higher costs. Left-wing votes is negatively associated with education spending and significant with an elasticity of 0, 04% as long as socioeconomic controls are not included. Having a larger share of elderly in the elected council does not seem to have any explanatory value of magnitude, the same being the case for Grants and income, as measured by tax power.

Table 2 OLS Regressions

	(1)	*(2)*	*(3)*	*(4)*	*(5)*
VARIABLES	**Log education spending per student**				
Children 6-15	-0.32***	-0.33***	-0.35***	-0.37***	-0.37***
	(0.06)	(0.06)	(0.07)	(0.07)	(0.07)
Elderly 65-79	0.21***	0.20***	0.07	0.09	0.09
	(0.05)	(0.06)	(0.07)	(0.07)	(0.08)
Elderly 80+	0.02	0.02	0.02	-0.11***	-0.09**
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Foreign Born		-0.01	-0.01	0.01	0.03
		(0.02)	(0.02)	(0.02)	(0.02)
Population Density				-0.04***	-0.03***
				(0.01)	(0.01)
Left-wing Vote				-0.04*	-0.02
				(0.02)	(0.03)
Grants				0.01	0.04
				(0.01)	(0.03)
Politicians 65+				0.02	0.01
				(0.01)	(0.01)
Tax Power			0.00		0.07
			(0.08)		(0.13)
Unemployment			-0.05***		-0.05***
			(0.02)		(0.02)
Higher Education			-0.14***		-0.03
			(0.03)		(0.04)
Constant	11.26***	11.20***	10.63***	10.61***	9.39***
	(0.21)	(0.24)	(1.06)	(0.35)	(1.85)
Observations	289	289	289	278	278
R-squared	0.42	0.42	0.47	0.55	0.56

*Note: The models are regressions on 2016 cross-section data, all variables are in natural logs. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1*
Source: own calculations using data from Kolada

4.1.2 Fixed effects regressions

Table 3 show the results of the fixed effects regressions presented in the same order as the OLS models. Each model includes municipal and time fixed effects. Models (1) and (2) include only demographic variables. Model (3) adds socioeconomic controls, model (4) contains demographic and political-structural control variables and model (5) includes all variables. Looking at the results from model (1) there is a strong negative association between share of school aged children and education spending of almost -0,44%. An increase in the school aged population is therefore associated with a substantial decrease in spending per student. The association between elderly aged 65-79 and education spending is positive but noticeably smaller and not statistically significant. In model (2) the expected positive relationship between share of foreign born and education spending did not materialize. As can be seen in subsequent models this does not change. The socioeconomic variables added in model (3) prove to have a significant relationship with education spending, as also seen in the OLS regressions. The coefficients for higher education is significantly positive through models (3) and (5) in line with expectations.

In model (4) the socioeconomic control variables are replaced by structural and political control variables. The negative association of children remain robust to the inclusion of both types of controls. Grants proves to be largely unimportant in relation education spending together with left wing vote. Population density has the expected negative relationship with spending. In the full model (5) the demographic variables remain largely unchanged. As in all previous models the share of children is strongly negatively associated with education spending per student. The younger group of elderly have a small positive association with spending that is comparable in size to the negative elasticity of elderly aged 80+. What is further noticeable in models (4) and (5) is the apparent lack of importance of population density. There is reason to believe that population density is important, as shown in the OLS results in Table 2, despite lacking magnitude or significance in the fixed effects model. Considering the structural nature of the variable this makes intuitive sense. Municipalities that were scarcely populated in 2000 likely remain so in 2016. Therefore, only larger changes over time or reaching certain threshold levels might be significant in relation to spending.

Table 3 Fixed Effects Regressions

	(1)	(2)	(3)	(4)	(5)
VARIABLES	**Log education spending per student**				
Children 6-15	-0.44***	-0.43***	-0.40***	-0.45***	-0.42***
	(0.04)	(0.05)	(0.05)	(0.06)	(0.06)
Elderly 65-79	0.05	0.05	0.04	0.07	0.06
	(0.04)	(0.04)	(0.04)	(0.05)	(0.05)
Elderly 80+	-0.06*	-0.06*	-0.04	-0.05	-0.05
	(0.03)	(0.03)	(0.03)	(0.04)	(0.04)
Foreign Born		0.01	0.00	0.02	0.00
		(0.02)	(0.02)	(0.02)	(0.02)
Population Density				0.03	-0.02
				(0.08)	(0.07)
Left-wing Vote				-0.01	-0.01
				(0.02)	(0.02)
Politicians 65+				-0.01	-0.00
				(0.00)	(0.00)
Grants				0.00	0.01
				(0.01)	(0.01)
Tax Power			0.21**		0.23**
			(0.09)		(0.11)
Unemployment			0.03**		0.02*
			(0.01)		(0.01)
Higher Education			0.18***		0.20***
			(0.06)		(0.06)
Constant	10.19***	10.24***	8.29***	10.14***	7.95***
	(0.16)	(0.20)	(0.99)	(0.37)	(1.31)
Municipal fixed effects:	YES	YES	YES	YES	YES
Time fixed effects	YES	YES	YES	YES	YES
Observations	1,436	1,436	1,436	1,344	1,344
R-squared	0.90	0.90	0.90	0.90	0.91
Number of Municipalities	289	289	289	284	284

*Note: All variables are in natural logs. Cluster-robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1*

Source: own calculations using data from Kolada

What is especially interesting about the results from the fixed effects regressions is that there is no large change in the demographic variables when controls are introduced in models (3-5). Although the negative elasticity of elderly 80+ is decreased somewhat. The relationship between the demographic variables and education spending seem not to be explained by income or changes in education. The association, or lack thereof, with the share of politicians over the age of 65 are particularly interesting. As the politicians in the municipal councils are directly involved in the budget and financing of municipal services. If there existed a strong self-interest among the elderly it would likely have been associated with a significant negative relationship. The estimated relationship is negative, but very close to zero, with an estimated elasticity of -0, 01%. This result speaks strongly against the notion of a future where an increasing share of elderly, even when in power to influence education resources, have a negative impact on education spending. As seen by the regression in Table 3, the most

important demographic variable to study in relation to education spending is the share of school aged children. The elderly and foreign born have considerable smaller elasticities.

4.1.3 Sensitivity analysis

In the first two columns are OLS models with Education spending per student as dependent variable similar to the full model in column (5) of Table 2 but with a restricted sample. In model (1) the sample is restricted based on population density by cutting of below and above the 10^{th} and 90^{th} percentiles. The rationale is to see how much the outcome of the OLS model is affected by the removal of the least and most densely populated municipalities, leaving the restricted sample to 230 municipalities in model (1). In model (2) the restriction is made by cutting of below and above the 10^{th} and 90^{th} percentiles based on tax power, which leaves 232 municipalities in the regression. In model (2) the sensitivity analysis does suggest that removing the top and bottom municipalities based on income actually provide substantive change to the association between the demographic variables and education spending. It significantly increases the magnitude of both groups of elderly. The elasticities for the group of younger elderly now have a larger positive association with spending of 0, 15% while the group of elderly 80+ have a negative elasticity of -0, 16%.

In models (3-6) the dependent variables are changed to elderly care spending per inhabitant aged 80+ and pre-school spending per inhabitant aged 1-5. In columns (3) and (4) are OLS regressions and in columns (5) and (6) are fixed effects models. Looking at the results from models (3-6) the demographic patterns are similar to the results from Tables 2 and 3. An increase by 1% in the user group of the service is associated with a significant decrease in spending per user of that service. In model (5) the elasticity of 80+ is -0, 53% and in model (6) the elasticity of children aged 1-5 is -0, 28%. The coefficients for elderly aged 65-79 are positive throughout the columns, and large in magnitude in models (5) and (6). Regardless of public service, the younger group of elderly are not a threat to either pre-school or elderly care. The positive association with elderly care spending is sensible seen in the light of self-interest. However, when looking at pre-school spending, pure self-interest would not explain a positive association. In conclusion, the main findings can be said to have withstood the robustness and sensitivity analysis.

Table 4 Sensitivity analysis regressions

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
	OLS				**Fixed effects**	
VARIABLES	**Education spending**		**Elderly care spending**	**Pre-school spending**	**Elderly care spending**	**Pre-school spending**
Children 1-5				-0.39***		-0.28***
				(0.07)		(0.06)
Children 6-15	-0.34***	-0.41***	-0.10		0.02	
	(0.08)	(0.09)	(0.11)		(0.07)	
Elderly 65-79	0.08	0.15**	0.09	-0.02	0.19***	0.24***
	(0.08)	(0.07)	(0.08)	(0.07)	(0.05)	(0.08)
Elderly 80+	-0.06	-0.16***	-0.33***	-0.18***	-0.53***	-0.13*
	(0.05)	(0.05)	(0.06)	(0.04)	(0.05)	(0.07)
Foreign Born	0.00	0.04**	0.01	-0.01	-0.01	-0.03
	(0.03)	(0.02)	(0.02)	(0.02)	(0.03)	(0.04)
Tax Power	0.04	0.19	0.28	0.05	0.35**	0.83***
	(0.13)	(0.19)	(0.17)	(0.13)	(0.14)	(0.25)
Unemployment	-0.04*	-0.06***	0.00	-0.02	-0.00	0.01
	(0.02)	(0.02)	(0.03)	(0.03)	(0.01)	(0.02)
Higher Education	-0.11***	-0.02	-0.01	0.15***	-0.16*	0.45***
	(0.04)	(0.04)	(0.04)	(0.04)	(0.08)	(0.13)
Population Density	-0.03***	-0.03***	-0.05***	-0.01**	-0.05	-0.14
	(0.01)	(0.01)	(0.01)	(0.01)	(0.09)	(0.14)
Left-wing Vote	-0.04	-0.01	0.11***	0.03	-0.00	0.03
	(0.03)	(0.04)	(0.03)	(0.03)	(0.03)	(0.05)
Politicians 65+	0.01	0.02	-0.02**	0.00	-0.00	-0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)	(0.01)
Grants	0.02	0.09***	0.04	0.04*	0.03***	0.02
	(0.03)	(0.03)	(0.04)	(0.02)	(0.01)	(0.01)
Constant	10.02***	7.39***	7.82***	9.16***	6.53***	1.64
	(1.95)	(2.62)	(2.57)	(1.69)	(1.67)	(2.92)
Municipal fixed effects	NO	NO	NO	NO	YES	YES
Time fixed effects	NO	NO	NO	NO	YES	YES
Restricted Sample	YES	YES	NO	NO	NO	NO
Observations	230	232	278	278	1,317	1,348
R-squared	0.49	0.56	0.42	0.24	0.62	0.86
Number of municipalities					284	284

*Note: All variables are in logs. In models (3) and (5) the dependent variable is log spending per inhabitant 80+. In models (4) and (6) the dependent variable is log spending per inhabitant aged 1-5 .Cluster-Robust or robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1*
Source: own calculations using data from Kolada

4.2 Discussion

The results from this study are to some expected as expected but also contains surprises. The relationship between students and education spending was significantly negative, as expected. This phenomenon has been found in countries as far apart as Norway (Borge & Rattsø, 1995) and the United States (Poterba, 1997). The elasticities in Table 3 were similar in magnitude, around -0,4%, to that found by Grob and Wolter (2007). This similarity in coefficient size is particularly interesting considering that Grob and Wolter (2007) studied Switzerland. Although the results do not establish any casual links the negative association with education spending is likely not the consequence of children or parents opposing spending on education. It is more likely caused by the mechanic effect of raising the denominator in the dependent variable and due to the sluggish nature of education spending.

The results from this study stand contrary to most previous studies when it comes to the elasticities of the elderly. Even compared to the results from neighboring Norway (Rattsø & Sørensen, 2010) and Denmark (Borge & Rattsø, 2008). The previous studies have mainly found a negative association between elderly and education spending. The lack of any strong association between the elderly and spending makes the studies of Ladd and Murray (2001) and Gallagher, Persky and Kurban (2018) close in terms of results. The association between population aging and decreasing per student spending is therefore not supported. Although the methodology does not allow for causal or definite claims. The age-based self-interest would likely have been captured in a negative association with the share of local politicians over 65 years and education spending. However, no such results were found in this study. Another interesting aspect of the results was the different signs of the two groups of elderly. The elderly aged 65-79 were insignificantly positively associated with spending whilst the elderly older than 80 had a small negative association with education spending. This suggests that the elderly could be heterogenous in relation to education spending. Although an important caveat is that these findings became insignificant when socioeconomic controls were introduced in Table 3. There is some evidence that support this heterogeneity. One possible explanation is that attitudes toward education spending decrease constantly with age, as suggested by Cattaneo and Wolter (2009). Therefore, the attitudes against spending is most prevalent in the very old, similar to Sørensen's (2013) findings that those born in the 1920s were most negative to education spending. However, this connection is highly speculative.

Regarding the association between ethnic diversity and resources the results are inconclusive but could be seen as interesting in light of the Eger's (2009) study and could mean that even if Swedes' willingness to support welfare spending decrease as the share of foreign-born increase it does not affect education spending, as no association between spending and foreign born could be found.

One interesting finding from the sensitivity analysis is the significant positive relationship between income, measured by tax power, and pre-school and elderly care spending. Especially when contrasted the lack of association with education spending. The services aimed towards the elderly and very young seem to have a more sensitive relationship with socioeconomic status. This would suggest that poorer municipalities with growing shares of dependent elderly or newborn should receive extra attention and support to be able to provide adequate resources.

A suggestion for further research is to try to disentangle and distinguish between the different modes of which demographic factors are related to education spending. This might be done using an instrumental variable approach, similar to that of Borge & Rattsø (2008), or by further accounting for migration between municipalities. That way the relocations based on municipal spending preferences, Tiebout sorting, would be less of a problem in the models. Another interesting avenue to explore further is the question of what decides the association with spending. Is it the needs of different groups that guide resource allocation by municipalities, the political influence and self-interest of a certain group or something different?

5 Conclusion

The purpose of this study was to explore the relationship between demographic change and education spending in Swedish municipalities during 2000-2016. Somewhat contrary to what was expected, the findings in this study suggest that the elderly are not a threat to education spending. No significant or large association could be found between elderly and education spending. The elderly aged 65-79 were found to have a small positive but insignificant association with education spending. The group of elderly over 80 years was found to have a small significant negative relationship with education spending. But when other variables associated with education spending were introduced in the models the relationship became insignificant. The share of elderly politicians in the municipal councils was not found to have any association with education spending. Suggesting that even when in power elderly have no significant negative association with education spending. The share of foreign born in a municipality were not found to have any significant association with spending. Instead the demographic change that is likely to affect education spending negatively is an increase in students, as children aged between 6 and 15 were found to be negatively associated with education spending. This Association was strong and robust to the inclusion of various controls with an estimated elasticity of around -0,4%.

6 References

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7 Appendix

Table 5 Panel Descriptive Statistics

Variable		*Mean*	*Std. Dev.*	*Min*	*Max*	*Observations*
Education spending per student	overall	87 052.990	15 664.620	55 254.450	161 413.900	N = 1436
	between		8 628.390	71 017.640	119 279.000	n = 289
	within		13 137.510	48 545.360	129 187.800	T-bar = 4.96886
Children 6-15	overall	0.121	0.018	0.069	0.178	N = 1445
	between		0.012	0.076	0.162	n = 289
	within		0.013	0.092	0.167	T = 5
Elderly 65-79	overall	0.149	0.030	0.067	0.248	N = 1445
	between		0.024	0.093	0.219	n = 289
	within		0.018	0.107	0.207	T = 5
Elderly 80+	overall	0.059	0.014	0.015	0.107	N = 1445
	between		0.014	0.022	0.098	n = 289
	within		0.004	0.045	0.074	T = 5
Foreign Born	overall	0.107	0.058	0.021	0.410	N = 1445
	between		0.053	0.041	0.395	n = 289
	within		0.025	0.039	0.218	T = 5
Tax Power	overall	145 403.700	33 159.250	81 249.000	346 200.000	N = 1445
	between		17 968.130	117 970.000	279 922.800	n = 289
	within		27 885.060	63 581.880	211 680.900	T = 5
Unemployment	overall	0.060	0.026	0.011	0.195	N = 1445
	between		0.020	0.018	0.129	n = 289
	within		0.016	0.011	0.131	T = 5
Higher Education	overall	0.279	0.095	0.126	0.732	N = 1445
	between		0.089	0.166	0.692	n = 289
	within		0.035	0.171	0.373	T = 5
Population Density	overall	135.527	469.598	0.229	5 494.822	N = 1445
	between		467.415	0.250	4 426.550	n = 289
	within		51.485	-399.018	1 204.434	T = 5
Left-wing Vote	overall	0.475	0.111	0.116	0.835	N = 1445
	between		0.103	0.128	0.783	n = 289
	within		0.042	0.317	0.619	T = 5
Politicians 65+	overall	0.131	0.078	0.000	0.400	N = 1445

	between		0.039	0.030	0.272	n = 289
	within		0.068	-0.075	0.361	T = 5
Grants	overall	9 967.985	6 107.651	-16 654.310	33 273.680	N = 1439
	between		5 707.802	-13 618.000	27 513.630	n = 289
	within		2 241.971	3 383.545	18 312.960	T-bar = 4.97924

Source: own calculations using data from Kolada

Table 6 Descriptive Statistics for Sensitivity analysis

Variable		*Mean*	*Std. Dev.*	*Min*	*Max*	*Observations*
Elderly care spending	overall	210 207.500	32 173.570	119 094.400	362 912.100	N = 1406
	between		26 333.970	105 277.300	345 542.500	n = 289
	within		19 450.060	104 930.200	287 933.700	T bar = 4.86505
Pre-school spending	overall	91 683.820	21 136.260	14 625.220	161 149.900	N = 1441
	between		9 268.727	65 025.140	120 844.000	n = 289
	within		18 999.620	32 909.470	158 667.900	T bar = 4.98616
Children 1-5	overall	0.053	0.009	0.033	0.084	N = 1445
	between		0.008	0.035	0.075	n = 289
	within		0.004	0.040	0.066	T = 5

Source: own calculations using data from Kolada

Table 7 OLS regressions on education spending per student 2000-2016

	(1)	*(2)*	*(3)*	*(4)*	*(5)*
VARIABLES	2000	2004	2008	2012	2016
Children 6-15	-0.41***	-0.32***	-0.38***	-0.31***	-0.37***
	(0.13)	(0.10)	(0.09)	(0.07)	(0.07)
Elderly 65-79	0.07	0.15**	0.13**	0.09	0.09
	(0.09)	(0.06)	(0.06)	(0.07)	(0.08)
Elderly 80+	-0.10**	-0.15***	-0.14***	-0.05	-0.09**
	(0.05)	(0.04)	(0.03)	(0.05)	(0.04)
Foreign Born	0.02	0.00	0.01	0.03**	0.03
	(0.02)	(0.01)	(0.01)	(0.02)	(0.02)
Tax Power	-0.01	0.06	-0.11	0.07	0.07
	(0.17)	(0.13)	(0.13)	(0.11)	(0.13)
Unemployment	-0.00	-0.02	-0.00	-0.08***	-0.05***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)

Higher Education	0.04	-0.03	0.00	-0.04	-0.03
	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)
Population Density	-0.05***	-0.04***	-0.05***	-0.04***	-0.03***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Left-wing Vote	0.02	0.03	-0.03	0.01	-0.02
	(0.03)	(0.03)	(0.02)	(0.03)	(0.03)
Politicians 65+	0.00	-0.01	-0.01	-0.01	0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Grants	-0.00	0.01	-0.02	-0.00	0.04
	(0.02)	(0.02)	(0.02)	(0.01)	(0.03)
Constant	10.60***	9.84***	12.13***	9.85***	9.39***
	(2.29)	(1.76)	(1.76)	(1.52)	(1.85)
Observations	254	260	272	280	278
R-squared	0.39	0.51	0.53	0.58	0.56

*Note: all variables are in natural logs. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1*
Source: own calculations using data from Kolada

Table 8 LSDV regressions

	(1)	*(2)*	*(3)*	*(4)*	*(5)*
VARIABLES	**log education spending per student**				
Children 6-15	-0.44***	-0.43***	-0.40***	-0.45***	-0.42***
	(0.05)	(0.05)	(0.05)	(0.07)	(0.07)
Elderly 65-79	0.05	0.05	0.04	0.07	0.06
	(0.04)	(0.05)	(0.05)	(0.05)	(0.05)
Elderly 80+	-0.06	-0.06	-0.04	-0.05	-0.05
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Foreign Born		0.01	0.00	0.02	0.00
		(0.02)	(0.02)	(0.03)	(0.03)
Tax Power			0.21**		0.23*
			(0.10)		(0.12)
Unemployment			0.03**		0.02*
			(0.01)		(0.01)
Higher Education			0.18***		0.20***
			(0.07)		(0.07)
Year=2004	0.11***	0.11***	0.05**	0.11***	0.04
	(0.01)	(0.01)	(0.02)	(0.01)	(0.03)
Year=2008	0.16***	0.16***	0.07*	0.16***	0.05
	(0.01)	(0.01)	(0.04)	(0.02)	(0.05)
Year=2012	0.19***	0.19***	0.04	0.18***	0.02
	(0.02)	(0.02)	(0.05)	(0.03)	(0.07)
Year=2016	0.32***	0.31***	0.15**	0.30***	0.11
	(0.02)	(0.02)	(0.06)	(0.03)	(0.08)
Population Density				0.03	-0.02
				(0.09)	(0.08)
Left-wing Vote				-0.01	-0.01
				(0.02)	(0.03)
Politicians 65+				-0.01	-0.00

				(0.01)	(0.00)
Grants				0.00	0.01
				(0.01)	(0.01)
Constant	10.18***	10.22***	8.27***	10.09***	7.95***
	(0.19)	(0.23)	(1.11)	(0.50)	(1.50)
Municipal fixed effects	YES	YES	YES	YES	YES
Time fixed effects	YES	YES	YES	YES	YES
Observations	1,436	1,436	1,436	1,344	1,344
R-squared	0.93	0.93	0.93	0.93	0.93

*Note: regression models are the same as in Table 3 but using LSDV estimates. Cluster-Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1*
Source: own calculations using data from Kolada