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ABSTRACT

Local Governments in the Wake of Demographic Change: Evidence from German Municipalities

by Benny Geys, Friedrich Heinemann and Alexander Kalb *

German municipalities are expected to suffer from intense demographic changes in the upcoming decades; not only in the form of population losses, but also through a changing demographic structure (i.e. less children and adolescents, more elderly, higher dependency ratio, and so on). We assess local governments' vulnerability to the fiscal consequences of these demographic transformations (using a sample of 1021 municipalities in the state of Baden-Württemberg) by determining the elasticity of local government cost functions to municipalities' demographic characteristics. Our findings indicate that smaller municipalities are especially vulnerable to increasing cost pressures following most of the currently predicted demographic changes. In the absence of increased higher-level government support (e.g. through the fiscal equalization scheme), these findings would support a case for boundary reviews or more extensive inter-communal cooperation.

Keywords: Demographic change, local government expenditures, cost elasticity, economies of scale, rolling regression, German municipalities

JEL Classification: H72, J11

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ZUSAMMENFASSUNG

Dezentrale Regierungen im Strudel von demographischen Wandel: Evidenz von deutschen Stadtverwaltungen

Deutsche Stadtverwaltungen werden erwartungsgemäß in den kommenden Jahrzehnten unter einem demographischen Wandel zu leiden haben, welcher nicht nur in Form eines allgemeinen Bevölkerungsrückgangs, sondern auch durch einen Wandel in der demographischen Struktur (d.h. veränderte Altersstruktur durch weniger Junge und mehr Alte, höhere Abhängigkeitsrate usw.) zum Ausdruck kommt. Wir untersuchen die diesbezügliche Anfälligkeit von dezentralen Regierungen (zugrunde liegt eine Stichprobe von 1021 Stadt- und Gemeindeverwaltungen im Land Baden-Württemberg), indem wir die Elastizität der Kostenfunktionen bezüglich der demographischen Charakteristika der jeweiligen Stadt- und Gemeindeverwaltungen bestimmen. Unsere Ergebnisse deuten darauf hin, dass gerade kleinere Gemeinden unter dem steigenden Kostendruck leiden, der mit den meisten vorhergesagten demographischen Veränderungen einhergeht. Wenn keine übergeordnete Regierungsebene diese kleineren Verwaltungsgebiete unterstützt (z.B. durch ein Finanzausgleichsystem), dann unterstützen unsere Ergebnisse eine kritische Überprüfung von fiskalischen Grenzen bzw. der Ausweitung der inter-kommunalen Kooperation.

1. Introduction

Even when immigration is taken into account, the German population has been in decline since 2003, and this trend is expected to continue in the upcoming decades. In fact, depending on specific assumptions made concerning migration, fertility and mortality, the German population is predicted to tumble from the current 82 million inhabitants to roughly 69-74 million in 2050 (Federal Statistical Office Germany, 2006). This negative population trend is not restricted to Germany. Within the EU27, several other – mainly central and eastern European – countries are expected to see their population decrease between now and 2050. Regarding the period between 2025 and 2050, the situation is even more general. In that time period, all but 8 countries in the EU27 (i.e. Belgium, France, Ireland, Cyprus, Luxemburg, Malta, Sweden and UK) are expected to witness population reductions (Eurostat, 2006).

Still, falling population size is not the only demographic challenge that lies ahead. Significant transformations of the demographic structure are likewise expected. This not only refers to the gradual ageing of the population (i.e. the lower share of children and higher share of elderly), but also to, for example, increasing dependency ratios. More specifically, in the German case, and once again depending on specific assumptions concerning fertility and mortality, the contingent under age 20 is expected to decrease from 20% of the population now to circa 15% in 2050 while the share of people over 65 will rise from 19% now to over 30% in 2050 (Federal Statistical Office Germany, 2006). The dependency ratio is expected to increase from 65 dependents (aged under 20 or over 65) per 100 inhabitants of working age (aged between 20 and 65) at the current moment to 89-94 dependents per 100 inhabitants of working age in 2050 (Federal Statistical Office Germany, 2006).

Such reductions in population size coupled with incisive shifts in demographic structure are unlikely to leave public finances unaffected. For example, fiscal revenues almost certainly reduce when there are less residents to work and pay taxes, while population aging puts upward pressure on public expenditures. As a consequence, significant strain on government budgets is probable. In line with this, it has been argued that "many Europeans view population decline and aging as threats to national influence and the welfare state" (Van de Kaa, 1987, 1).

Interestingly, academic research and popular opinion thus far pay most attention to population aging and its consequences (e.g., Jackson and Felmingham, 2002; Bloom and Canning, 2004; Seitz *et al*., 2007). Moreover, this discourse habitually centres on effects at the country or even global level (e.g., Bloom and Canning, 2004; Batini *et al*., 2006). However, as indicated above, demographic change is not limited to alterations in the age distribution, but can also refer to variations in population size or other shifts in the demographic structure. Furthermore, the effects of demographic change (whether in terms of demographic structure or size) are unlikely to be constrained to the national level. Regional and local governments are also susceptible to its implications since "the lived experience of population ageing" – as well as demographic transformations more generally – "will be played out at the level of local rather than national government" (Jackson, 2004, 101). An exclusive focus on the national level is thus unwarranted and, crucially, fails to discern possible differences across regions within a country (cf. Jackson and Felmingham, 2002).

In the present paper, we take a first step to address these shortcomings. First, we analyse the local level of government (see also Seitz *et al*., 2007). Specifically, the analysis exploits data on 1021 municipalities of the German state Baden-Württenberg in the year 2001. Second, we take a more general view of demographic change – assessing the impact of population decline, ageing, reduced fertility and increasing dependency ratios – rather than regard only one aspect of this phenomenon. Finally, by using a methodological tool known as 'rolling regressions', we also assess the effects of demographic changes across different types of municipalities (with types referring to municipalities of different socio-demographic make-up; see below for details). These three central characteristics of our study allow us to come to more differentiated and meaningful results with respect to a) the type of municipality especially vulnerable to predicted demographic changes and b) the specific demographic shifts chiefly invoking such financial difficulties.

Previewing our main findings, our analysis firstly shows that the costs for providing public goods generally rise (fall) underproportionally with population size, but, importantly, this effect is stronger for smaller municipalities. This implies that smaller municipalities will be especially hard hit by the population losses forecast for German municipalities (since, for a given change in population size, their costs will fall at a slower pace than those of larger municipalities). Second, public spending increases significantly with the number of elderly when the number of elderly is (relatively) low, but is unaffected by it once the population over 65 becomes large. This suggests that it is mainly the initial investment in old-age care that carries along significant costs to the local community. Hence, municipalities with currently a larger number of elderly will be better able to cope with the predicted population ageing. Third, cost pressure will be higher in municipalities with few children aged below 6 years since in these municipalities fixed costs for e.g. kindergarten buildings carry more weight. Finally, our results point to the fact that costs can be cut significantly with a declining share of employees in the population, but that such cost savings approach zero in municipalities with low levels of employees. Taken together, these results indicate that especially smaller municipalities will face hard times ahead due to the expected demographic transformations. This suggests a case for boundary reviews to generate larger municipalities or increased inter-communal cooperation in the provision of (certain) public goods – unless higher-level governments increase support for smaller municipalities (e.g., through the fiscal equalization scheme).

The remainder of the paper is structured in six parts. Section 2 introduces the institutional setting of the German local governments, while section 3 provides more information about demographic changes in the German state Baden-Württemberg. Section 4 introduces our methodological approach and section 5 presents the results using a dataset of 1021 German municipalities in the year 2001. Finally, conclusions are drawn in section 6.

2. German local institutional setting

Baden-Württemberg consists of 1109 municipalities[1] ranging in size from about 100 inhabitants in the smallest municipality to almost 600,000 inhabitants in the largest one. The institutional setting is the same in all these municipalities (such that our analysis will be unaffected by the institutional design of government). That is, municipal political institutions consist on the one hand of the *local council*, which is elected every five years and is the main decision-making body of the municipalities. On the other hand, there is a directly elected *major* (eight-year terms), who acts as chairman of the municipal council. Both institutions have their own statutory responsibilities, although the major has significant agenda-setting powers.[2]

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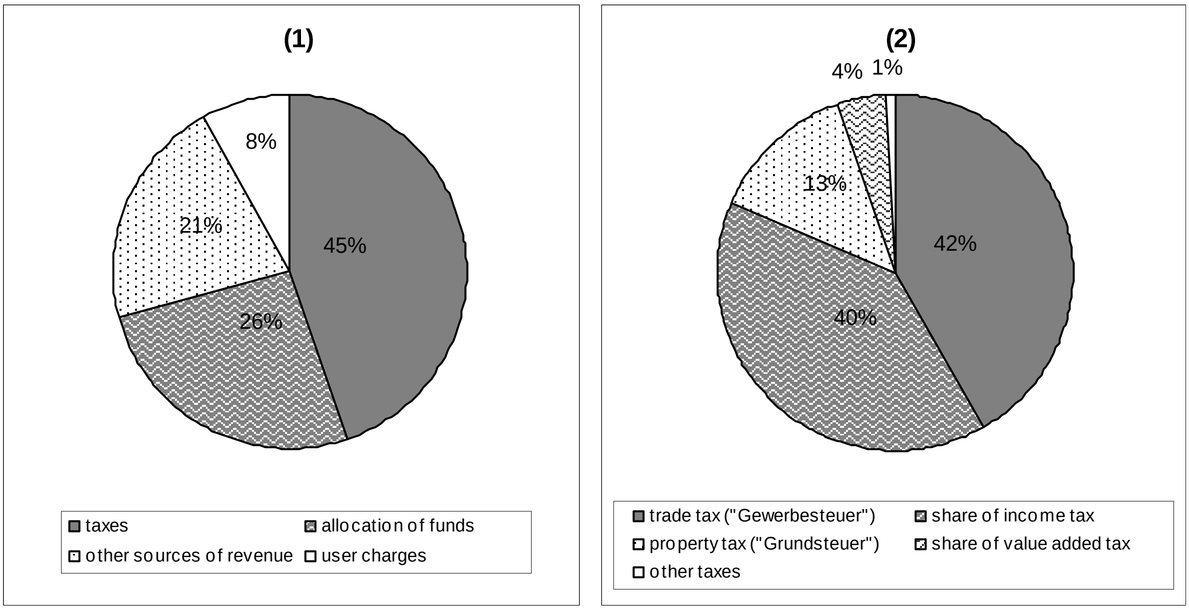
1 Since 1975 Baden-Württemberg consisted of 1111 municipalities. In 2006 and 2007, however, there were two mergers so that the number of municipalities decreased to 1109.

2 We should note here that, contrary to the state or federal level, the formation of governing majorities within the local council is not institutionalized in the local law of Baden-Württemberg. Nonetheless, their existence

Though the municipalities constitute the lowest level of government in Germany, they still retain considerable autonomy in raising revenue and assume significant responsibilities at the expenditure side. Looking first at the revenue structure of German local governments, we find that they have three main income sources: tax revenue (45 % of current revenues[3] in 2001), allocation of funds (from the federal and state level, from municipal equalization schemes, and so on; 26 % of current revenues) and revenue from user charges (8% of current revenues) (see Figure 1(1)[4]). With respect to tax revenues, local governments can independently decide on five types of taxes: trade tax ("Gewerbesteuer"), property tax ("Grundsteuer"), tax on keeping dogs, second residence tax and entertainment tax. Only the first two of these yield significant revenues (42% and 13% of total tax revenue in 2001 respectively, see Figure 1(2)). Besides these own tax revenues, the municipalities receive a share of the revenue accruing from the federal income tax (15% of revenue raised in Baden-Württemberg), the interest income tax (12% of revenue generated in Baden-Württemberg) and the value added tax (2.2% of the VAT-revenue raised in Germany as a whole). As shown in Figure 1(2), these revenues constitute a considerable share of local government tax revenues (i.e. 40% and 4% respectively).

Figure 1: Structure of the current revenue (1) and composition of tax revenue (2) for all municipalities in Baden-Württemberg in 2001



Source: Statistical office of Baden-Württemberg and own calculations

Turning to the expenditure side, the revenue obtained by local governments in Baden-Württemberg serves to finance three types of tasks.[5] Firstly, local governments face *voluntary tasks*. The municipalities are not obliged to perform these tasks but they can assume responsibility for them if they so desire. Examples are cultural affairs (e.g. library), social affairs (e.g. residential home for the elderly), sport facilities (e.g. public swimming pools), entertainment facilities (e.g. hiking trails), traffic facilities (e.g. tram, harbour), partnership

is uncontested. These inter-party cooperations are used to facilitate and, to a certain extent, control the formation of opinions and decision-making.

3 We focus on current rather than total revenue, thereby excluding revenue from the capital account. The reason is that revenues on the capital account are much more volatile and would give a biased view of revenues at a given point in time.

4 Other sources of revenue include administrative revenue, shares in profits, concession levy, support for debt service and sales revenues.

5 A more detailed classification and description of these tasks is given in Gern (2005).

with foreign municipalities and municipal business development. The second type of tasks can be labelled as *duties without instruction*. These have to be performed by the municipalities, but do not involve detailed prescriptions imposed by a higher-level government concerning how local governments should perform these tasks. Examples of tasks in this category are the lighting and cleaning of public roads, children playgrounds and so on. Finally, there are *duties with instruction*. Local governments are obliged to perform the tasks, and the state imposes detailed regulations on how municipalities should perform them. Therefore, the implementation of these tasks is predetermined by the state. An example would be the running of local police authorities.

Table 1 provides a detailed overview of spending on different types of tasks as well as the corresponding share of total (current) expenditures – using the classification of functions as given in Baden-Württemberg's administrative regulation on the municipalities' budgets ("Verwaltungsvorschrift über die Gliederung und Gruppierung der Haushalte der Gemeinden"). It is clear that general financial management which includes, among other things, interest and amortization repayments as well as share of costs (such as the share of the trade tax belonging to the state; "Gewerbesteuerumlage") accounts for the bulk of current expenditures (approximately one third). Social security (e.g., kindergartens and youth welfare services) as well as public facilities and business development each account for roughly 12% of the budget while general administration absorbs approximately 9%. Other posts on the budget are generally somewhat smaller. Architecture, housing and traffic jointly account for 8% of the budget, schools for 6%, health, sports and recovery for 5%. Interestingly, public safety accounts for only 3% of the budget, even less than science and culture (which are allotted 4%).

With respect to labor costs, it should be noted that municipalities within a German federal state operate under identical conditions. Wages are defined by a uniform state-wide collective agreement without any possibility to differentiate wages across municipalities. In Baden-Württemberg, this changed slightly in 2005 when a new collective agreement ("Tarifvertrag für den öffentlichen Dienst der Kommunen": wage agreement for the public service at the municipal level) has become effective allowing for performance-oriented wages. Before that innovation, municipal wages were solely dependent on formal qualification, age and personal characteristics (marriage and number of children).

Table 1: Apportionment of the current expenditures according to the administrative regulation on the classification of the municipalities' (annual) budgets in 2001

Classification number	**Scope of functions**	**Expenditure (in € per capita)**	**Share of total current expenditure (in %)**
0	General Administration	172.34	8.94
1	Public Safety	63.79	3.31
2	Schools	114.26	5.91
3	Science, Research, Culture	80.74	4.18
4	Social Security	228.52	11.84
5	Health, Sport, Recovery	100.93	5.25
6	Architecture, Housing, Traffic	150.44	7.82
7	Public Facilities, Business Development	226.61	11.73
8	Commercial Companies, General Basic and Separate Assets	90.26	4.68
9	General Financial Management	700.78	36.34
	Sum	1928.67	100.00

Source: Statistical office of Baden-Württemberg and own calculations

3. Demographic change at the local level: The case of Baden-Württemberg

Since 2003 the population of Germany is in decline. Moreover, between now and 2050, it is expected to shrink further from the current 82 million inhabitants to roughly 69 to 74 million (Federal Statistical Office Germany, 2006). Still, substantial differences exist among the German states. While population decline set in years ago in all (former) Eastern German states, some states (especially in the south of Germany) have not started their decline yet (see Federal Statistical Office Germany, 2007). However, all will reach their tipping point in the near future. One of these is Baden-Württemberg, the state considered here.

Population projections for Baden-Württemberg for the period 2005-2025 are summarized in Figure 2.[6] The black solid line in Figure 2 shows the population development of Baden-Württemberg from 2005 to 2025. As can be seen, the population is predicted to grow to almost 10.8 million inhabitants in 2011, but then declines to reach 10.6 million inhabitants in 2025. Further projections by the Federal Statistical Office show that this decline will continue afterwards, and reach roughly 9.7 million inhabitants in 2050 (Federal Statistical Office Germany, 2007). Moreover, concurrent with the decline in population, significant changes in the age structure and population composition are expected. In Figure 2 four (structural) indicators are shown: (1) *old-age dependency ratio*, defined as the share of inhabitants aged older than 65 as a percentage of inhabitants between 20 and 65; (2) *young dependency ratio*, defined as the inhabitants younger than 20 divided by the population aged between 20 and 65; (3) *share of 'learning' population*, which specifies the ratio of inhabitants between 6 and 28 years (i.e. scholars and students) to total population; and (4) *share of 'employable' population*, which gives the inhabitants aged between 15 and 65 divided by total population. As can be seen in Figure 2, the old-age dependency ratio is set to increase by 11 percentage points (from 30% in 2005 to 41% in 2025) while the young dependency ratio falls from roughly 35% to 29%. Hence, the share of elderly in the Baden-Württemberg population will grow strongly in the next 15 to 20 years. This is accompanied by a decline in the share of the employable (from 66% to 63%) as well as the learning (from 25% to 21%) population.

To have a first glance at how these changes affect municipalities of different (size) dimensions in Baden-Württemberg, we establish four (municipal) size classes (using the 0.25, 0.75, and 0.95 quantiles of the municipal population distribution as cut-off points). They will, for convenience, be referred to below as 'very small', 'small', 'medium-sized' and 'large' respectively. The lower and upper limits of the number of inhabitants in every size class are given in Table 2.

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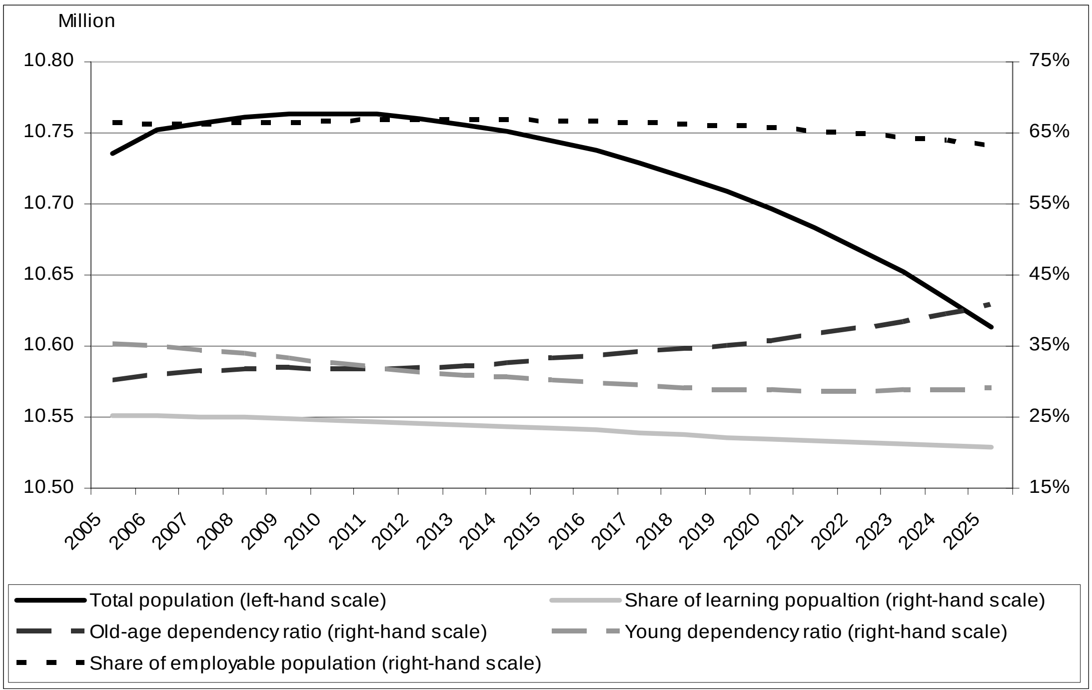
[6] These data are taken from Statistical Office of Baden-Württemberg and are based on following assumptions (as employed in their 11th coordinated projection; "11. koordinierte Landesvorausberechnung"). First, the starting point of the projection is the number of inhabitants in the municipalities on December 31st 2005. Second, birth rates remain constant over the period. Third, life expectancy increases by 3 years until 2025. Fourth, annual migration surpluses will be approximately 17,000 persons in Baden-Württemberg (these migration surpluses are not included in municipalities with less than 5000 inhabitants). Finally, the population in Baden-Württemberg is assumed to grow at a rate corresponding to the past relative development of the years 1997 to 2005 (Statistical Office of Baden-Württemberg, 2008).

Figure 2: Population projections for Baden-Württemberg (2005 to 2025)



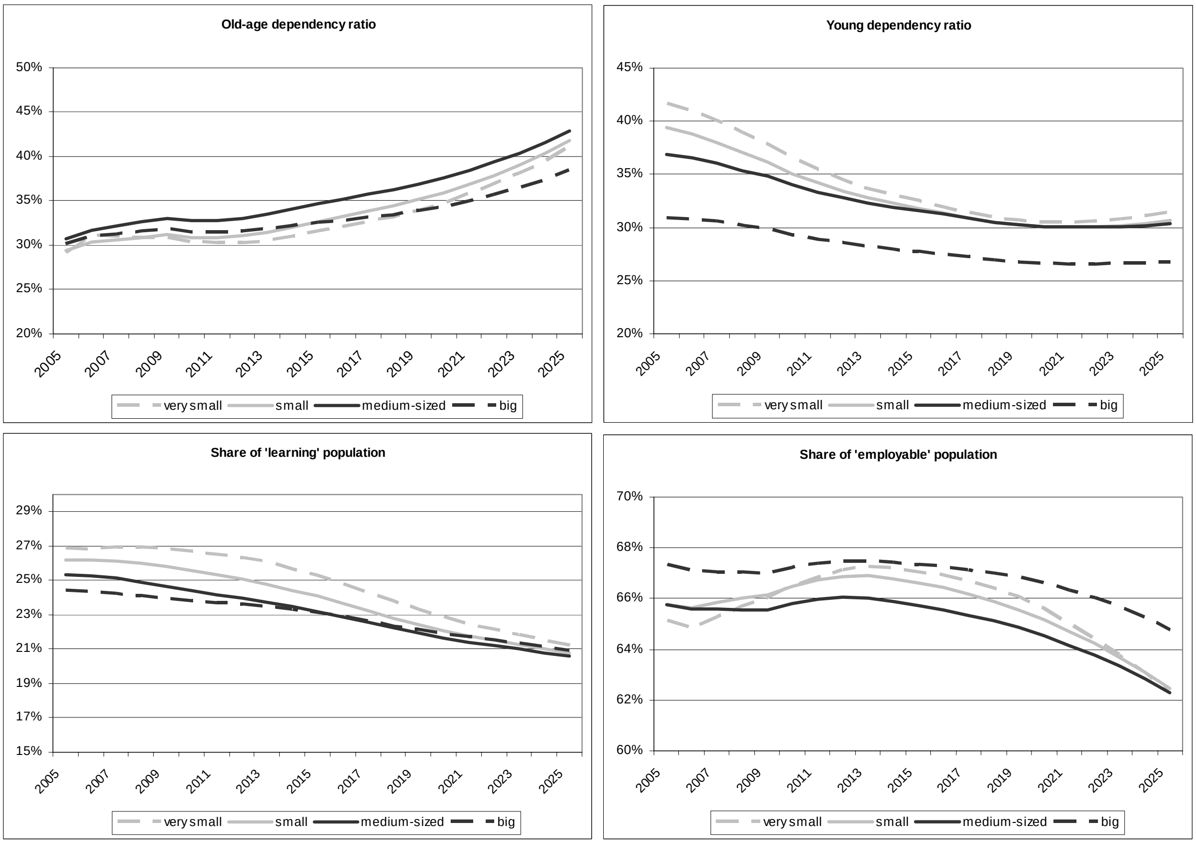
Source: Statistical Office of Baden-Württemberg and own calculations

Table 2: Number of inhabitants in the corresponding size class in 2005

Category (municipality)							
(1) *'very small'* (< 0.25-quantile)		(2) *'small'* (0.25-0.75-quantile)		(3) *'medium-sized'* (0.75-0.95-quantile)		(4) *'large'* (> 0.95-quantile)	
Number of inhabitants							
from…	to…	from…	to…	from…	to…	from…	to…
103	2489	2490	9137	9138	29627	29628	592569

Figure 3 depicts the development of the old-age and young dependency ratio as well as the share of 'learning' and 'employable' population for the four size classes presented in Table 2 for the period 2005-2025. While the trend in most cases is similar across all four municipal types, some interesting differences appear. First, in the next 15 to 20 years, there will be a tremendous increase in the old-age dependency ratio in all four size classes. Still, its increase is predicted to be highest in the 'medium-sized' (12 percentage points) and lowest in the 'large' municipalities (8 percentage points). As a consequence, the old-age dependency ratio is set to diverge strongly across the four municipal types, whereas at present it is at a comparable level (circa 30%). Second, a somewhat similar development is predicted to occur for the young dependency ratio, though in the reverse direction. That is, while there currently are substantial differences between the four municipal size classes, these are expected to reduce dramatically. Specifically, the young dependency ratio in 'very small' municipalities will fall substantially until 2025 (from approximately 42% in 2005 to 32% in 2025), whereas in 'big' municipalities this reduction is much more moderate (from 31% to 27%). This convergence is mirrored in the evolution of the ratio of inhabitants between 6 and 28 years to total population ('learning' population). While presently highest in the 'very small' (27%) and lowest in the 'big' (24%) municipalities, this ratio reduces in all size classes over the next 15-20 years and converges to a value of about 21% (in 2025). Finally, the share of inhabitants aged between 15 and 65 ('employable' population) declines more or less equally strongly across all four municipal size classes over the period studied. However, in this case, the evolution between 2005 and 2025 is somewhat different (with a stronger initial increase and stronger subsequent drop in the smaller municipalities).

Figure 3: Population projections for different municipal size classes (2005 to 2025)



Source: Statistical Office of Baden-Württemberg and own calculations

To sum up, the decline in population in Baden-Württemberg will be accompanied by significant changes in the structure and composition of total population. The old-age dependency ratio will increase, while the young dependency ratio as well as the share of the 'learning' and 'employable' population will decline. Moreover, these structural changes are not equally distributed among municipalities. In fact, the decomposition in Figure 3 suggests that structural changes will be strongest in smaller municipalities. In the next (two) parts of this paper, we try to assess how these changes affect local public finances. As such, we intend to gauge local governments' vulnerability to the fiscal consequences of these demographic transformations (by determining cost elasticities to municipalities' demographic characteristics).

4. Methodological approach

How can one gauge the expected effects of (predicted) demographic transformations on local public finances? Our approach rests on the determination of the *elasticity* of local public spending to changes in local demographic characteristics. To that aim, we estimate a basic expenditure function of local governments, which can be written as (with *i* subscript for municipality):

$$\ln Exp_i = \beta_0 + \sum_{r=1}^{5} \beta_r \ln DEMOG_{ri} + \sum_{l=1}^{6} \gamma_l CONTROL_{li} + \varepsilon_i \qquad (1)$$

where Exp_i represents total public expenditures, $DEMOG_{ri}$ is a vector containing a number of demographic characteristics determining the spending needs and/or preferences of the municipality's population, and $CONTROL_{li}$ corresponds to a vector of further 'control' variables that affect public spending (since this section delineates the empirical methodology, details concerning the specific variables employed are relegated to the next section). Importantly, the model is estimated in logarithmic form. Since the dependent as well as the demographic variables are in natural logs, the estimated coefficients of the demographic variables (i.e. β_r) in equation (1) can be interpreted as real cost elasticities. Therefore, they show how a one percentage increase/decrease of a given demographic variable affects the costs for providing a bundle of public goods.

While straightforward estimation of equation (1) above provides us information about the cost elasticity of demographic factors, it does not enable us to assess how these elasticities differ over subsamples of the dataset. Such information is, however, essential to uncover the types of municipalities (i.e. large or small population size, share of elderly, and so on) facing most serious cost problems in the coming decades. To address this issue, we employ an estimation technique known as 'rolling regressions'. In 'rolling OLS', the parameters of the regression model are first estimated for a certain subsample of the dataset S_1 = 1, 2, …, x (e.g., the x smallest municipalities in the sample). The subsample is then 'rolled over' by one observation and the model is estimated again using this slightly altered sample S_2= 2, 3, …, x+1 (e.g., including the next-largest municipality while dropping the smallest one). This overlapping ("moving window") procedure continues until the subsample reaches the other end of the sample (e.g., the x largest municipalities). While 'rolling' least squares over the changing subsamples of the data, the coefficient estimates are kept after each estimation and the path of these is plotted.[7]

This procedure is often employed to test parameter stability in time series analyses. By analysing the plotted coefficient estimates from the various estimations, one can indeed easily assess the existence (and strength) of sudden breaks and patterns (with Chow tests allowing examination of parameter stability; cf. Thomas, 1997). In our specific setting, analysis of the coefficient estimate plots for the coefficients in the vector β_r permits us to determine how the cost elasticity of demographic characteristics changes for various clusters of municipalities (with clusters based on the demographic characteristic at hand). As such, we can evaluate which types of municipalities are most sensitive to certain demographic changes: e.g., whether large rather than small municipalities are most sensitive – in terms of the elasticity of public spending to population size – with regard to population declines.

Before we turn to the empirical analysis in the next section, it should be noted that, while not strictly required to employ rolling regressions or perform tests of parameter stability, we sort the dataset (i.c. from municipalities with low to high levels of a given demographic characteristic) prior to rolling the 'moving window' over the data. The reason is that such sorting of the data greatly simplifies the interpretation of the coefficient plot in terms of how parameters alter given certain (pre-defined by the sorting process) variations in the underlying data. That is, when the data are ordered from low to high, say, population size, it is straightforward to compare the elasticity of public spending with respect to population for municipalities with different population sizes. It is exactly such an interpretation of the results

[7] Rolling OLS thus is closely related to 'recursive' least squares. However, while the former uses a moving window of constant size, the latter starts with a small subsample of the data and extends this by one observation between each estimation until estimation is carried out on the full sample (Thomas, 1997, 269).

that are of most interest to us in the present analysis (rather than simply whether or not parameter estimates are stable over the various estimations).[8]

5. Empirical Analysis

5.1. Model specification

The empirical analysis employs data concerning 1021 of the 1111 municipalities in the state of Baden-Württemberg in the year 2001 (data availability precluding the inclusion of the remaining municipalities). As mentioned, we exploit these data via the estimation of a basic expenditures function of local governments – as given in equation (1) above. Our measure for public spending (Exp_i) equals total current local government expenditures, which includes all spending on the current budget except interest and amortization repayments.[9] The vector of demographic variables analysed ($DEMOG_{ri}$) contains five variables: (a) total population, (b) population over age 65, (c) population aged below 6 years, (d) number of students in local public schools ("Grund- and Hauptschulen"), and (e) number of employees who are subject to social insurance contributions. These five variables were selected not only because they describe the main demographic characteristics of the German municipalities, but also because the Statistical Office of Baden-Württemberg has, at the municipal level, made some predictions as to the evolution of (closely related) demographic indicators over the period 2005-2025 (see section 3).

To more adequately measure the effect of our demographic variables, we complete the empirical model with a vector of control variables ($CONTROL_{li}$) containing six further, commonly acknowledged, determinants of public spending. Firstly, we include population density to proxy the rural/urban divide. While high population density might entail cost advantages due to regional concentration of services (Stevens, 2005), higher property costs in urban areas and the fact that large cities tend to have central place functions, such as the arts and culture (cf. Heilbrun, 1992; Werck *et al*., 2008), may render production more costly. Then, we control for the unemployment rate since it implies a) higher spending on unemployment and housing benefits (a '*cost effect*') and b) lower demand for high-cost (or high-quality) public services (demand for such services is likely to increase with income levels) (a '*preference effect*'). Moreover, following the literature on the Weak Government Hypothesis (for an overview, see Ashworth *et al*., 2005), we include a measure of political concentration or monopolization in the local council as a political control variable. This is quantified via the Herfindahl index and calculated using seat shares of the main national parties (CDU, FDP, SPD, GRÜNE) as well as the so-called 'free voter unions'.[10] Low concentration (or high fragmentation) represents high political competition and is expected to increase public spending. Finally, we include three fiscal variables: intergovernmental grants,

8 An alternative approach to assess the effect of demographic structures (though not population size) on local public spending is to estimate the relation between (the log of) expenditures *per capita* and the demographic variables defined as a percentage of the total population (controlling, as before, for other influences). This log-linear approach would generate semi-elasticities of current primary expenditures *per capita* with regard to changes in the demographic variables (thus representing how a one percentage point change in, say, the share of elderly affects public spending per capita). The inferences drawn from this alternative approach are closely in line with those based on the (arguably more standard) approach discussed above. Hence, we refrain from presenting both sets of results to preserve space (full results available from the authors).

9 Spending from the capital budget is ignored as decisions to invest in large infrastructure projects are infrequent events and thus tend to inflate spending in the year they occur. Given the cross-sectional nature of our analysis, focus on the current budget avoids distortions resulting from fluctuating investment decisions.

10 'Free voter unions' are loose federations of persons not belonging to specific political parties and exist only at the local level.

revenue from the trade tax and outstanding debts. To reduce (obvious) endogeneity problems, we use one-period lagged values for all three variables. For intergovernmental grants and tax revenue, we expect a positive relationship with current expenditures while debts are expected to reduce municipalities' spending. Summary statistics for all variables are given in Table A1 of appendix A.

It is important to note at this point that we perform one set of rolling regressions – following the procedure elucidated in section 4 – for each of the five demographic variables contained in our empirical specification. In each case, prior to rolling OLS over the dataset, we sort the dataset from the municipality with the lowest to the municipality with the highest value on the particular demographic variable. Also, we selected an 'observation window' of size 500 to perform the regressions (implying we include exactly 500 municipalities in each run of the model). This window size is admittedly a somewhat arbitrary choice, but balances the desire to have sufficient observations in each run of the model with the need to perform a sufficient number of estimations to examine the evolution of the parameter estimates under observation (β_r). Similar results are, however, obtained using a window size of 300 and 400 (though the coefficient estimates then somewhat less stable in these cases; full results available upon request). After each run of the model, we retain the coefficient estimates and the results (for each of the five demographic variables) are discussed in the next sub-section via the plotted outcomes of the rolling regressions.[11]

5.2. Empirical results

a) <u>Population size</u>

The first results presented regard the cost elasticity of population size across different population sizes. As such, this subsection takes a closer look at economies of scale in the provision of public goods by Baden-Württemberg's municipal governments, and gives some insight into how predicted population declines might affect the development of local public spending in municipalities of differing dimensions. The results of the rolling regression are graphically represented in Figure 4. This figure shows the average population size of the 500 municipalities in every subsample of the rolling regression on the X-axis. The corresponding estimated cost elasticity – that is, the estimated coefficient for the variable 'total population' in equation (1) – is represented on the Y-axis. The full line depicts the cost elasticity estimates while interrupted lines portray the 95%-confidence intervals around each individual estimate.

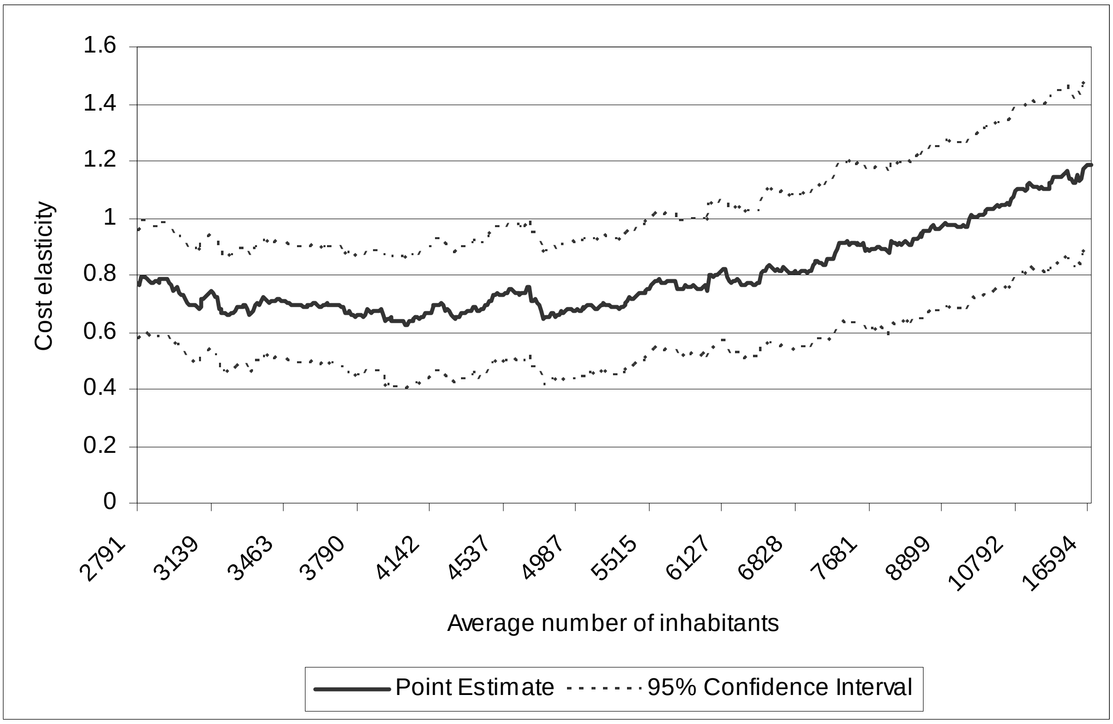
Two conclusions can be drawn from Figure 4. First, coefficient estimate is always statistically significantly different from 0 and ranges from 0.63 to 1.19. This implies that when population size increases (decreases) with ten percent, public spending increases (decreases) with six to twelve percent. Hence, some of the municipalities in Baden-Württenberg operate on average under conditions with increasing economies of scale. That is, costs per capita could be cut when the average scale of production were larger. Second, and crucially, these economies of scale play a different role in small versus large municipalities such that population decline affects small and large municipalities differently. More specifically, for the main part of the range in population size, cost elasticity (with respect to population) is an increasing function of population size.[12] Therefore, cost pressure as a result of a shrinking population threatens

[11] For comparison purposes, the results of a standard OLS regression on all 1021 municipalities is presented in Table A2 of appendix A.

[12] Effectively, economies of scale become (close to) exhausted once population size reaches approximately 6000 inhabitants (i.e. the cost elasticity for population sizes of 6000 and above is not significantly different from one, whereas this is not the case for population sizes below this threshold).

particularly smaller municipalities (as they are less able to reduce their spending level in line with the population reduction). From a policy perspective, this raises obvious questions concerning mergers, inter-municipal cooperation, or increased assistance of small municipalities from higher-level governments (e.g. through the German fiscal equalization scheme) once the demographic change gains momentum.[13]

Figure 4: Development of cost elasticities with increasing size of population



b) Population over age 65

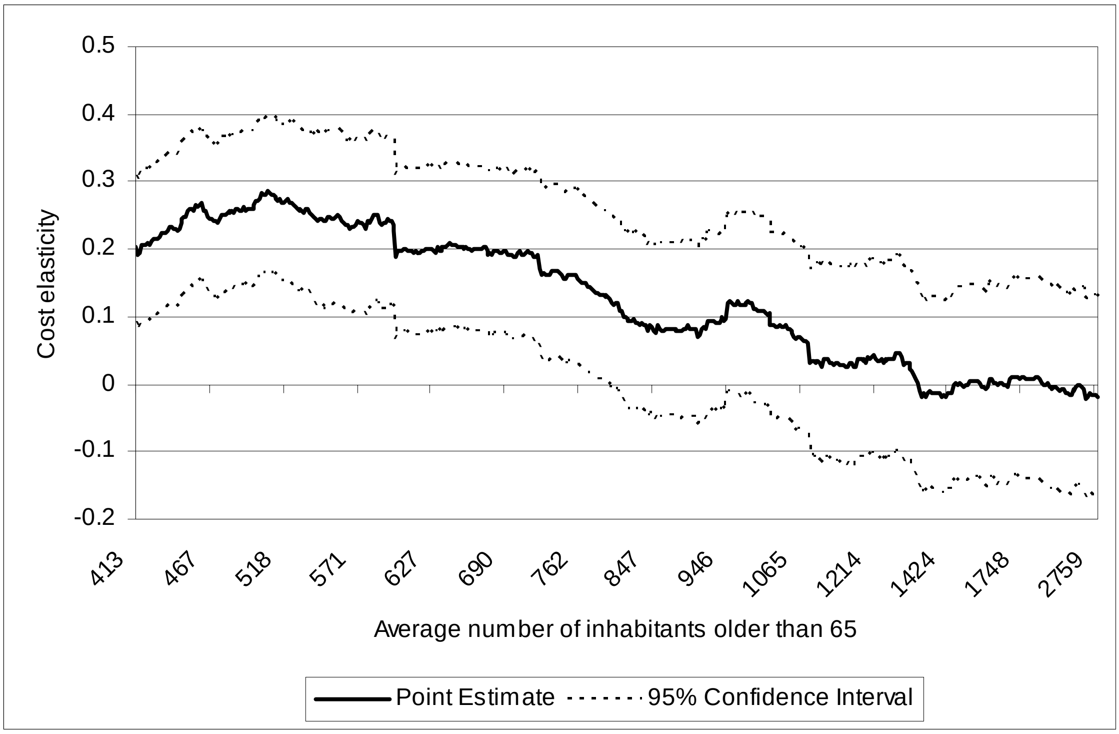
Population decline is only one aspect of demographic change. As illustrated in section 3, many municipalities should also expect (often dramatic) shifts in the demographic structure. Therefore, we likewise consider the impact of changing population structure on local public spending in this and the following three subsections. Here, we first cast a detailed look at the relation between public spending and the population over 65 (and how this relation is affected for varying sizes of the elderly population). The results of the rolling regression – for subsamples with increasing numbers of elderly in the population – are graphically represented in Figure 5. In line with Figure 4, the X-axis shows the average number of elderly in the subsample, while the estimated cost elasticity is on the Y-axis.

Figure 5 clearly illustrates that when the number of elderly in a municipality is low, increasing numbers of elderly will lead to higher costs. That is, for (average) levels of elderly below approximately 500, the cost-elasticity estimate varies from 0.2 to 0.3. However, this cost pressure quickly abates. Once the number of elderly surpasses this threshold, estimated cost elasticities decline towards zero and appear to stabilize around this level at high levels of elderly. Note also that estimated cost elasticities are only significantly different from zero at low levels of elderly (up to approximately 800). This suggests that, in a sense, it is mainly the initial stages of developing a policy program on care for the elderly that lays a significant burden on the municipal budget. Once these initial steps are taken and a municipality has

[13] Clearly, we analyze the 'optimal' (population) size of municipalities with respect to cost considerations only. This disregards other characteristics that may play a role here (such as geographical characteristics).

made its policy program fit the needs of the aged, additional numbers of elderly do not appear to create strong upward shifts in public spending.[14] Overall, this result suggests that, once again, small municipalities are in a bad position to tackle the upcoming demographic changes as they are least likely to have made the initial 'investments' in extensive old-age policy programs.

Figure 5: Development of cost elasticities with increasing size of elderly population



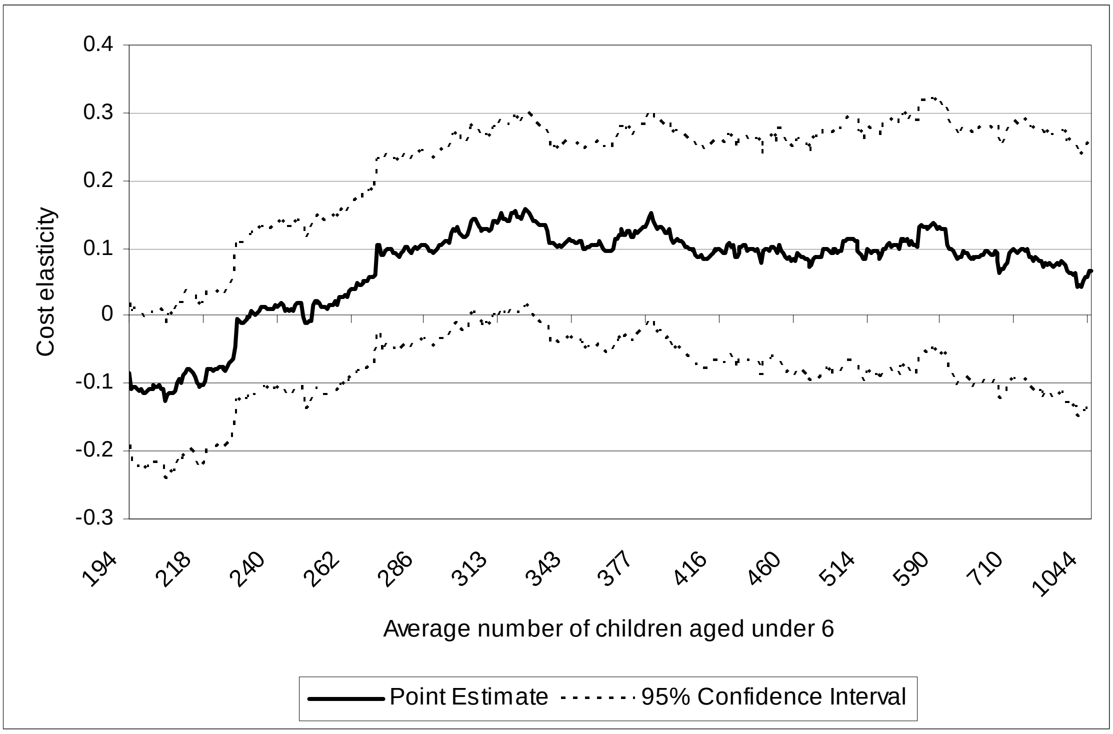
c) Population under age 6

In this subsection we consider the relationship between public spending and the population aged less than 6 years. The investigation of this relationship shows how municipalities' public spending responds to (relative) losses in the youngest population group. The results of the rolling regression for subsamples with increasing numbers of children aged under 6 years are given in Figure 6. Again, the X-axis shows the average number of children less than 6 years in the subsample, whereas estimated cost elasticities are represented on the Y-axis.

Figure 6 reveals that, initially, the cost elasticity is an increasing function of the average number of children aged below 6 years (up to approximately 280 children). Afterwards, the estimates of the cost elasticites vary around 0.1%. This means that cost pressure will be highest for municipalities with few children. This could be due to the fact that fixed costs for public services (e.g. kindergarten buildings) are carrying more weight when there are fewer people (e.g., little children) who use the services provided by the municipalities. Note, however, that cost elasticities are only significantly different from zero at the very beginning of the scale (up to approximately 220 children aged under 6). Again, this result suggests that (very) small municipalities are in a bad position to manage the upcoming demographic changes.

[14] Note that this is consistent with the observation that German municipalities do not really carry a direct burden for transfers to the elderly (such as pensions) or for parts of old-age care (such as increased reliance on health care) (see Seitz *et al.*, 2007).

Figure 6: Development of cost elasticities with increasing size of young children

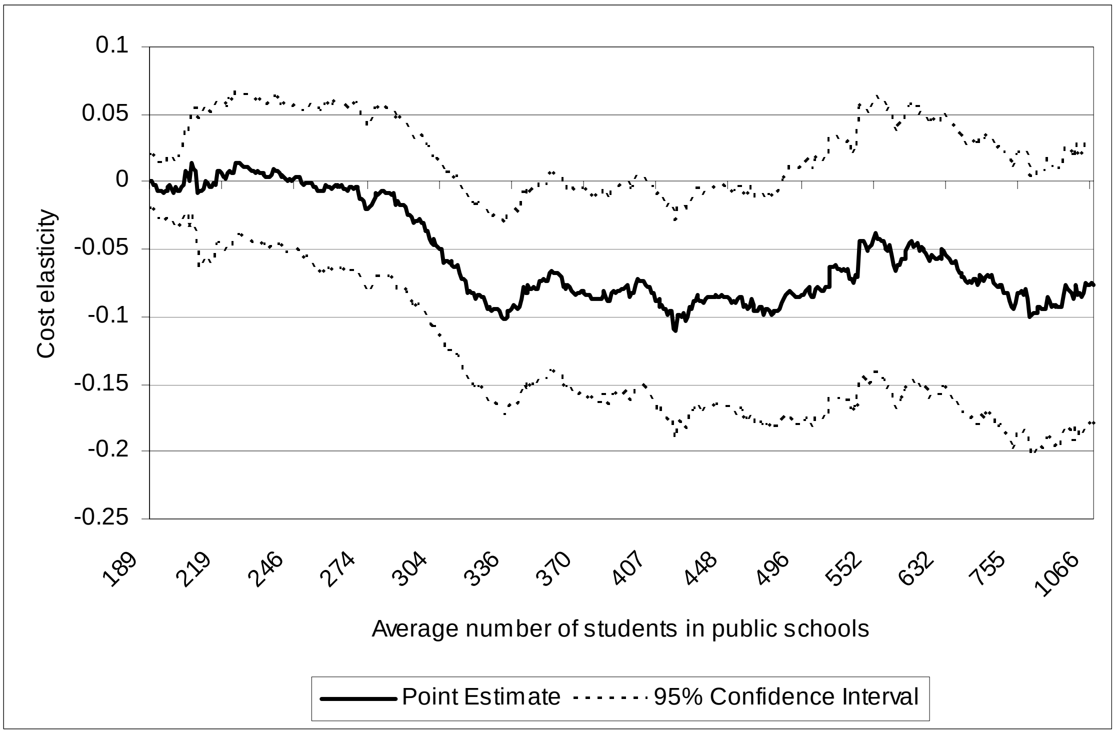


d) Students in public schools

In section 3, we saw that the share of the 'learning' population (inhabitants between the ages of 6 to 28 years) will decrease in all (municipal) size classes in the next 15 to 20 years. To investigate how this might affect local public spending, this subsection considers cost elasticities with respect to the number of students in public schools (which is a significant part of the 'learning' population, and one for which education costs fall at least partly on the municipality). In Figure 7, the Y-axis shows the point estimates of the coefficients for the variable 'students in public schools', whereas the average number of students of the 500 municipalities in every given subsample of the rolling regression is depicted on the X-axis.

As can be seen from Figure 7 the cost elasticity initially hovers around zero. At an average number of students of about 280 the elasticity starts to decline until it reaches a value of about -0.l. In contrast to the previous case this result would suggest that, once student numbers start to decline, bigger municipalities will be (financially) more affected than smaller ones. One intuitively appealing explanation is that smaller municipalities (with few children required to attend school) do not run their own schools; they sent their scholars to the next (bigger) municipality. Hence, fixed costs for, e.g. maintenance of school buildings, are absent. Note, however, that the point estimates tend to be insignificant over the whole range (the estimates at best flirt with significance at the 95% confidence level at the middle range of the 'learning population'). This leads us to, carefully, conclude that there is no identifiable cost impact.

Figure 7: Development of cost elasticities with increasing scholars

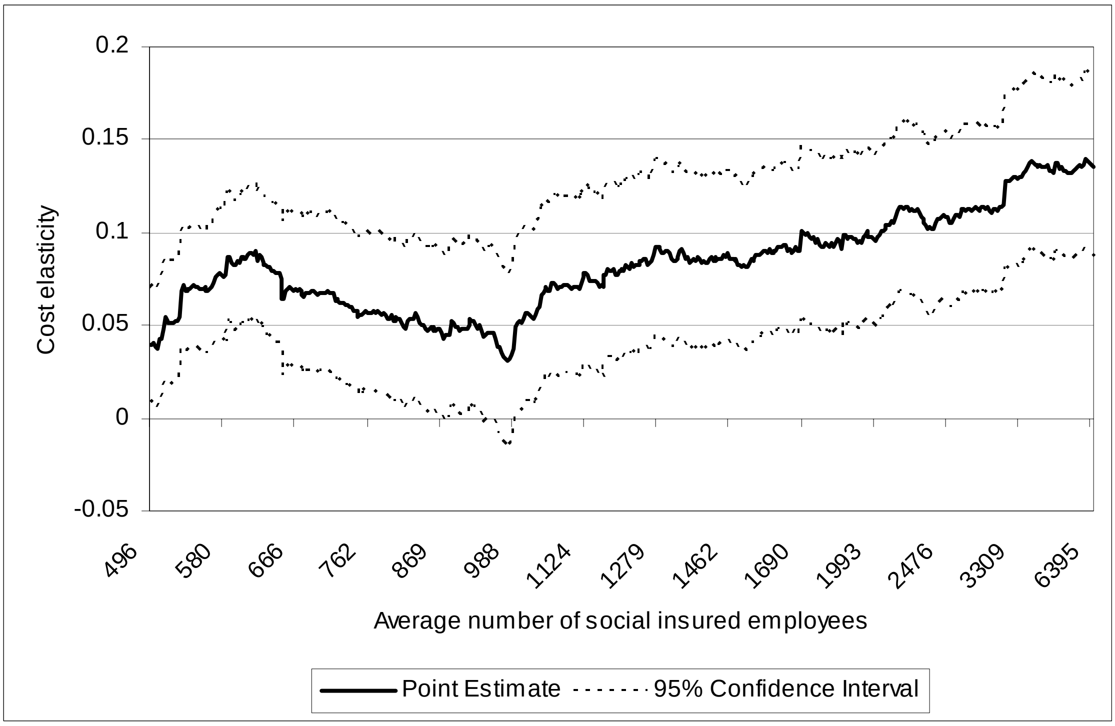


e) Social insured employees

Finally, our last demographic variable is the number of employees subject to social insurance contributions. Section 3 illustrated that the share of the 'employable' population (defined as the number of inhabitants aged between 15 and 65 divided by total population) is expected to decline substantially between now and the year 2025. The number of employees who are subject to social insurance contributions, therefore, will decrease too. As in the previous cases, Figure 8 shows the relationship between the cost elasticities (with respect to the number of social insured employees) and the average number employees of the 500 municipalities in every subsample of the rolling regression.

First of all, it should be emphasized that a decline in the number of social insured employees will be a burden for the revenue side of municipal budgets. However, our focus is on the expenditure side where this decline could result in cost savings related to providing business infrastructure. Figure 8 shows that, similar to the total population case in subsection (a), (1) the cost elasticity is an increasing function of the average number of social insured employees, and (2) the point estimates are significantly different from zero over nearly the entire range of employees who are subject to social insurance contributions. This implies that costs can be cut significantly once the number of social insured employees starts to decline. This cost reduction could be due to the fact that a declining number of employees is also accompanied by a reduction in (expensive) business related infrastructure expenditures. As can be seen from Figure 8, the cost reduction is highest in municipalities with many employees, suggesting, once more, that smaller municipalities benefit less from this population evolution than bigger ones.

Figure 8: Development of cost elasticities with increasing number of social insured employees



6. Conclusion

In this paper we investigate local governments' vulnerability to the fiscal consequences of demographic change (which will take place over the next decades in Germany). For this purpose, we estimate expenditure functions of local governments of different size and determine cost elasticities with respect to municipalities' demographic characteristics (total population, population older than 65, population younger than 6, number of students in public schools and number of social insured employees). Using an estimation technique known as 'rolling regression', we in each case (that is, for each demographic variable) estimate these elasticities for different subsamples of the municipalities (based on the demographic variable of interest). As such, we obtain a set of cost elasticities for each different demographic variable, and can analyse how these elasticities differ for the different subsamples.

Our results indicate that demographic change constitutes a (fiscal) challenge at the local government level (in Baden-Württemberg). However, it transpires that not all municipalities will be hit equally powerfully by the demographic transformations. According to our calculations, municipalities characterized by the following properties will suffer most from demographic transformations (a summary of these results is also given in Table 3 below):

- Cost pressure as a result of a shrinking population threatens particularly smaller municipalities (up to approximately 6000 inhabitants) since they are less able to reduce their spending level in line with the population reduction.
- Municipalities with a low level of elderly are in a bad position to manage the upcoming population ageing since they are least likely to have made the initial 'investments' in extensive (and expensive) old-age policy programs.
- Municipalities with a low level of children aged below 6 years are likely to suffer more from decreasing fertility since with a declining number of children fixed costs for e.g. kindergarten buildings carry more weight. (Interestingly, the effect of students in public schools is weak to non-existent.)

- Municipalities with a low level of employees who are subject to social insurance contributions may benefit less from a reduction in (expensive) business related infrastructure expenditures.

Table 3: Summary of the results

Cost driver	**Demographic trend**	**Significant impact**	**Cost pressure**	**Cost savings**
Population size	Decreasing	Yes	For population size below 6000	For no type
Population older than 65	Increasing	Only for low levels of elderly	For levels of elderly up to 500	For no type
Population younger than 6	Decreasing	Only for very low levels of children under 6	For levels of children under age 6 up to 220	For no type
Students in public schools	Decreasing	No	For no type	For no type
Social insured employees	Decreasing	Yes	For no type	For high and medium levels of employees

Overall, our findings underscore the importance of taking the upcoming demographic transition seriously. Moreover, most of these demographic changes are likely to have especially severe consequences – in terms of cost pressures – on smaller municipalities. From a policy perspective, this raises obvious questions concerning mergers, inter-municipal cooperation, or increased assistance of small municipalities from higher-level governments (e.g., through the German fiscal equalization scheme).

References

Ashworth, J., B. Geys and B. Heyndels (2005). Government Weakness and Local Public Debt Development in Flemish Municipalities. *International Tax and Public Finance*, 12 (4): 395-422.

Batini, N., T. Callen, and W. McKibbin (2006). The Global Impact of Demographic Change. *IMF Working Paper*, No. WP/06/9.

Bloom, D.E., and D. Canning (2004). Global Demographic Change: Dimensions and Economic Significance. *NBER Working Paper*, No. 10817.

Eurostat (2006). Population Statistics, Luxemburg: Eurostat.

Federal Statistical Office Germany (2006). Bevölkerung Deutschlands bis 2050 – Ergebnisse der 11. koordinierte Bevölkerungsvorausberechnung nach Ländern. Wiesbaden: DeStatis.

Federal Statistical Office Germany (2007). Bevölkerung Deutschlands nach Bundesländern bis 2050 – 11. koordinierte Bevölkerungsvorausberechnung. Wiesbaden: DeStatis.

Gern, A. (2005). Kommunalrecht Baden-Württemberg. Nomos: Baden-Baden, 117-129.

Heilbrun, J. (1992). Art and Culture as Central Place Functions. *Urban Studies*, 29 (2): 205-215.

Jackson, N.O., and B. Felmingham (2002). As the Population Clock winds down: Indicative Effects of Population Ageing in Australia’s States and Territories. *Journal of Population Research*, 19(2): 97-118.

Jackson, N.O. (2004). Some Considerations on Regional Population Ageing and Local Government Funding in Australia. University of Tasmania, *mimeo*.

Seitz, H., D. Freigang, S. Högel, and G. Kempkes (2007). Die Auswirkungen der demographischen Veränderungen auf die Budgetstrukturen der öffentlichen Haushalte. *Perspektiven der Wirtschaftspolitik*, 8(2): 147-164.

Statistical Office of Baden-Württemberg (2008). Methode der Bevölkerungsvorausberechnung. Stuttgart, URL: http://www.statistik-bw.de/BevoelkGebiet/BevProg/Methode.asp.

Stevens P.A. (2005). Assessing the Performance of Local Government. *National Institute Economic Review*, No. 193.

Thomas R.L. (1997). *Modern Econometrics: An Introduction*. Addison-Wesley-Longman Ltd.: Harlow.

Van de Kaa, D.J. (1987). Europe's Second Demographic Transition. *Population Bulletin*, 42(1), Population Reference Bureau, Washington, D.C.

Werck K., B. Heyndels and B. Geys (2008). The Impact of ‘Central Places’ on Spatial Spending Patterns: Evidence from Flemish Local Government Cultural Expenditures. *Journal of Cultural Economics*, 32(1): 35-58.

Appendix A

Table A1: Descriptive Statistics (1021 municipalities of Baden-Württemberg in 2001)

Variable	Mean	Standard Deviation	Minimum	Maximum
Current primary expenditures (in million euros)	19.30	68.40	0.34	1650.00
Demographic variables:				
Total population	10163.37	26273.20	237	583843
Population older than 65	1664.17	4482.28	34	98205
Population younger than 6 years	643.74	1451.29	10	31497
Students in public schools	647.96	1293.33	1	26342
Number of social insured employees (at place of work)	3742.52	14920.20	6	353801
Control variables:				
Population density (inhabitants per hectare)	3.25	3.29	0.20	28.16
Unemployment rate (in %)	5.19	1.01	2.60	10.38
Herfindahl index	0.53	0.25	0.22	1.00
Intergovernmental grants (per capita), lag	418.77	173.55	77.97	1454.21
Revenue from trade tax (per capita), lag	254.87	286.09	1.00	3027.94
Outstanding debts (per capita), lag	410.43	306.60	0.10	1832.30

Source: Statistical office of Baden-Württemberg

Table A2: Results of the regression with all 1021 municipalities (for the year 2001)

Variable	**OLS-estimates**
Total population, log	0.875403**
	(0.079426)
Population older than 65, log	0.144154**
	(0.044004)
Population aged below 6 years, log	-0.057208
	(0.053690)
Students in public schools, log	-0.016100*
	(0.009439)
Number of social insured employees, log	0.063641**
	(0.015856)
Population density	0.003827**
	(0.001867)
Unemployment rate	-0.005629
	(0.005133)
Herfindahl index	0.054742**
	(0.025797)
Intergovernmental grants, lag	0.000154**
	(0.000031)
Revenue from trade tax, lag	0.000393**
	(0.000044)
Outstanding debts, lag	-0.000005
	(0.000016)
Intercept	7.281156**
	(0.197415)
R-squared (adjusted)	0. 976182

Note: N = 1021, Dependent variable: current primary expenditures. Robust standard errors in parenthesis.
** (*) denotes significance at 5% (10%) level.