Undergraduate Economic Review

Volume 5 | Issue 1 Article 10

2009

Wrinkles in Fiscal Policy: An Examination of the Effects of Aging Demographics on Public Expenditures and Revenues

Thuy P. Le
Carleton College, thuy.le@alumni.carleton.edu

Wrinkles in Fiscal Policy: An Examination of the Effects of Aging Demographics on Public Expenditures and Revenues

Abstract

The speculation that public spending may shift as the age composition changes in the United States raises questions regarding the sustainability of government programs. This paper addresses this issue by examining how age demographics alter a county government's spending on public goods and its sources (local taxes or intergovernmental transfers from the state and/or federal level) for funding these expenditures. Building on an existing model, this study finds that it is not enough to simply examine this question with cross-sectional analysis, suggesting that time and county fixed effects need to be considered to address consequences from the Tiebout bias. The results report that the consequences of age composition vary according to the spillover and cost dimensions of each public good. However, these changes are rendered benign as revenues shift in a similar manner as spending, which eliminates potential imbalances within county governments.

Keywords

Demographics, Fiscal Policy, Government, Revenues, Expenditures, Tiebout Bias

1. Introduction

The United States' demographic is transforming dramatically due to changing patterns in fertility and mortality. The Office of the Actuary of the Social Security Administration (OASSA) reports that life expectancies at birth are expected to increase from 73.0 years for men and 79.2 years for women in 1996 to 82.4 and 85.6 years, respectively, in 2080. At the same time, fertility is decreasing, as indicated by the percentage of childless women rising from 35.1 percent in 1976 to 45.1 percent in 2006. Declining fertility and rising life expectancy contribute to an older U.S. demographic. According to the U.S. Census Bureau, the proportion of the United States' population over 65 years of age is projected to increase from 12.4 percent in 2000 to 20.7 percent in 2050. Lee and Tuljapurkar (2001) indicate that the elderly dependency ratio will peak at around 41 percent to 45 percent in the decade from 2030 to 2040. The demographic makeup of the United States will undergo a dramatic restructuring according to these projections. In order to plan for these changes, it is important to study the effects of demographic transformation, especially the effects of aging demographics on public expenditures and revenues.

As constituent demographics shift, governments face the possibility of changing public support for expenditures and the funding problems that may arise. A possible relationship between demographics and spending is characterized in a median voter framework. One scenario using the median voter framework is called the selfish choice model (Cutler, Elmendorf, and Zeckhauser, 1993). According to Becker (1983), individuals identify with groups defined by commonalities such as occupation, industry, income, geography, and age. These groups use political influence to improve the well-being of members. Competition among these political groups determines the equilibrium structure of taxes, subsidies, and spending. Assuming that the majority determines the outcome of voting, an aging demographic changes the identity of the median voter to its desired level of spending and/or tax revenues (Cutler et al., 1993).

The occurrence of spillovers is another argument for a correlation between age demographics and public expenditures in the selfish choice model. Spillovers are created when the benefits of publicly funded services are enjoyed by nonresidents or when a community invests in those who leave the jurisdiction before returns are realized (MaCurdy and Nechyba, 2001). For instance, a spillover is generated when a community funds the education of children who move away before the community realizes returns on its investment. Spillovers are a concern because they are a fiscal burden on communities. Funding problems for public programs arise as a result of these fiscal burdens. Fiscal burdens can be lowered according to the selfish choice model. For example, in a community with a large elderly population, the identity of the median voter has a spending agenda closer to that of the elderly population. The elderly population only wants a small portion of local tax revenues to be allocated to spending for education since large fiscal burdens come about as a result of the high likelihood that the elderly will not realize returns on this particular investment due to their advanced age and/or a lack of children that could benefit from education spending.

Cutler et al. also describe a second model involving the median voter framework called the community preference model. In this model, people care about the welfare of other people living in their community, which means an individual's spending preferences alter as community demographics change. For example, if there are more children in a community, the elderly population would desire to spend more money on education because they care about the children in their community. Thus, the identity of the median voter changes so taxes are increased to fund education expenditures.

Much of the empirical work on the effects of aging demographics is narrow. The literature tends to focus on individual expenditure categories and the corresponding federal or

state grant program. Studies of this nature include work such as that of Poterba (1997), Harris, Evans, and Schwab (2001), and Ladd and Murray (2001) on education spending. However, one exception in this trend is presented in a study by MaCurdy and Nechyba (2001). In their paper, they analyze the impact of demographic factors on five different expenditure categories of a local government, i.e. the 58 counties of California, in 1990. To do this, they regress each expenditure category on a number of demographic variables. In addition, they examine how aging demographics affect intergovernmental transfers from the state and federal governments and local tax revenues of these county governments to understand the ability of counties to fund expenditures. This is done by regressing each revenue type on demographic variables. By using this method, the issue of fungibility[1] that has been neglected in previous research is addressed. From their work, MaCurdy and Nechyba answer the question: How does a change in the age composition of a county's population alter a local government's spending on public goods and on its sources (local taxes or state/federal) for funding these expenditures?

The goal of this paper is to answer the same question as that of MaCurdy and Nechyba. However, I deviate from their investigation in two ways. The first way is by examining all counties in the 48 continental United States instead of focusing solely on Californian counties. Secondly, I modify their study by using a panel data set to account for county specific factors and time fixed effects. This method is commonly utilized in research examining the effects of demographic change on public education spending such as that of Poterba (1997), Harris et al. (2001), and Ladd and Murray (2001). In deviating from MaCurdy and Nechyba's method, there is evidence that their results do not hold in different time periods, with added county and time fixed effects, and when the study is extended to the rest of the United States. This leads me to

[1] Fungibility refers to the ability of spending on public goods to be freely exchangeable or replaceable by substitution.

conclude that the Tiebout bias, the idea that people vote with their feet, does play a significant role in expenditures and revenues.[2] However, a common thread was found in both this study and that of MaCurdy and Nechyba. In all the different data sets used, the results suggest that, though expenditures in a county may rise, a corresponding rise in revenues do adjust to compensate; thus the shifts in expenditures that may be caused by age composition are rendered harmless for county governments since revenues tend to shift in a similar manner.

The remainder of this paper has the following organization. Section 2 describes and analyzes the work of MaCurdy and Nechyba. Section 3 contains the presentation and examination of my proposed method. Section 4 discusses replication of MaCurdy and Nechyba's work on California counties in 1990, including the data, empirical specification, regression results, and implications of findings. Section 5 examines California counties using 1990, 2000, and panel data sets. Section 6 then extends the study to the rest of the United States. The results of this study and an analysis of the consequences of the change in methodology are presented in Section 7. The final section of this paper contains the summary and conclusion.

2. A discussion of MaCurdy and Nechyba

In their study, MaCurdy and Nechyba empirically and theoretically investigate how "demographic decomposition affects the fiscal burden of communities and the extent to which centralized governments can correct for under-provision of goods with positive spillover that may occur at the local level" (Wilson, 2002). Their study is significant in that it introduces a new approach in studying public expenditures. In a majority of studies examining demographics and government spending, the focus has typically been aimed at individual expenditure categories, such as education, and the corresponding federal or state grant program. MaCurdy and Nechyba

[2] See Section 3 for explanation of Tiebout bias.

analyze the impact of demographic factors on intergovernmental transfers (transfers from the federal and state governments to counties), local tax revenues, and five expenditure categories that include: education, health, welfare, police and fire protection, and infrastructure. By using this method, the issue of fungibility that has been neglected in previous research is addressed. For example, earlier studies did not take into account the budget decisions a local government makes when it receives a grant from the federal government for school supplies. This local government is able to allocate a smaller amount of funding for education expenditures and raise spending for an entirely different expenditure such as the fire department. MaCurdy and Nechyba's method is helpful in making transparent such movements and transfers within federal and local government spending for different expenditure categories.

MaCurdy and Nechyba's work is a good basis for the study of aging demographics because their methods are consistent with previous work. Specifically, MaCurdy and Nechyba's use of county-level data is in keeping with the discussion between Poterba (1997) and Ladd and Murray (2001). Poterba examines a panel set of data in an empirical study to understand the relationship between the level of per child education spending and a number of demographic variables including the portion of the population over 65 years old, the portion of the population of school age children (5 to 17 years old), the fraction of the state's population living below the poverty line or in urban areas, and the fraction of the population that is not white. He uses a panel of state-level data for the 48 contiguous states from 1961, 1971, 1981, and 1991 to regress the logarithm of per child education spending onto the logarithm of demographic variables with state and time fixed effects.

Poterba's study lays the foundation for additional studies on the effect of an aging demographic structure on public education spending. Ladd and Murray replicate his research, but

modify it by examining a different level of data. They use a panel of county level data of the 48 contiguous states for the years 1970, 1980, and 1990 instead of state level data. They argue that the use of state level data provides a limited view of the effects of aging on education spending. State level data ignores differences across communities within states, differences that affect both the location decisions of the elderly and spending on education. Another motivation for using county level data is due to the fact that local governments raise a significant share of total revenue. In 1995-1996, local government accounted for 46 percent of the total revenues, the state government 47 percent, and the federal government provided 7 percent (Ladd and Murray, 2001). Furthermore, in 20 states, the local share exceeded that of the state (Ladd and Hansen, 1999). The use of county level data seems to be the best choice to provide the most visibility in this discussion.

MaCurdy and Nechyba's inclusion of five different expenditure categories rather than just one category is also consistent with Bogart (1991)'s research. In his study, Bogart investigates the consequences of omitting quasi-governmental expenditures when estimating the demand for local public services. These quasi-governmental expenditures include fire protection and public works such as streets, drainage, sewers, sewage processing, garbage and trash disposal, and public buildings and grounds. Bogart argues that these quasi-expenditures should be included in expenditure analysis because they contribute to the variance in the spending between states due to a wide range of spending in public works and fire protection from one community to another. Bogart finds evidence of this in his inspection of public works and fire protection expenditures from 179 New Jersey municipalities in 1980. Within the data set, the median per capita public works spending ranges from $60 to $85, a 42 percent difference in expenditures. Additionally, spending on fire protection in communities can vary great due to the

structure of their fire protection forces. A community can have a force that consists of all volunteers or, at the other extreme, all paid full-time fire fighters. Bogart finds evidence of biases that arise in studying how aging demographics affect expenditures due to ignoring these quasi-governmental expenditures. Bogart's study confirms that it is important to include a full accounting of public expenses.

MaCurdy and Nechyba's work also includes an examination of county governments' intergovernmental revenues from the state and/or federal government. By studying the flow of intergovernmental revenues, MaCurdy and Nechyba adhere to the fiscal federalism model. In fiscal federalism, several layers of government co-exist with different expenditure programs and responsibilities are assigned to different levels of government. This method is in keeping with studies from Echevarria (1995) and Seitz (2007). Echevarria starts with the hypothesis that different ages demand different kinds of public goods and services. This means there are some expenditure items that are mainly aimed at satisfying the needs of individuals within a specific age range and there are some that support programs that are independent of age. From there, he creates a model with two levels of government, one regional and one national, and three groups of population according to the age of members. This model is useful because it is designed to analyze the consequences of population growth and how changes in the age structure impose on the relative needs of different levels of governments in a fiscal policy setup. Echevarria argues that a fiscal federalism model is helpful in evaluating the sustainability of the current allocation of responsibilities for funding expenditures among different levels of government as demographics are projected to change. Echevarria's work points out that more than one layer of government exist. The use of a fiscal federalism model is valuable in understanding how

different layers of government interact with one another to provide for the changing needs of people as the age structure of a population fluctuates.

Seitz (2007) scrutinizes the effects of demographic change on federal, state, and local government expenditures in Germany to learn whether or not demographic change will induce expenditure imbalances among the different levels of government. From his work, Seitz reports that changes in demographic will produce significant vertical expenditure imbalances between the federal and subnational (state and local) governments in addition to imbalances within the state and local governments. Unfortunately, Seitz only examines expenditures and ignores the sources – revenues – that finance these expenditures. Discussion of the sustainability of government spending is missing in the work; however, MaCurdy and Nechyba's study of revenues fills in this gap and allows them to answer the question of sustainability.

MaCurdy and Nechyba create a model of fiscal federalism to examine how expenditure categories, with different types of spillovers, are funded by a community's government. In their model, MaCurdy and Nechyba define three different types of spillovers: 1) across communities within the current time period, 2) within the community but across time, and 3) across communities and across time. They use a budget constraint for a community's government, which incorporates tax competition and tax exporting. They also create a public-good cost function for different types of public goods for a community's government. In their set-up public goods are described along two dimensions. The first dimension is the type of spillovers the good generates. There are four different types of public goods in terms of spillovers. These stylized public goods include: g_1 is a pure local consumption good with no interregional or intergenerational spillovers such as a local park; g_2 refers to a pure local investment good with intergenerational but no interregional spillovers such as local infrastructure; g_3 represents an

investment with interjurisdictional spillovers such as education; and g_4 corresponds to a good with only interjurisdictional consumption spillovers such as pollution control. The second dimension of public goods is cost. Goods of type c_1, c_2, and c_3 are targeted solely at the young, middle-aged, and elderly constituents, respectively. The following table summarizes the predictions for funding of expenditure categories MaCurdy and Nechyba construct from their theoretical analysis:

Table 1: *California County Spending Categories as Convex Combinations of Stylized Public Goods*

Spending Category	Spillover Dimension	Cost Dimension	Implication from Model
Education	(g_1), g_3	c_1	Central grants targeted at communities with large young population
Health	g_1,(g_3)	c_1,(c_2),c_3	Local funding, limited central grants
Welfare	g_1,(g_3), $(g_4)^b$	c_1,(c_2),(c_3)	Mainly local funding if local public good, some central funding targeted somewhat to young population otherwise
Police and Fire Protection	g_1,(g_4)	(c_1),c_2,(c_3)	Some central funding targeted, somewhat targeted to communities with middle-aged population
Infrastructure	g_1,g_2,g_3	(c_1),c_2,(c_3)	Split between local and central funding, somewhat targeted to communities with large middle-aged population

[a]In this column, we enclose an item in parentheses to indicate that it is of secondary importance as a component in the expenditure category under consideration and thus receives relatively smaller weight in the perceived combination of stylized goods making up the category.

[b]Depends on whether reductions in poverty are local or state public goods.

Source: MaCurdy and Nechyba(2001)

MaCurdy and Nechyba predict that spending for education, a mostly public good of type g_3, is dependent solely upon the proportion of the young population present in the community. This means that most of the education funding for education will come from intergovernmental transfers. The authors also predict that health, which is targeted at mostly the young and the elderly, will get most of its funding from the local level. They believe that infrastructure

spending increases when a community has a large middle-aged population. Predictions for other expenditure categories are interpreted in the same straightforward manner.

In addition to the theoretical study, MaCurdy and Nechyba also investigate the empirical applicability of their model of fiscal federalism. They use expenditure and demographic data from the Census of Governments for the years 1986-87 and 1991-92 and from the 1990 Census STF3A files for the 58 counties of California to carry out a cross-sectional examination. From there, they regress seven different dependent variables on selected demographic variables. These dependent variables include the five expenditure categories (education, health, welfare, police and fire protection, and infrastructure) and the two revenue categories (intergovernmental transfers to counties and local taxes used to fund expenditures). The demographic variables include: the fraction of persons in a county aged 0 to 20, the fraction of persons in a county aged 65 or older, median income for households in the county, and the fraction of households in the county living in rural areas. MaCurdy and Nechyba perform regressions on their data in two different ways: one as expenditure and revenue shares and the other as per capita measures. They also report two sets of estimates for the model, least squares (LS) and least absolute deviations (LAD), both of which are performed by implementing bootstrap procedures.

From their research, MaCurdy and Nechyba find how each expenditure category is funded (by local tax revenues and/or by intergovernmental revenues) as the age demographics of the counties in California shift. They find evidence suggesting the age makeup of a county's residents strongly influence its allocations across expenditure categories in both the LAD and LS estimates. This change in allocations also seem consistent with the predictions from their model of fiscal federalism. (See Table 1.) For example, education expenditures decline when demographics shift from young to elderly or from young to middle-aged. They also find that

spending on infrastructure increases when demographics tend towards the middle-aged population. Their results also show that totals for changes in total expenditures and revenues associated with demographic changes are similar (See Tables A and B in Appendix I for MaCurdy and Nechyba's results).

MaCurdy and Nechyba provide a useful method in studying how aging demographics affect public expenditures and revenues. Their method grants improved visibility in understand the flows between expenditure categories and revenues. However, their method can be modified in keeping with other studies, to provide more accurate results. The suggested changes to MaCurdy and Nechyba are explained and examined in the next section.

3. Method

The method for the empirical analysis of this study differs from that of MaCurdy and Nechyba in two ways. One modification to the methodology involves extending the study from focusing solely on California counties to counties of the 48 continental United States. This change will allow for the variations that can occur among states to be captured in the study.

The other deviation from MaCurdy and Nechyba's method is the use of a panel data set to account for county specific factors and time fixed effects rather than a just cross-sectional data set. The rationale for this is that it is important to consider the relationship between aging demographics and public expenditure and revenues in a time series. Gradstein and Kaganovich (2004) find that in a cross-section analysis, a negative relationship is present between the fraction of elderly citizens in a population and education spending, but the same does not necessarily hold true in a time series. A district with a larger fraction of the elderly population spends less on education than districts with a smaller fraction of the elderly. However, an increase in *longevity*

raises the overall spending on education since education can be seen as a way to increase productivity, which ensures a higher return on savings for retirement. Evidence of the significance of longevity suggests that it is not be enough to simply study the cross-sectional effect of aging populations. Looking at the relationship in a panel data set that covers both cross-sectional and time series data is more helpful in understanding how aging demographics affect spending and revenues.

There is an additional strong motivation for using a panel data set to account for county fixed effects and time fixed effects in this study. The inclusion of county fixed effects plays a significant role in mitigating the consequences of the Tiebout bias, as illustrated in studies by Poterba, Ladd and Murray, and Harris et al. The Tiebout bias suggests that "people vote with their feet" (Tiebout, 1998). This means that people live in communities in which the local government satisfies their preferences, i.e. where the availability and quality of facilities and services funded by the local government match their need. For example, families with children would want to live in communities with high education spending. Accordingly, a community with a larger proportion of school-aged children should have higher spending on education simply because parents choose to live there due to this higher education spending. In this example, the presence of children does not have any direct impact on education expenditures. Instead, high education spending is a cause for an increase in the presence of children. By accounting for county fixed effects, I "eliminate all correlation between the error term and the elderly population share in each cross-section and thereby reduce the simultaneity bias that would otherwise occur (Ladd and Murray, 2001). For example, the county fixed effects can capture factors such as a county's reputation for quality of education (Ladd and Murray, 2001).

However, Ladd and Murray do note that the county fixed effects do not completely eliminate the Tiebout bias since residential location decisions *within* counties are not addressed.

The fact that this study uses data at the county level is an added benefit in the case of eliminating the Tiebout bias. If this study were to use state-level data, like that of Poterba as mentioned previously, then the Tiebout bias cannot be as completely addressed as it is with county-level data. By using county-level data I can address the spending differences between communities within states which can affect residential location decisions in addition to the movement of households from county to county, rather than just state to state.

4. Replication of MaCurdy and Nechyba

4.1. Data description

The goal of this paper is to first replicate MaCurdy and Nechyba's study, then to deviate from their methodology using the proposed plan outlined in the previous section. In order to reproduce the study, efforts were made to follow MaCurdy and Nechyba's method as closely as possible. Revenue and expenditure data for the fifty-eight California counties are collected from the Census of Governments, a survey collected every five years by the U.S. Bureau of the Census, for the fiscal years 1987 and 1992. Each observation provides data for expenditures or revenues in a given county. Data for expenditures are divided into the following categories: education (K-12 and community colleges), health (including hospitals), public welfare, and police and fire protection. A fifth category is created as a residual of all expenditure not classified in the other categories. It is referred to as infrastructure since most of the majority of the expenditures in the category is devoted to infrastructure. The revenue data is divided into two categories. The first category refers to intergovernmental transfers from the state- and/or federal-

levels of government to counties, and the second category consists of the amount of total local taxes used to fund expenditures within the county. Revenue and expenditure data are expressed as shares of total revenue or total expenditure and per capita measures. Demographic variables from the 1990 Census STF3A files are also compiled for California counties (MaCurdy and Nechyba). A detailed description of the data is provided in Appendix II. Table 2 reports the descriptive statistics for the data I collected. All pecuniary values are reported in 1990 dollars, deflated using the CPI (all items) for all urban consumers in the western region of the United States.

Table 2, when compared to the corresponding summary statistics table generated by MaCurdy and Nechyba, is almost an exact replica. However, there are several points of divergence. The first difference appears in all per capita measures and the population data. The slight difference in the descriptive statistics for per capita values is related to the difference in the population data used. The population data is from the Census of Governments, which is presumably the same source as MaCurdy and Nechyba used to obtain their data. A second difference in the descriptive statistics is the in tax share and intergovernmental share reported for 1992. Again, the data is from the Census of Governments, the same source as that of MaCurdy and Nechyba. Both differences in my data set could be contributed to a number of reasons, such as an update of the data. Despite the differences, I can continue with the data set since the variation is insignificant. (See Table C in Appendix I for MaCurdy and Nechyba's summary statistics table.)

Table 2: *Summary Statistics, California Counties in 1990*

	Mean		Minimum		Lower Quartile		Median		Upper Quartile		Maximum	
Variable	1987	1992	1987	1992	1987	1992	1987	1992	1987	1992	1987	1992
County expenditure and revenue variables												
Population (1,000s)	465.2	513.1	1.3	1.1	31.8	36.7	120.1	133.5	432.7	480.6	8295.9	8863.2
Total expenditures ($millions)	1.124	1.389	0.007	0.007	0.078	0.099	0.272	0.333	1.114	0.428	20.799	24.304
Total revenue ($millions)	1.182	1.427	0.006	0.008	0.078	0.096	0.291	0.338	1.129	1.387	21.363	26.227
Education share (%)	0.383	0.383	0.198	0.199	0.339	0.343	0.381	0.381	0.426	0.429	0.565	0.563
Health share (%)	0.101	0.114	0.017	0.022	0.044	0.057	0.095	0.094	0.146	0.163	0.283	0.335
Welfare share (%)	0.110	0.113	0.036	0.047	0.079	0.083	0.104	0.104	0.141	0.141	0.217	0.204
Police and fire protection share (%)	0.073	0.072	0.032	0.031	0.058	0.059	0.071	0.067	0.086	0.085	0.124	0.141
Infrastructure share (%)	0.333	0.318	0.177	0.169	0.276	0.266	0.340	0.313	0.371	0.364	0.581	0.478
Intergovernmental transfers share (%)	0.502	0.484	0.307	0.259	0.416	0.411	0.496	0.492	0.571	0.556	0.732	0.689
Taxes share (%)	0.498	0.516	0.268	0.311	0.429	0.444	0.504	0.508	0.584	0.589	0.693	0.741
Education per capita (1,000s)	0.941	1.030	0.582	0.610	0.802	0.862	0.887	0.972	1.050	1.179	1.881	2.164
Health per capita (1,000s)	0.253	0.321	0.040	0.056	0.111	0.131	0.228	0.261	0.348	0.426	0.948	1.286
Welfare per capita (1,000s)	0.269	0.302	0.105	0.113	0.189	0.146	0.272	0.295	0.328	0.370	0.476	0.582
Police and fire protection per capita (1,000s)	0.181	0.196	0.081	0.094	0.136	0.144	0.171	0.176	0.203	0.214	0.542	0.776
Infrastructure per capita (1,000s)	0.846	0.873	0.414	0.442	0.647	0.656	0.747	0.806	0.883	0.951	3.346	1.898
Total expenditures per capita (1,000s)	2.491	2.723	1.814	1.981	2.123	2.280	2.335	2.560	2.648	2.818	5.754	6.301
Taxes per capita (1,000s)	1.296	1.410	0.734	0.731	1.054	1.151	1.252	1.342	1.466	1.559	3.110	3.016
Intergov. transfers per capita (1,000s)	1.303	1.325	0.642	0.620	1.051	1.043	1.268	1.232	1.426	1.532	3.232	3.556
Total revenue per capita (1,000s)	2.599	2.735	1.850	2.026	2.194	2.284	2.470	2.488	2.800	2.885	5.638	6.484
Demographic variables (as of 1990)												
Fraction of households in rural areas	0.365		0.000		0.107		0.296		0.633		1.000	
Median household income ($10,000)	3.056		2.049		2.445		2.875		3.506		4.854	
Fraction of population aged 0-20	0.304		0.194		0.282		0.298		0.330		0.393	
Fraction of population aged 21-64	0.568		0.506		0.543		0.563		0.590		0.661	
Fraction of population aged 65 and up	0.128		0.061		0.102		0.122		0.151		0.264	

Note: All monetary values are in 1990 dollars, deflated by the CPI for all urban consumers in the western region of the United States.

4.2. Empirical specification

In order to understand the relationship among the five expenditure categories and revenue types, MaCurdy and Nechyba use separate empirical specifications with each revenue and expenditure measure of as dependent variables. The following model is estimated according to the seven specifications:

$$\mathbf{y}_j = \boldsymbol{\beta}_1 \text{YOUNG}_j + \boldsymbol{\beta}_2 \text{OLD}_j + \boldsymbol{\beta}_3 \text{INCOME}_j + \boldsymbol{\beta}_4 \text{RURAL}_j + \boldsymbol{\varepsilon}_j.$$

In the model, the subscript j = 1-7 indicates the seven different specifications. In the regression equation, $\mathbf{y}$ is the vector of expenditure or revenue variables for each U.S. county, each $\boldsymbol{\beta}$ is a parameter value and $\boldsymbol{\varepsilon}$ is the disturbance variable. In this equation, there are four control variables. They include: the fraction of persons in a county aged 0 to 20 (YOUNG), the fraction of persons in a county aged 65 or older (OLD), median income for households in the county (INCOME), and the fraction of households in the county living in rural areas (RURAL). This analysis also considers two forms of revenue and expenditure data: measures expressed as budget shares, and measures reported as per capita expenditures and revenues.

4.3. Regression results

The next two tables report two sets of results of the estimates of the model. Table 3 reports the results for expenditure and revenue shares. In Table 3, the first column lists the dependent variables. Each expenditure and revenue share is the average of the 1987 and 1992 data. For example, "Education share" is the result for which $\mathbf{y}$ = 0.5 (1987 education expenditure / 1987 total expenditure) + 0.5 (1992 education expenditure / 1992 total expenditure). Similarly, "Intergovernmental transfer share" is the result in which $\mathbf{y}$ = 0.5 (1987 intergovernmental transfers / 1987 total revenue) + 0.5 (1992 intergovernmental transfers / 1992 total revenue). Two sets of estimates are reported in the table. The top result in each row is the ordinary least

Table 3: *Effects of Population Age Composition on Expenditure and Revenue Shares for California Counties in 1990*

	Proportion in Age Group				
Budget Measure	20 and Below	65 and Above	Median Income ($10,000s)	Rural	Intercept
Expenditure shares					
Education share	1.086**	0.616**	0.005	0.042*	-0.057
	(0.280)	(0.302)	(0.016)	(0.036)	(0.154)
	0.849**	0.845*	0.007	0.026	-0.014
	(0.478)	(0.641)	(0.024)	(0.062)	(0.271)
Health share	0.049	0.518*	0.009	0.009	-0.005
	(0.328)	(0.354)	(0.019)	(0.043)	(0.180)
	-0.090	0.606*	0.003	-0.034	0.055
	(0.576)	(0.529)	(0.032)	(0.071)	(0.315)
Welfare share	0.195*	0.033	-0.040**	-0.062**	0.192**
	(0.137)	(0.148)	(0.008)	(0.018)	(0.075)
	0.274*	0.117	-0.042**	-0.072**	0.169**
	(0.167)	(0.220)	(0.008)	(0.023)	(0.088)
Police and fire protection share	-0.264**	-0.156**	0.007**	-0.021**	0.158**
	(0.069)	(0.074)	(0.004)	(0.009)	(0.038)
	-0.147*	-0.014	0.010**	-0.028**	0.096*
	(0.113)	(0.175)	(0.005)	(0.014)	(0.061)
Infrastructure share	-1.066**	-1.011**	0.018*	0.031	0.711**
	(0.252)	(0.272)	(0.014)	(0.033)	(0.138)
	-1.166**	-0.960**	0.028**	0.020	0.703**
	(0.375)	(0.537)	(0.015)	(0.052)	(0.189)
Revenue shares					
Intergovernmental transfer share	0.674**	-0.046	-0.083**	-0.018	0.554**
	(0.377)	(0.407)	(0.022)	(0.049)	(0.207)
	0.867**	-0.081	-0.091**	-0.065	0.548
	(0.518)	(0.836)	(0.029)	(0.065)	(0.313)
Taxes share	-0.674**	0.046	0.083**	0.018	0.446**
	(0.377)	(0.407)	(0.022)	(0.049)	(0.207)
	-0.867*	0.081	0.091**	0.065	0.452*
	(0.548)	(0.864)	(0.030)	(0.063)	(0.329)

Notes: The LAD estimates and standard errors were computed with bootstrap procedures (with 1,000 sample draws). For each budget measure, the first row shows the least squares coefficients, and the second row shows the least absolute deviations coefficients. Numbers in parentheses are standard errors.

* Statistically significant t the 75% confidence level. ** Statistically significant at the 90% confidence level.

squares coefficient (OLS), with its corresponding standard deviation reported underneath. Under this standard deviation is the bootstrapped coefficient for least absolute deviations (LAD) estimates, which are computed with bootstrap procedures with 1,000 sample draws. The standard deviation for the bootstrapped LAD estimation is presented immediately below.

The estimates in Table 3 show that increasing the share of the young population increases education expenditure while decreasing the funding going to police and fire protection and to infrastructure. In addition, there is some evidence indicating that a larger proportion of the young leads to higher public welfare spending, but this is only statistically significant at the 75 percent confidence level. In terms of revenue, an increase in the young population leads to greater funding from intergovernmental transfers paired with a smaller amount of revenue from taxes.

An increase in the elderly share in the county also causes a decrease in the spending on infrastructure. The coefficients on both revenue groups are not significant, but the results suggest that an older population would result in lower proportions of intergovernmental transfers and more from taxes. These results from the regression confirm that of MaCurdy and Nechyba and the predictions of Table 1. (See Table D in Appendix I for MaCurdy and Nechyba's corresponding results.)

Table 4 reports the results for expenditures and revenue shares. The first column lists the dependent variables. Expenditure and revenue per capita is constructed as the average of the 1987 and 1992 per capita data. For example, "Education per capita" is the result for which **y** = 0.5 (1987 education expenditure / 1987 population) + 0.5 (1992 education expenditure / 1992 population). The OLS and bootstrapped LAD coefficients and standard deviations are reported in the same way as Table 3. The estimates reported in Table 4 largely confirm the insights provided

Table 4: *Effects of Population Age Composition on per Capita Expenditures and Revenues for California Counties in 1990*

	Proportion in Age Group				
Per Capita Measure	20 and Below	65 and Above	Median Income ($10,000s)	Rural	Intercept
Expenditure per capita					
Education per capita	1.527*	-0.127	-0.057	0.388**	0.569
	(1.025)	(1.104)	(0.059)	(0.133)	(0.562)
	1.319*	-1.266	-0.046	0.425**	0.732*
	(0.986)	(1.766)	(0.051)	(0.167)	(0.592)
Health per capita	-0.466	0.745	-0.026	0.024	0.405
	(1.023)	(1.103)	(0.059)	(0.133)	(0.561)
	0.031	0.279	0.035	0.113	0.060
	(1.886)	(1.581)	(0.095)	(0.206)	(0.993)
Welfare per capita	0.142	-0.546*	-0.116**	-0.077**	0.694**
	(0.360)	(0.387)	(0.021)	(0.047)	(0.197)
	-0.187	-0.771	-0.127**	-0.091*	0.852**
	(0.715)	(0.930)	(0.029)	(0.073)	(0.387)
Police and fire protection	-1.417**	-1.523**	-0.012	0.043	0.834**
per capita	(0.366)	(0.395)	(0.021)	(0.048)	(0.201)
	-0.915**	-0.728	-0.009	-0.093	0.606**
	(0.477)	(0.730)	(0.018)	(0.058)	(0.273)
Infrastructure per capita	-6.110**	-7.662**	-0.085	0.534**	3.765**
	(1.655)	(1.783)	(0.095)	(0.215)	(0.907)
	-4.058**	-5.138*	-0.051	0.089	2.790**
	(2.412)	(3.846)	(0.094)	(0.264)	(1.435)
Total per capita	-6.323**	-9.113**	-0.296**	0.913**	6.268**
	(3.045)	(3.281)	(0.174)	(0.396)	(1.669)
	-2.333	-6.007	-0.287*	0.329	4.778*
	(5.454)	(7.309)	(0.239)	(0.539)	(3.171)
Revenue per capita					
Intergovernmental	0.022	0.881*	0.044*	0.138**	0.693**
transfer per capita	(0.512)	(0.552)	(0.029)	(0.067)	(0.281)
	-0.587	-0.529	0.024	0.256**	1.076**
	(0.946)	(1.108)	(0.034)	(0.107)	(0.492)
Taxes per capita	0.088	-0.464	0.016	0.020	0.905**
	(0.679)	(0.732)	(0.039)	(0.088)	(0.373)
	-0.769	-1.452*	-0.022	0.072	1.374**
	(0.798)	(1.046)	(0.036)	(0.113)	(0.393)
Total per capita	-8.653**	-10.291**	-0.393**	0.739**	7.549**
	(3.140)	(3.383)	(0.180)	(0.408)	(1.722)
	0.365	-2.854	-0.253	0.170	3.489
	(6.438)	(8.770)	(0.282)	(0.602)	3.730

Notes: The LAD estimates and standard errors were computed with bootstrap procedures (with 1,000 sample draws). For each per capita measure, the first row shows the least squares coefficients, and the second row shows the least absolute deviations coefficients. Numbers in parentheses are standard errors.

* Statistically significant t the 75% confidence level. ** Statistically significant at the 90% confidence level.

on the relationships between demographics and spending of Table 3. (See Table E in Appendix I for MaCurdy and Nechyba's results.)

There is one important point in this section of the empirical analysis that diverges from that of MaCurdy and Nechyba. They perform bootstrapped LAD estimates in their empirical analysis whereas I did not. However, when comparing the results with that of the original authors, the implications are very similar.

4.4. Implications of findings

In replicating the study of MaCurdy and Nechyba, the method of exploring the budgetary consequences of changing the age composition of a California county's population using results from OLS and LAD regressions are also reproduced. This is displayed in Tables 5 and 6.

Tables 5 and 6 are constructed in a similar way. A single difference between the tables stems from the fact that one is an examination of OLS estimates while the other examines results from least absolute deviation estimates. The information in these tables is drawn from Table 4, in which all dependent variables are reported in per capita values. The first column of each table describes the demographic change under scrutiny. The first row investigates the consequences of increasing the fraction of middle-aged people by decreasing the fraction of elderly people by the same magnitude, while the fraction of young people is held constant. The second and third rows are created in a similar fashion. The second column in each table gives the prediction of the effect of the demographic shift on per capita expenditures. The third column calls out the projection of the effects of the demographic shift on per capita intergovernmental transfers and local government taxes when demographic shifts are applied. The values in both columns are simply the consequences implied by the point estimates in Table 4. The last row of each table

describes the effects generated by shifting the demographics from young to old, which are calculated by subtracting the young coefficients from the elderly coefficients reported in Table 4.

Table 5: *Budgetary Consequences of Changing the Age Composition of a County's Population in California in 1990, Ordinary Least Squares Estimates (MaCurdy and Nechyba's Method)*

Shift in Age Composition of Population	Effects on Expenditures			Effects on Revenues		
Old => middle-aged	Education	+	$127	IG Transfers	-	$881
	Police and Fire	+	$1,523	Own Taxes	+	$464
	Infrastructure	+	$7,662	Total		
	Total	+	$7,312		-	$417
Young => middle-aged	Education	-	$1,527	IG Transfers	-	$22
	Police and Fire	+	$1,417	Own Taxes	-	$88
	Infrastructure	+	$6,110			
	Total	+	$6,000	Total	-	$110
Young => old	Education	-	$1,400	IG Transfers	+	$859
	Public Welfare	-	$688	Own Taxes	-	$552
	Police and Fire	-	$106			
	Total	-	$2,194	Total	+	$307

Table 6: *Budgetary Consequences of Changing the Age Composition of a County's Population in California in 1990, Least Absolute Deviation Estimates (MaCurdy and Nechyba's Method)*

Shift in Age Composition of Population	Effects on Expenditures			Effects on Revenues		
Old => middle-aged	Education	+	$1,266	IG Transfers	+	$529
	Police and Fire	+	$728	Own Taxes	+	$1,452
	Infrastructure	+	$5,138			
	Total	+	$7,132	Total	+	$1,981
Young => middle-aged	Education	-	$1,319	IG Transfers	+	$587
	Police and Fire	+	$915	Own Taxes	+	$769
	Infrastructure	+	$4,058			
	Total	+	$3,654	Total	+	$1,356
Young => old	Education	-	$2,585	IG Transfers	+	$58
	Public Welfare	-	$584	Own Taxes	-	$683
	Police and Fire	+	$187			
	Total	-	$2,982	Total	-	$625

Note that not all expenditure categories appear in Tables 5 or 6. The expenditure categories that do appear in the first and second rows are selected based on the fact that at least one of the estimated coefficients in Table 3 or 4 is statistically significant at the 90 percent confidence level for either LAD or OLS estimates. This means that if a coefficient is significant at the 90 percent confidence level for the LAD estimate, but not for OLS, it will still be reported. The expenditure categories that appear in the third row are categories in which the linear combinations of the coefficients of young (20 and Below) share and old (65 and Above) share in Table 3 or 4 are significant at the 90 percent confidence level for either LAD or OLS estimates. Table 7 on the next page lists the results of these linear combinations.

In Table 7, the first column lists the dependent variables. The second column shows results for budget share figures and the third column reports the results for per capita measures. The results of the linear combinations of the coefficients of the young (20 and Below) share and the old (65 and Above) share for OLS estimators are at the top of each row with its standard error immediately underneath. Underneath these standard errors are the coefficients for LAD estimates with corresponding standard errors underneath.

In investigating the budgetary consequences of changing age compositions, as shown in Tables 5 and 6, I have ascertained different implications than that of MaCurdy and Nechyba. (See Tables A and B in Appendix I for MaCurdy and Nechyba's budgetary consequences. Tables A and B mostly confirm the predictions MaCurdy and Nechyba report in Table 1.) MaCurdy and Nechyba find that, "While the total for changes in expenditures and revenues associated with each demographic shift may appear to produce budgetary imbalance, conventional hypothesis tests indicate that total changes in expenditures and revenues are never significantly different from one another for any of the shifts considered, using either LS or LAD" (MaCurdy and

Table 7: *Linear combinations of Coefficients of Young and Old Shares for Expenditure and Revenue Shares and per Capita Expenditure and Revenue for California Counties in 1990*

Measure	Budget Share	Per Capita
Expenditures		
Education	0.470**	1.654**
	(0.247)	(0.904)
	0.005	2.585**
	(0.462)	(1.262)
Health	-0.469*	-1.211*
	(0.290)	(0.903)
	-0.696*	-0.248
	(0.543)	(1.533)
Welfare	0.161*	0.687**
	(0.121)	(0.317)
	0.158	0.584
	(0.144)	(0.620)
Police and fire protection	-0.108**	0.106
	(0.061)	(0.323)
	-0.133*	-0.187
	(0.114)	(0.389)
Infrastructure	-0.055	1.553
	(0.223)	(1.460)
	-0.206	1.080
	(0.385)	(1.993)
Revenue shares		
	0.720**	-0.858**
Intergovernmental transfer	(0.333)	(0.452)
	0.948*	-0.058
	(0.578)	(0.683)
Taxes	-0.720**	0.552
	(0.333)	(0.600)
	-0.948*	0.683
	(0.591)	(0.755)

* Statistically significant t the 75% confidence level. ** Statistically significant at the 90% confidence level.

Nechyba, 2001). Instead, I find that total changes in per capita expenditures and revenues associated with each demographic shift are vastly different from one another.

Analyzing the budgetary consequences of age compositions in the manner of MaCurdy and Nechyba is helpful because it makes visible the way demographic shifts affect total revenues and expenditures. However, I suggest a different approach be taken in accomplishing this task. Instead of reporting the change in individual expenditure and revenue categories and finding the sum of all the categories reported to find the total change in expenditure per capita and revenue per capita, I suggest that budgetary consequences can be found by simply comparing the point estimates of total expenditure per capita and revenue per capita taken from Table 4. The reason for this alternative method is to minimize the standard error. When different expenditure (or revenue) categories are added together in order to find the total change, the standard errors of all the categories are compounded together. As a result, the standard error of the resulting sum of revenues or expenditures tends to be high. By simply taking the total per capita revenue or total per capita expenditure point estimates in Table 4 to compare how they are affected by demographic shifts, the standard error is kept as small as possible. The results of this alternative method using OLS estimates are presented in Table 8 and the results with LAD is shown in Table 9.

Table 8: *Budgetary Consequences of Changing the Age Composition of a County's Population in California in 1990, Ordinary Least Squares Estimates (Alternative Method)*

Shift in Age Composition of Population	Effects on Total Expenditure	Effects on Total Revenue
Old => middle-aged	+ $9,113	+ $10,291
Young => middle-aged	+ $6,323	+ $8,653
Young => old	- $2,790	- $1,638

Table 9: *Budgetary Consequences of Changing the Age Composition of a County's Population in California in 1990, Least Absolute Deviation Estimates (Alternative Method)*

Shift in Age Composition of Population	Effects on Total Expenditure	Effects on Total Revenue
Old => middle-aged	+ $6,007	+ $2,854
Young => middle-aged	+ $2,333	- $365
Young => old	- $3,674	- $3,219

The total revenue and expenditure changes in Tables 8 and 9 mostly correspond to the results of MaCurdy and Nechyba in analyzing budgetary consequences. The OLS estimates show that per capita revenues and per capita expenditures shift in a similar fashion as one another as the age composition alters. The LAD estimates do not show this result when shifting the demographics from old to middle-aged and from young to middle-aged. However, all these LAD figures are neither statistically significant at the 90 percent confidence level nor the 75 percent confidence level as shown in Table 4. Admittedly, these tables do not make visible the changes in individual expenditure and revenue categories due to shifting demographics that contribute to the total change. However, that information is available in the form of Tables 3 and 4, which display the effects of population age composition on individual expenditures and revenues.

5. A different look at California

MaCurdy and Nechyba examine how aging demographics affect the expenditures and revenues of the fifty-eight counties of California in 1990. But what happens if I examine the fifty-eight counties of California in 2000? Will the results be the same? What if I examined the counties of California with county fixed and time fixed effects?

5.1. Data description, empirical specifications, and regression results for California counties in 1990, 2000 and with fixed effects

To investigate how aging demographics affect the expenditures and revenues of the fifty-eight counties of California in 2000, I repeat almost the same method as described previously. One divergence in the methodology involves using a different data set. The new data set originates from the same sources as that of MaCurdy and Nechyba. The new data set contains revenue and expenditure data for the fifty-eight California counties from the Census of Governments for the fiscal years 1997 and 2002. Demographic variables from the 2000 Census STF3A files are used. (See Table F in Appendix I for the summary statistics for this data set.)

The same model as previously described is estimated using this new 2000 California county data set. There are two additional differences in methodology. The model is estimated using only OLS estimators for this data set. In addition, all pecuniary values for revenues and expenditures are reported in 2007 dollars, which are deflated using the CPI (all items) for the all urban consumers in the United States.[3] In order to allow for comparison with measures reported in the same dollars, this procedure is performed with the 1990 California county data set. The results of the OLS estimates are reported in Table 10 and Table 11. Table 10 reports the effects of population age composition on expenditure and revenue shares. Table 11 displays the effects of population age composition on per capita expenditure and revenue. For both tables, the first column underneath each independent variable refers to coefficients obtained from 1990 California county data, while the second column refers to 2000 California county data.

The third column under each explanatory variable in Tables 10 and 11 relays the coefficients of OLS estimators for a different model, one that uses a single panel data set created

[3] Note that median household income, an explanatory variable, is not in 2007 dollars. Instead, it is in 2000 dollars. To get point-estimates for median household income, deflate using CPI.

Table 10: *Effects of Population Age Composition on Expenditure and Revenue Shares for California Counties*

	Proportion in Age Group														
	20 and Below			65 and Below			Median Income ($10,000s)			Rural			Intercept		
Budget Measure	1990	2000	Panel Data Set	1990	2000	Panel Data Set	1990	2000	Panel Data Set	1990	2000	Panel Data Set	1990	2000	Panel Data Set
Expendiure shares															
Education share	1.086**	0.787**	0.959**	0.616**	0.246	0.910**	0.005	-0.016*	-0.002	0.042*	-0.014	-0.114**	-0.057	0.191*	0.025
	(0.280)	(0.290)	(0.337)	(0.302)	(0.364)	(0.314)	(0.016)	(0.010)	(0.004)	(0.036)	(0.040)	(0.047)	(0.154)	(0.157)	(0.126)
Health share	0.049	-0.081	-0.467	0.518*	0.452	-1.302**	0.009	0.000	0.004	0.009	0.043	0.172**	-0.005	0.062	0.345**
	(0.328)	(0.336)	(0.532)	(0.354)	(0.421)	(0.495)	(0.019)	(0.012)	(0.006)	(0.043)	(0.046)	(0.074)	(0.180)	(0.182)	(0.199)
Welfare share	0.195*	0.029	0.295*	0.033	0.021	0.243*	-0.040**	-0.020**	-0.013**	-0.062**	-0.045**	0.043*	0.192**	0.179**	0.013
	(0.137)	(0.102)	(0.194)	(0.148)	(0.127)	(0.181)	(0.008)	(0.004)	(0.002)	(0.018)	(0.014)	(0.027)	(0.075)	(0.055)	0.073
Police and fire protection share	-0.264**	-0.109*	-0.038	-0.156**	0.043	-0.054	0.007**	0.009**	-0.000	-0.021**	-0.017**	-0.006	0.158**	0.066**	0.095**
	(0.069)	(0.068)	(0.106)	(0.074)	(0.085)	(0.099)	(0.004)	(0.002)	(0.001)	(0.009)	(0.009)	(0.015)	(0.038)	(0.037)	(0.040)
Infrastructure share	-1.066**	-0.626**	-0.748**	-1.011**	-0.760**	0.204	0.018*	0.027**	0.012**	0.031	0.033	-0.095**	0.711**	0.502**	0.523**
	(0.252)	(0.252)	(0.382)		(0.316)	(0.356)	(0.014)	(0.009)	(0.004)	(0.033)	(0.034)	(0.053)	(0.138)	(0.136)	(0.143)
Revenue shares															
Intergovernmental transfer share	0.674**	0.110	0.100	-0.046	-0.582*	0.660*	-0.083**	-0.080**	-0.004	-0.018	-0.043	-0.089*	0.554**	0.894**	0.425**
	(0.377)	(0.321)	(0.470)	(0.407)	(0.403)	(0.438)	(0.022)	(0.012)	(0.005)	(0.049)	(0.044)	(0.065)	(0.207)	(0.174)	(0.176)
Taxes share	-0.674**	-0.110	-0.100	0.046	0.582*	-0.660*	0.083**	0.080**	0.004	0.018	0.043	0.089*	0.446**	0.106	0.575**
	(0.377)	(0.321)	(0.470)	(0.407)	(0.403)	(0.438)	(0.022)	(0.012)	(0.005)	(0.049)	(0.044)	(0.065)	(0.207)	0.174	(0.176)

* Statistically significant at the 75% confidence level. ** Statistically significant at the 90% confidence level.

Table 11: *Effects of Population Age Composition on per Capita Expenditures and Revenues for California Counties*

	Proportion in Age Group														
	20 and Below			65 and Below			Median Income ($10,000s)			Rural			Intercept		
Per Capita Measure	1990	2000	Panel Data Set	1990	2000	Panel Data Set	1990	2000	Panel Data Set	1990	2000	Panel Data Set	1990	2000	Panel Data Set
Expenditure per capita															
Education per capita	2.430*	3.390**	2.126	-0.202	-3.097*	1.144	-0.090	-0.044	0.203**	0.618**	0.920**	-0.085	0.906	1.121*	0.207
	(1.631)	(1.589)	(1.987)	(1.758)	(1.992)	(1.849)	(0.093)	(0.057)	(0.022)	(0.212)	(0.216)	(0.276)	(0.894)	(0.860)	(0.744)
Health per capita	-0.742	-1.816	-5.668*	1.185	0.737	-13.439**	-0.042	-0.0112	0.134**	0.038	0.594**	1.456**	0.645	0.925	2.972**
	(1.629)	(2.587)	(3.538)	(1.755)	(3.242)	(3.292)	(0.093)	(0.093)	(0.039)	(0.212)	(0.352)	(0.491)	(0.893)	(1.399)	(1.325)
Welfare per capita	0.224	-0.145	0.675	-0.869*	-1.250*	0.390	-0.185**	-0.082**	-0.007	-0.122*	0.045	0.206**	1.105**	0.970**	0.140
	(0.572)	(0.635)	(0.753)	(0.617)	(0.795)	(0.700)	(0.033)	(0.023)	(0.008)	(0.074)	(0.086)	(0.104)	(0.314)	(0.343)	(0.282)
Police and fire protection per capita	-2.255**	-1.517**	-0.245	-2.424**	-2.143**	-1.089**	-0.018	0.041*	0.050**	0.069	0.184**	0.155**	1.328**	0.854**	0.306**
	(0.583)	(0.709)	(0.496)	(0.628)	(0.888)	(0.462)	(0.033)	(0.025)	(0.005)	(0.076)	(0.097)	(0.069)	(0.320)	(0.383)	(0.186)
Infrastructure per capita	-9.724**	-7.408**	-5.730*	-12.192**	-15.820**	0.606	-0.136	0.150	0.318**	0.849**	1.722**	0.339	5.993**	4.795**	1.935**
	(2.632)	(3.812)	(3.810)	(2.836)	(4.777)	(3.545)	(0.151)	(0.137)	(0.042)	(0.342)	(0.519)	(0.529)	(1.443)	(2.061)	(1.427)
Total per capita	-10.067**	-7.497	-8.842*	-14.502**	-21.574**	-12.388**	-0.4705**	0.053	0.699**	1.452**	3.464**	2.071**	9.977**	8.664**	5.561**
	(4.846)	(7.254)	(7.151)	(5.221)	(9.090)	(6.654)	(0.277)	(0.260)	(0.078)	(0.630)	(0.988)	(0.992)	(2.657)	(3.921)	(2.679)
Revenue per capita															
Intergovernmental transfer per capita	0.022	-0.175	3.361**	0.875*	-0.284	0.781	0.044*	0.006	-0.120**	0.137**	0.048	0.242*	0.689**	0.858**	0.139
	(0.509)	(0.381)	(1.296)	(0.549)	(0.478)	(1.206)	(0.029)	(0.014)	(0.014)	(0.066)	(0.052)	(0.180)	90.279)	(0.206)	(0.485)
Taxes per capita	0.088	0.840	-2.649*	-0.461	0.008	-5.601**	0.016	-0.004	-0.014	0.020	0.155*	0.032	0.899**	0.628*	2.485**
	(0.675)	(0.800)	(2.076)	(0.728)	(1.003)	(1.932)	(0.039)	(0.029)	(0.023)	(0.088)	(0.109)	(0.288)	(0.370)	(0.433)	(0.778)
Total per capita	-13.772**	-7.493	-4.274	-16.380**	-24.839**	-10.350*	-0.625**	0.080	0.722**	1.175**	3.963**	1.625*	12.014**	8.951**	4.105*
	(4.997)	(7.712)	(8.308)	(5.384)	(9.664)	(7.730)	(0.286)	(0.276)	(0.091)	(0.649)	(1.050)	(1.153)	(2.740)	(4.169)	(3.112)

* Statistically significant at the 75% confidence level. ** Statistically significant at the 90% confidence level.

by combining the 1990 and 2000 data sets to examine the fifty-eight counties of California with county and time fixed effects. The model is as follows:

$$\mathbf{y}_{ijt} = \boldsymbol{\beta}_1 \text{YOUNG}_{ijt} + \boldsymbol{\beta}_2 \text{OLD}_{ijt} + \boldsymbol{\beta}_3 \text{INCOME}_{ijt} + \boldsymbol{\beta}_4 \text{RURAL}_{ijt} + \boldsymbol{\delta}_{ij} + \boldsymbol{\tau}_{jt} + \boldsymbol{\varepsilon}_{ijt}.$$

This model is very similar to the previous model except for several additions. In this regression equation, the subscript *i* represents county and *t* denotes time. In addition, **δ** captures county fixed effects, **τ** accounts for time fixed effects, and **ε** is the disturbance variable.

All parameters and explanatory variables remain the same. As in the previous model, this analysis also considers the two different forms of revenue and expenditure data: measures expressed as budget shares, and measures reported as per capita expenditures ad revenues.

The results of Tables 10 and 11 for California counties in 1990 largely agree with that of Tables 3 and 4. The revenue and expenditure share estimates are exactly the same while the per capita and the per capita measure coefficients have changed by a scalar, which is to be expected since the only disparity between the 1990 regressions in Tables 10 and 11 and in Tables 3 and 4 is the CPI used to deflate the revenue and expenditure measures. However, in comparing the results of the three data sets, the conclusions to be drawn are not the same. This is evident when comparing the relationship (positive or negative) between age composition and expenditure and revenue. Table 12 summarizes the differences between the effects (positive or negative) of age demographics shares on expenditures and revenue shares. Table 13 recaps this information for per capita expenditure and revenue.

Tables 12 and 13 show the signs of estimated coefficients for each expenditure and revenue category. These tables show that the relationships between demographics and expenditures and revenues change when looking at the three different data sets. For example,

Table 12: *Summary of Changes of Young Share and Old Share in 1990, 2000, and Panel California County Data Sets for Expenditure and Revenue Shares*

	20 and Below			65 and Below		
Budget Measure	1990	2000	Panel Data	1990	2000	Panel Data
Expenditure shares						
Education share	+**	+**	+**	+**	+	+**
Health share	+	-	-	+*	+	-**
Welfare share	+*	+	+*	+	+	+*
Police and fire protection share	-**	-*	-	-**	+	-
Infrastructure share	-**	-**	-**	-**	-**	+
Revenue shares						
Intergovernmental transfer share	+*	+	+	-	-*	+*
Taxes share	-**	-	-	+	+*	-*

* Statistically significant at the 75% confidence level. ** Statistically significant at the 90% confidence level.

spending on health increases when the young proportion grows according to the 1990 data set, but according to the panel data set, the relationship is negative.

Additionally, according to the tables, some relationships change when comparing one year to another. For instance, intergovernmental transfers rise when the young population share increases for the year 1990, but the relationship is negative in 2000. The health, police and fire protection, public welfare, taxes, and intergovernmental transfers are affected by age demographics in a different way in 1990 than in 2000. The tables also report that the effects of age demographics on health, police and fire protection, infrastructure, and public welfare shift in the opposite direction when time and/or county fixed effects are applied. This may mean that a least these expenditure categories are affected by the Tiebout bias, that people choose to live in

Table 13: *Summary of Changes in 1990, 2000, and Panel California County Data Sets for per Capita Expenditures and Revenues*

	20 and Below			65 and Below		
Per Capita Measure	1990	2000	Panel Data	1990	2000	Panel Data
Expenditure per capita						
Education per capita	+*	+**	+	-	-*	+
Health per capita	-	-	-*	+	+	-**
Welfare per capita	+	-	+	-*	-*	+
Police and fire protection per capita	-**	-**	-	-**	-**	-**
Infrastructure per capita	-**	-**	-*	-**	-**	+
Total per capita	-**	-	-*	-**	-**	-**
Revenue per capita						
Intergovernmental transfer per capita	+	-	+**	+*	-	+
Taxes per capita	+	+	-*	-	+	-**
Total per capita	+**	+	-	-**	-**	-*

* Statistically significant at the 75% confidence level. ** Statistically significant at the 90% confidence level.

specific counties according to the counties' spending. The same implication applies to intergovernmental transfers and taxes.

5.2. Implications of findings

Table 14 examines the implications of the OLS regression results in the alternative method proposed in Section 4.4. (See Tables G, H, and I in Appendix I for analysis of implications using MaCurdy and Nechyba's method to compare. Results from this method largely correspond to the findings of Tables 5 and 6 in this paper.)

Table 14: *Budgetary Consequences of Changing the Age Composition of a County's Population in California using 1990, 2000, and Panel Data Sets, Ordinary Least Squares Estimates (Alternative Method)*

Shift in Age Composition of Population	Effect on Total per Capita Expenditures			Effect on Total per Capita Revenues		
	1990	2000	Panel Data Set	1990	2000	Panel Data Set
Old => middle-aged	+ $14,502	+ $21,574	+ $12,388	+ $16,380	+ $24,839	+ $10,350
Young => middle-aged	+ $10,067	+ $7,497	+ $8,842	+ $13,772	+ $7,493	+ $4,274
Young => old	- $4,435	- $14,077	- $3,546	- $2,608	- $17,346	- $6,076

The budgetary consequences due to changing the age composition of a county's population in California according to the 1990, the 2000, and the panel data sets largely confirm the findings of MaCurdy and Nechyba and my version of their analysis in Tables 8 and 9. The totals for changes in expenditures and revenues associated with a demographic transformation seem to generate budgetary imbalances. However, these budgetary imbalances are rendered benign as total change in expenditures and revenues tend to change in a similar manner. This suggests that, at least for California counties, aging demographics do affect expenditure categories; however, intergovernmental transfers and/or tax revenues respond in a similar way in an attempt to bridge the change in public spending.

6. A look at the United States

Now that I have examined the counties of California in 1990, 2000, and with county and time fixed effects, what happens when I extend the study to the rest of the United States?

6.1. Data description

In examining how aging demographics affect the revenues and expenditures of counties in the United States, a new 1990, 2000, and panel data set is needed. For this, data is once again collected from the same sources. Revenue and expenditure are gathered from the data for the Census of Governments for the fiscal years 1987, 1992, 1997 and 2002 for all the counties in the

United States, except for Washington D.C., counties in Hawaii and Alaska, and any other counties with missing data for any of the years under examination. (Missing data results from county boundaries being redrawn so that new counties are added or eliminated.) The total number of counties investigated amount to 3,103 counties. Demographic variables from the 1990 and 2000 Census STF3A files are also used. Note that all pecuniary variables are reported in 2007 dollars, deflated using the CPI (all items) for all urban consumers in the United States.[4] (See Tables J and K in Appendix I for summary statistics of the 1990 and 2000 Unites States county data sets.)

6.2. Empirical specification

The empirical specification for the 1990, 2000, and panel data sets is the same as in Section 5.

6.2. Regression results

Tables 15 and 16 show the results of OLS estimates of the three data sets constructed. These tables have the same format as that of Tables 10 and 11. Table 15 reports effects of population age composition on expenditure and revenue shares. Table 16 displays the effects of population age composition on per capita expenditure and revenue. Like the California results, the regressions from using 1990 United States county data, 2000 United States county data, and a panel data set of 1990 and 2000 United States county data yield conflicting insights on how age demographics affect expenditures and revenues.

[4] Note that median household income, an explanatory variable, is not in 2007 dollars. Instead, it is in 1990 or 2000 dollars. To get point-estimates for median household income, deflate using CPI.

Table 15: *Effects of Population Age Composition on Expenditure and Revenue Shares for United States Counties*

	Proportion in Age Group														
	20 and Below			65 and Below			Median Income ($10,000s)			Rural			Intercept		
			Panel Data			Panel Data			Panel Data			Panel Data			Panel Data
	1990	2000	Set	1990	2000	Set	1990	2000	Set	1990	2000	Set	1990	2000	Set
Expendiure shares															
Education share	0.196**	0.264**	0.316**	-0.314**	-0.520**	-0.123*	-0.017**	-0.016**	0.003**	0.130**	0.117**	0.031**	0.468**	0.507**	0.417**
	(0.077)	(0.075)	(0.075)	(0.072)	(0.069)	(0.079)	(0.004)	(0.003)	(0.001)	(0.008)	(0.008)	(0.012)	(0.040)	(0.034)	(0.034)
Health share	0.118**	0.172**	0.123**	0.058	0.170**	0.256**	-0.024**	-0.013**	0.001	-0.043**	-0.042**	-0.007	0.124**	0.079**	0.009
	(0.068)	(0.069)	(0.072)	(0.064)	(0.064)	(0.076)	(0.002)	(0.003)	(0.001)	(0.007)	(0.007)	(0.011)	(0.035)	(0.033)	(0.033)
Welfare share	-0.022	-0.034*	0.015	0.067**	0.086**	-0.041*	0.011**	0.007**	-0.001**	0.001	0.001	0.004	-0.006	-0.005	0.027**
	(0.024)	(0.023)	(0.024)	(0.022)	(0.021)	(0.025)	(0.001)	(0.001)	(0.000)	(0.002)	(0.002)	(0.004)	(0.012)	(0.011)	(0.011)
Police and fire	-0.159**	-0.144**	-0.082**	-0.109**	-0.061**	0.001	0.002**	0.001**	0.003**	-0.041**	-0.041**	0.002	0.142**	0.130**	0.072**
protection share	(0.014)	(0.014)	(0.017)	(0.013)	(0.013)	(0.018)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.003)	(0.007)	(0.007)	(0.008)
Infrastructure share	-0.133**	-0.258**	-0.371**	0.298**	0.325**	-0.093*	0.028**	0.021**	-0.006**	-0.047**	-0.037**	-0.030**	0.273**	0.290**	0.475**
	(0.063)	(0.058)	(0.067)	(0.059)	(0.054)	(0.071)	(0.003)	(0.002)	(0.001)	(0.006)	(0.006)	(0.011)	(0.032)	(0.027)	(0.030)
Revenue shares															
Intergovernmental	-0.463**	-0.177**	0.175**	-1.188**	-0.951**	0.122*	-0.111**	-0.066**	0.012**	0.070**	0.086**	0.036**	0.977**	0.822**	0.314**
transfer share	(0.087)	(0.078)	(0.080)	(0.082)	(0.072)	(0.084)	(0.005)	(0.003)	(0.002)	(0.009)	(0.008)	(0.013)	(0.045)	(0.037)	(0.036)
Taxes share	0.463**	0.177**	-0.175**	1.188**	0.951**	-0.122*	0.111**	0.066**	-0.012**	-0.070**	-0.086**	-0.036**	0.023	0.178**	0.686**
	(0.087)	(0.078)	(0.080)	(0.082)	(0.072)	(0.084)	(0.005)	(0.003)	(0.002)	(0.009)	(0.008)	(0.013)	(0.045)	(0.037)	(0.036)

* Statistically significant at the 75% confidence level. ** Statistically significant at the 90% confidence level.

Table 16: *Effects of Population Age Composition on per Capita Expenditures and Revenues for United States Counties*

	Proportion in Age Group														
	20 and Below			65 and Below			Median Income ($10,000s)			Rural			Intercept		
			Panel Data			Panel Data			Panel Data			Panel Data			Panel Data
	1990	2000	Set	1990	2000	Set	1990	2000	Set	1990	2000	Set	1990	2000	Set
Expenditure per capita															
Education per capita	4.546**	5.062**	0.120	3.029**	3.108**	-0.224	0.233**	0.116**	0.226**	0.234**	0.163**	0.123**	-1.262**	-0.883**	0.701**
	(0.292)	(0.316)	(0.276)	(0.273)	(0.294)	(0.292)	(0.016)	(0.012)	(0.005)	(0.029)	(0.032)	(0.043)	(0.150)	(0.148)	(0.125)
Health per capita	0.666**	0.919**	-0.118	0.603**	1.257**	0.434*	-0.033**	-0.027**	0.056**	-0.123**	-0.153**	0.015	0.104	0.045	0.079
	(0.227)	(0.315)	(0.312)	(0.212)	(0.293)	(0.329)	(0.012)	(0.012)	(0.006)	(0.022)	(0.032)	(0.049)	(0.116)	(0.148)	(0.141)
Welfare per capita	0.055	0.027	0.147*	0.333**	0.446**	-0.082	0.040**	0.029**	0.009**	-0.008	-0.001	0.007	-0.083**	-0.094**	0.016
	(0.086)	(0.095)	(0.098)	(0.080)	(0.088)	(0.104)	(0.005)	(0.004)	(0.002)	(0.008)	(0.010)	(0.015)	(0.044)	(0.045)	(0.045)
Police and fire															
protection per capita	-0.341**	-0.418**	-0.230**	-0.183**	-0.010	0.186**	0.026**	0.023**	0.034**	-0.111**	-0.135**	0.014*	0.283**	0.313**	0.096**
	(0.052)	(0.068)	(0.071)	(0.049)	(0.063)	(0.075)	(0.003)	(0.003)	(0.001)	(0.005)	(0.007)	(0.011)	(0.027)	(0.032)	(0.032)
Infrastructure per															
capita	0.299	-0.710*	-1.603**	1.178**	1.852**	-0.992**	0.216**	0.174**	0.123**	-0.040	-0.063*	-0.005	0.103	0.395**	1.223**
	(0.429)	(0.448)	(0.475)	(0.402)	(0.416)	(0.502)	(0.024)	(0.017)	(0.009)	(0.042)	(0.046)	(0.075)	(0.220)	(0.211)	(0.216)
Total per capita	5.226**	4.879**	-1.685**	4.960**	6.653**	-0.678	0.483**	0.315**	0.447**	-0.048	-0.190**	0.154*	-0.854**	-0.224	2.115**
	(0.724)	(0.799)	(0.694)	(0.678)	(0.743)	(0.733)	(0.040)	(0.030)	(0.013)	(0.071)	(0.082)	(0.109)	(0.372)	(0.376)	(0.315)
Revenue per capita															
Intergovernmental															
transfer per capita	-0.661**	-0.447**	-0.628**	-0.876**	-0.012	-1.761**	0.023**	0.000	-0.038**	0.061**	0.045**	0.093**	1.180**	1.007**	1.427**
	(0.160)	(0.123)	(0.328)	(0.149)	(0.115)	(0.346)	(0.009)	(0.005)	(0.006)	(0.016)	(0.013)	(0.052)	(0.082)	(0.058)	(0.149)
Taxes per capita	1.197**	-0.355**	0.628*	0.479**	-0.172	0.655*	-0.037**	-0.025**	0.007	-0.002	0.034**	-0.083	0.605**	1.160**	0.702**
	(0.261)	(0.177)	(0.495)	(0.244)	(0.165)	(0.522)	(0.014)	(0.007)	(0.010)	(0.026)	(0.018)	(0.078)	(0.134)	(0.083)	(0.225)
Total per capita	5.598**	4.912**	-2.012**	5.175**	6.769**	0.942*	0.502**	0.313**	0.444**	-0.028**	-0.118*	0.090	-1.009**	-0.231	2.079**
	(0.767)	(0.844)	(0.764)	(0.718)	(0.785)	(0.807)	(0.042)	(0.032)	(0.015)	(0.075)	(0.086)	(0.120)	(0.394)	(0.397)	(0.347)

* Statistically significant at the 75% confidence level. ** Statistically significant at the 90% confidence level.

Table 17 recaps the negative or positive effects of aging demographics on expenditure and revenue shares, while Table 18 sums up the consequences for per capita expenditure and revenue. Tables 17 and 18 are formatted the same way as Tables 12 and 13. These tables report that the effect of age demographics on expenditures and revenues vary from one data set to another.

As with California, Tables 17 and 18 show that the relationships between demographics and expenditures and revenues differ when comparing the three data sets. For instance, infrastructure expenditures decrease as the elderly proportion increase in 1990, but the relationship is actually positive when time and/or county fixed effects are added. However, unlike in the case of California, only one effect is different when comparing 1990 to 2000. When the share of the elderly population grows, the taxes increase in 1990, but decrease in 2000. It seems as if the element of time does not have a significant role when investigating the expenditures of counties of the United States.

Table 17: *Summary of Changes of Young Share and Old Share in 1990, 2000, and Panel United States County Data Sets for Expenditure and Revenue Shares*

	20 and Below			65 and Below		
Budget Measure	1990	2000	Panel Data	1990	2000	Panel Data
Expendiure shares						
Education share	+**	+**	+**	-**	-**	-*
Health share	+**	+**	+**	+	+**	+**
Welfare share	-	-*	+	+**	+**	-*
Police and fire protection share	-**	-**	-**	-**	-**	+
Infrastructure share	-**	-**	-**	+**	+**	-*
Revenue shares						
Intergovernmental transfer share	-**	-**	+**	-**	-**	+*
Taxes share	+**	+**	-**	+**	+**	-*

* Statistically significant at the 75% confidence level. ** Statistically significant at the 90% confidence level.

Table 18: *Summary of Changes in 1990, 2000, and Panel United States County Data Sets for per Capita Expenditures and Revenue*

	20 and Below			65 and Below		
Per Capita Measure	1990	2000	Panel Data	1990	2000	Panel Data
Expenditure per capita						
Education per capita	+**	+**	+	+**	+**	-
Health per capita	+**	+**	-	+**	+**	+*
Welfare per capita	+	+	+*	+**	+**	-
Police and fire protection per capita	-**	-**	-**	-**	-	+**
Infrastructure per capita	+	-*	-*	+**	+**	-**
Total per capita	+**	+**	-**	+**	+**	-
Revenue per capita						
Intergovernmental transfer per capita	-**	-**	-**	-**	-	-**
Taxes per capita	+**	-**	+*	+**	-	+*
Total per capita	+**	+**	-**	+**	+**	+*

* Statistically significant at the 75% confidence level. ** Statistically significant at the 90% confidence level.

Tables 17 and 18 also indicate that, like California counties, aging demographics affect health, police and fire protection, infrastructure, public welfare spending, and both revenue categories of United States counties in the opposite direction when time and/or county fixed effects are applied. This may be evidence that these particular categories, at the very least, are affected by the Tiebout bias since the addition of fixed effects has changed results.

6.3. Implications of findings

Table 19 below examines the budgetary consequences of shifting age demographics of a county in the United States with 1990, 2000, and panel data sets on total per capita expenditure

and per capita revenue. (See Tables L, M, and N in Appendix I for analysis of implications using MaCurdy and Nechyba's method to compare. Again, results from this method largely correspond to the findings of Tables 5 and 6 in this paper.)

Table 19: *Budgetary Consequences of Changing the Age Composition of a County's Population in California using 1990, 2000, and Panel Data Sets, Ordinary Least Squares Estimates (Alternative Method)*

Shift in Age Composition of Population	Effect on Total per Capita Expenditures			Effect on Total per Capita Revenues		
	1990	2000	Panel Data Set	1990	2000	Panel Data Set
Old => middle-aged	- $4,960	- $6,653	+ $678	- $5,175	- $6,769	- $942
Young => middle-aged	- $5,226	- $4,879	+ $1,685	- $5,598	- $4,912	+ $2,012
Young => old	- $266	+ $1,774	+ $1,007	- $423	+ $1,857	+ $2,954

The budgetary consequences of changing the age composition of changing a county's population in California according to the 1990, the 2000, and a panel data set largely confirm the findings of MaCurdy and Nechyba and my version of their analysis in Tables 8 and 9. The totals for changes in expenditures and revenues associated with a demographic transformation seem to generate budgetary imbalances. However, these potential budgetary imbalances in county governments are rendered benign as total change in expenditures and revenues tend to change in a similar manner.

7. Comparing California and the United States

The previous sections have compared the counties of the United States and of California within their respective triad of data sets. How about comparing California counties to all the counties of the United States? Is it legitimate to apply the results of California counties to the rest of the counties in the United States?

Tables 20 and 21 provide an answer to whether the effects of aging demographics on expenditures and revenues using 1990, 2000, and panel data sets for California counties and United States counties differ. Table 20 examines budget shares while Table 21 investigates per capita measures. The information presented in the tables report that there are a good number of conflicting effects that appear when comparing the counties of California and the United States. This implies that, at least in terms of the direction of the effect if aging demographics, the results of California counties cannot be extended to the counties of the United States.

Table 20: *Do the Effects of Aging Demographics on Expenditure and Revenue Shares Differ when Comparing the Data Sets from California Counties to that of United States Counties?*

	20 and Below			65 and Below		
Budget Measure	1990	2000	Panel Data	1990	2000	Panel Data
Expendiure shares						
Education share	*No*	*No*	*No*	*Yes*	*Yes*	*Yes*
Health share	*No*	*Yes*	*Yes*	*No*	*No*	*Yes*
Welfare share	*Yes*	*Yes*	*No*	*No*	*No*	*Yes*
Police and fire protection share	*No*	*No*	*No*	*No*	*Yes*	*Yes*
Infrastructure share	*No*	*No*	*No*	*Yes*	*Yes*	*Yes*
Revenue shares						
Intergovernmental transfer share	*Yes*	*Yes*	*No*	*No*	*No*	*No*
Taxes share	*Yes*	*Yes*	*No*	*No*	*No*	*No*

* Statistically significant at the 75% confidence level. ** Statistically significant at the 90% confidence level.

Table 21: *Do the Effects of Aging Demographics on per Capita Expenditures and Revenues Differ when Comparing the Data Sets from California Counties to that of United States Counties?*

	20 and Below			65 and Below		
Per Capita Measure	1990	2000	Panel Data	1990	2000	Panel Data
Expenditure per capita						
Education per capita	*No*	*No*	*No*	*Yes*	*Yes*	*Yes*
Health per capita	*Yes*	*Yes*	*No*	*No*	*No*	*Yes*
Welfare per capita	*No*	*Yes*	*No*	*Yes*	*Yes*	*Yes*
Police and fire protection per capita	*No*	*No*	*No*	*No*	*No*	*Yes*
Infrastructure per capita	*Yes*	*No*	*No*	*Yes*	*Yes*	*Yes*
Total per capita	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*No*
Revenue per capita						
Intergovernmental transfer per capita	*Yes*	*No*	*Yes*	*Yes*	*No*	*Yes*
Taxes per capita	*No*	*Yes*	*Yes*	*Yes*	*No*	*Yes*
Total per capita	*No*	*No*	*No*	*Yes*	*Yes*	*Yes*

* Statistically significant at the 75% confidence level. ** Statistically significant at the 90% confidence level.

8. Conclusion

This study is designed to answer the question: How does a change in the age composition of a county's population alter a local government's spending on public goods and on its sources (local taxes or state/federal) for funding these expenditures? MaCurdy and Nechyba find that their regressions results, which are generated using data for the fifty-eight California counties in 1990, largely correspond with their predictions, which are summarized in Table 1. They find that infrastructure and police and fire protection are indeed public goods targeted at middle-aged

communities. An increase in the share of the elderly population or in the young population causes a decrease in spending for these two categories. In addition, education spending increases as the proportion of the young population increases. It also appears to be true that an increase in the proportion of the young population leads to greater revenues from intergovernmental transfers with a smaller amount of revenues generated from taxes. There is also some evidence for a positive relationship between public welfare expenditures and the share of the young population.

By replicating MaCurdy and Nechyba's study for California counties in 1990, I also find the same results with some adjustments. However, when I examine California counties in 2000 using the same methods, the results do not correspond to that of MaCurdy and Nechyba. In fact, the regression results of two expenditure categories and intergovernmental transfers indicate that the age composition has the opposite effect of what is reported in 1990. Furthermore, when I investigate the effects of age demographics on expenditures and revenues while factoring in time and county fixed effects to control for the Tiebout bias, the results do not correspond to that of MaCurdy and Nechyba. Consequently, the effects of age demographics differ from the 1990, 2000, and the panel data sets. The fact that the cost of age composition differ from the cross-sectional data set to the panel data set suggests that the categories, at the very least, that exhibit a different relationship are subject to the Tiebout bias, meaning that people choose to live in certain counties because the spending or revenues in certain counties correspond with their preferences. For the California county data, these categories include: health, police and fire protection, infrastructure, public welfare, intergovernmental transfers, and taxes.

This study also extends the examination to the counties of the United States. Similar conclusions to that of counties of California are reached in that there were conflicting results in

comparing the 1990 data set to the 2000 data set to the panel data set. Once again, I am led to believe that at least certain revenue and expenditure categories are affected by the Tiebout bias. The results seem to imply that looking at cross-sectional data to answer the question of the effects of age demographics is not enough, that county and time fixed effects also need to be considered.

The study also compares the results of the United States counties to that of California. The consequences of age demographics are not consistent when comparing the two sets of outcomes. This leads me conclude that the conclusions MaCurdy and Nechyba obtained in their study of California county governments is not representative of all United States county governments.

Interestingly enough, the effects of age demographics found using the United States panel data largely corroborate with MaCurdy and Nechyba's projections regarding expenditure categories. However, the consequence on intergovernmental transfers and taxes do not line up as neatly.

Despite all the mixed results, there is one point that MaCurdy and Nechyba find that remains consistent from one data set to the next. They find, in their study that the effects of aging demographics are benign because revenues and expenditures tend to shift in a similar manner; this means that an increase in expenditure is compensated by an increase in revenue. This suggests that tax and intergovernmental programs that are in place in county governments are on the right path to dealing with the effects of aging demographics.

8.1. Suggestions for further studies

The conclusion of this study indicates that the county and time fixed effects play a role in public spending and revenues in county governments. This implies that the Tiebout bias is a

consequence that should be seriously considered. In order to more fully account for the Tiebout bias, there are two suggestions that can be incorporated into the panel data set for the United States. The first is that additional data can be gathered. The panel data in this study only includes two years. Additional years can lend further insights to the topic. This data set can also include an instrument variable such as that of Ladd and Murray (2001). They instrument for elderly population, which are people 65 years and older, with the share of population between ages 55 to 64 in the county ten years earlier. This method should eliminate any remaining issues caused by the Tiebout bias.

Appendix

Appendix I. Additional Tables

Table A: *Budgetary Consequences of Changing the Age Composition of a County's Population in California, Least Squares Estimates*

Shift in Age Composition of Population	Effects on Expenditures		Effects on Revenues	
Old => middle-aged	Infrastructure	+ $6,125	IG Transfers	+ $3,343
			Own Taxes	+ $4,804
	Total	+ $6,125	Total	+ $8,147
Young => middle-aged	Education	- $2,143	IG Transfers	+ $418
	Police and Fire	+ $1,157	Own Taxes	+ $5,353
	Infrastructure	+ $4,864		
	Total	+ $3,878	Total	+ $5,771
Young => old	Education	- $2,138	IG Transfers	- $2,925
			Own Taxes	+ $549
	Total	- $2,138	Total	- $2,376

Source: MaCurdy and Nechyba (2001)

Table B: *Budgetary Consequences of Changing the Age Composition of a County's Population in California, Least Absolute Deviation Estimate*

Shift in Age Composition of Population	Effects on Expenditures		Effects on Revenues	
Old => middle-aged	Infrastructure	+ $4,130	IG Transfers	+ $4,427
			Own Taxes	+ $2,402
	Total	+ $4,130	Total	+ $6,829
Young => middle-aged	Education	- $1,813	IG Transfers	- $107
	Police and Fire	+ $746	Own Taxes	+ $2,682
	Infrastructure	+ $3,651		
	Total	+ $2,584	Total	+ $2,575
Young => old	Education	- $2,694	IG Transfers	- $4,534
			Own Taxes	+ $280
	Total	- $2,694	Total	- $4,254

Source: MaCurdy and Nechyba (2001)

Table C: *Summary Statistics, California Counties in 1990*

	Mean		Minimum		Lower Quartile		Median		Upper Quartile		Maximum	
Variable	1987	1992	1987	1992	1987	1992	1987	1992	1987	1992	1987	1992
County expenditure and revenue variables												
Population (1,000s)	465.2	513.1	1.3	1.1	31.8	36.7	120.1	133.5	432.7	480.6	8295.9	8863.2
Total expenditures ($millions)	1.124	1.389	0.007	0.007	0.078	0.099	0.272	0.333	1.114	0.428	20.799	24.304
Total revenue ($millions)	1.182	1.427	0.006	0.008	0.078	0.096	0.291	0.338	1.129	1.387	21.363	26.227
Education share (%)	0.383	0.383	0.198	0.199	0.339	0.344	0.381	0.381	0.426	0.429	0.565	0.563
Health share (%)	0.101	0.114	0.017	0.022	0.044	0.058	0.095	0.094	0.146	0.162	0.283	0.335
Welfare share (%)	0.110	0.113	0.036	0.047	0.079	0.083	0.104	0.104	0.141	0.141	0.217	0.204
Police and fire protection share (%)	0.073	0.072	0.032	0.031	0.059	0.059	0.071	0.067	0.086	0.085	0.124	0.141
Infrastructure share (%)	0.333	0.318	0.177	0.169	0.277	0.266	0.340	0.313	0.371	0.363	0.581	0.478
Intergovernmental transfers share (%)	0.502	0.479	0.307	0.257	0.416	0.411	0.496	0.492	0.571	0.556	0.732	0.689
Taxes share (%)	0.498	0.521	0.268	0.314	0.430	0.449	0.513	0.582	0.596	0.589	0.693	0.743
Education per capita (1,000s)	0.944	1.076	0.573	0.646	0.820	0.886	0.904	1.025	1.057	1.258	1.799	2.144
Health per capita (1,000s)	0.254	0.333	0.041	0.057	0.114	0.150	0.233	0.265	0.357	0.432	0.927	1.293
Welfare per capita (1,000s)	0.270	0.316	0.108	0.119	0.198	0.234	0.270	0.310	0.320	0.394	0.480	0.600
Police and fire protection per capita (1,000s)	0.182	0.204	0.078	0.095	0.136	0.148	0.172	0.189	0.208	0.228	0.476	0.800
Infrastructure per capita (1,000s)	0.845	0.908	0.414	0.463	0.662	0.702	0.773	0.849	0.873	1.017	2.936	2.986
Total expenditures per capita (1,000s)	2.493	2.838	1.822	2.128	2.164	2.395	2.377	2.680	2.645	2.962	5.051	6.493
Taxes per capita (1,000s)	1.298	1.485	0.723	0.783	1.076	1.214	1.259	1.419	1.472	1.593	2.729	3.161
Intergov. transfers per capita (1,000s)	1.303	1.371	0.651	0.657	1.065	1.073	1.281	1.330	1.444	1.544	3.091	3.665
Demographic variables (as of 1990)												
Fraction of households in rural areas	0.365		0.000		0.109		0.296		0.632		1.000	
Median household income ($10,000)	3.056		2.049		2.457		2.875		3.505		4.854	
Fraction of population aged 0-20	0.304		0.194		0.283		0.298		0.330		0.393	
Fraction of population aged 21-64	0.568		0.506		0.543		0.563		0.590		0.661	
Fraction of population aged 65 and up	0.128		0.061		0.102		0.122		0.149		0.264	

Note: All monetary values are in 1990 dollars, deflated by the CPI for all urban consumers in the western region of the United States.

Source: MaCurdy and Nechyba (2001)

Table D: *Effects of Population Age Composition on Expenditure and Revenue Shares for California Counties*

	Proportion in Age Group				
Budget Measure	20 and Below	65 and Above	Median Income ($10,000s)	Rural	Intercept
Expenditure shares					
Education share	1.001**	0.493	0.003	0.049	-0.009
	(0.369)	(0.535)	(0.017)	(0.052)	(0.209)
	0.896**	0.688	0.005	0.036	-0.006
	(0.479)	(1.647)	(0.024)	(0.060)	(0.276)
Health share	0.062	0.553*	0.009	0.011	-0.014
	(0.334)	(0.405)	(0.019)	(0.048)	(0.186)
	-0.027	0.510	0.008	-0.012	0.025
	(0.569)	(0.541)	(0.032)	(0.070)	(0.311)
Welfare share	0.183*	0.005	-0.041**	-0.061**	0.202**
	(0.161)	(0.206)	(0.008)	(0.017)	(0.090)
	0.211*	0.001	-0.041**	0.061**	0.195**
	(0.164)	(0.230)	(0.008)	(0.024)	(0.086)
Police and fire protection share	-0.253**	-0.131	-0.007**	-0.025**	0.153**
	(0.094)	(0.147)	(0.004)	(0.013)	(0.053)
	-0.179*	-0.031	0.009**	-0.030**	0.111**
	(0.119)	(0.180)	(0.005)	(0.014)	(0.066)
Infrastructure share	-1.021**	-0.967**	0.020*	0.026	0.688**
	(0.321)	(0.449)	(0.013)	(0.042)	(0.173)
	-1.223**	-1.024**	0.015	-0.004	0.778**
	(0.382)	(0.536)	(0.016)	(0.049)	(0.198)
Revenue shares					
Intergovernmental transfer share	0.663**	-0.139	-0.085**	-0.018	0.571**
	(0.389)	(0.646)	(0.021)	(0.048)	(0.239)
	0.541	-0.290	-0.091**	-0.051	0.662**
	(0.553)	(0.825)	(0.031)	(0.067)	(0.331)
Taxes share	-0.696**	0.126	0.083**	0.014	0.448**
	(0.397)	(0.636)	(0.020)	(0.047)	(0.240)
	-0.571	0.271	0.089**	0.048	0.356
	(0.529)	(0.817)	(0.029)	(0.066)	(0.317)

Notes: All estimates and standard errors were computed with bootstrap procedures (with 1,000 sample draws). For each budget measure, the first row shows the least squares coefficients, and the second row shows the least absolute deviations coefficients. Numbers in parentheses are standard errors.

* Statistically significant t the 75% confidence level. ** Statistically significant at the 90% confidence level.

Source: MaCurdy and Nechyba(2001)

Table E: *Effects of Population Age Composition on per Capita Expenditures and Revenues for California Counties*

	Proportion in Age Group				
Per Capita Measure	20 and Below	65 and Above	Median Income ($10,000s)	Rural	Intercept
Expenditure per capita					
Education per capita	2.143**	00.52	-0.046	.352**	0.360
	(0.921)	(2.018)	(0.052)	(0.131)	(0.629)
	1.813**	-0.884	-0.056	0.325**	0.613
	(0.980)	(1.700)	(0.052)	(0.161)	(0.583)
Health per capita	-0.155	1.052	-0.016	0.037	0.241
	(1.130)	(1.264)	(0.061)	(0.142)	(0.618)
	-0.235	0.514	0.013	0.047	0.208
	(1.889)	(1.627)	(0.104)	(0.208)	(1.042)
Welfare per capita	0.312	-0.467	-0.116**	-0.094**	0.646**
	(0.137)	(0.148)	(0.008)	(0.018)	(0.075)
	0.107	-0.647	-0.122**	-0.093*	0.742**
	(0.713)	(0.947)	(0.030)	(0.078)	(0.388)
Police and fire protection	-1.157**	-1.214	-0.004	0.015	0.705**
per capita	(0.577)	(1.095)	(0.019)	(0.085)	(0.341)
	-0.746*	-0.529	-.0002	-0.082*	0.505**
	(0.479)	(0.721)	(0.017)	(0.057)	(0.273)
Infrastructure per capita	-4.864**	-6.152*	-0.047	0.409*	3.129**
	(2.408)	(4.339)	(0.086)	(0.350)	(1.413)
	-3.651*	-4.103*	-0.029	0.074	2.514**
	(2.316)	(3.493)	(0.093)	(0.248)	(1.360)
Total per capita	-3.846	-7.156	-0.230*	0.757*	5.162**
	(4.117)	(7.176)	(0.163)	(0.577)	(2.427)
	-0.226	-5.503	-0.163	0.440	3.689
	(5.693)	(7.624)	(0.252)	(0.501)	(3.334)
Revenue per capita					
Intergovernmental	-0.418	-3.343	-0.326**	0.328	2.761**
transfer per capita	(2.068)	(4.161)	(0.095)	(0.318)	(1.314)
	0.107	-4.427*	-0.315**	0.039	2.872**
	(2.225)	(2.897)	(0.104)	(0.234)	(1.331)
Taxes per capita	-5.353**	-4.804*	0.019	0.335	3.443**
	(2.912)	(4.124)	(0.120)	(0.340)	(1.631)
	-2.682	-2.402	0.125	0.314	1.976
	(4.918)	(6.323)	(0.195)	(0.410)	(2.771)

Notes: All estimates and standard errors were computed with bootstrap procedures (with 1,000 sample draws). For each per capita, the first row shows the least squares coefficients, and the second row shows the least absolute deviations coefficients. Numbers in parentheses are standard errors.
* Statistically significant t the 75% confidence level. ** Statistically significant at the 90% confidence level.

Source: MaCurdy and Nechyba(2001)

Table F: *Summary Statistics, California Counties in 2000*

	Mean		Minimum		Lower Quartile		Median		Upper Quartile		Maximum	
Variable	1997	2002	1997	2002	1997	2002	1997	2002	1997	2002	1997	2002
County expenditure and revenue variables												
Population (1,000s)	555.5	603.2	1.2	1.2	44.3	44.2	153.1	168.8	540.0	612.6	9126.1	9763.8
Total expenditures ($millions)	2.352	3.020	0.148	0.017	0.187	0.220	0.625	0.800	2.198	2.844	40.004	49.339
Total revenue ($millions)	2.444	3.176	0.158	0.019	0.191	0.238	0.629	0.807	2.209	3.045	43.388	54.194
Education share (%)	0.370	0.403	0.141	0.142	0.326	0.366	0.326	0.409	0.420	0.443	0.561	0.564
Health share (%)	0.113	0.106	0.011	0.026	0.055	0.061	0.088	0.081	0.143	0.156	0.376	0.314
Welfare share (%)	0.096	0.083	0.033	0.022	0.071	0.061	0.090	0.079	0.117	0.097	0.176	0.164
Police and fire protection share (%)	0.072	0.072	0.028	0.038	0.059	0.054	0.071	0.073	0.087	0.087	0.122	0.123
Infrastructure share (%)	0.348	0.336	0.225	0.234	0.290	0.281	0.347	0.328	0.398	0.379	0.594	0.527
Intergovernmental transfers share (%)	0.484	0.511	0.278	0.263	0.407	0.420	0.487	0.508	0.555	0.604	0.676	0.718
Taxes share (%)	0.516	0.489	0.324	0.282	0.445	0.396	0.513	0.492	0.593	0.580	0.722	0.737
Education per capita (1,000s)	1.633	2.098	0.904	1.004	1.380	1.787	1.583	2.018	1.877	2.377	2.648	3.972
Health per capita (1,000s)	0.581	0.627	0.046	0.126	0.213	0.272	0.370	0.377	0.641	0.785	2.976	2.551
Welfare per capita (1,000s)	0.424	0.434	0.210	0.183	0.310	0.295	0.427	0.378	0.523	0.535	0.879	1.131
Police and fire protection per capita (1,000s)	0.327	0.389	0.153	0.194	0.242	0.292	0.291	0.347	0.371	0.421	0.976	1.474
Infrastructure per capita (1,000s)	1.631	1.849	0.780	0.996	1.224	1.315	1.430	1.638	1.690	1.981	7.259	7.480
Total expenditures per capita (1,000s)	4.596	5.397	2.556	2.887	3.745	4.418	4.084	4.852	4.743	5.852	12.215	14.190
Taxes per capita (1,000s)	2.479	2.748	1.212	1.195	1.883	1.960	2.182	2.506	2.666	3.060	7.509	8.174
Intergov. transfers per capita (1,000s)	2.251	2.819	1.157	1.354	1.694	2.138	2.149	2.644	2.560	3.223	5.523	7.857
Total revenue per capita (1,000s)	4.730	5.567	2.692	3.075	3.791	4.419	4.157	4.970	4.890	6.101	13.033	16.031
Demographic variables (as of 1990)												
Fraction of households in rural areas	0.319		0.000		0.089		0.199		0.474		1.000	
Median household income ($10,000)	4.290		2.752		3.473		4.090		5.148		7.434	
Fraction of population aged 0-20	0.304		0.173		0.275		0.984		0.340		0.390	
Fraction of population aged 21-64	0.570		0.515		0.542		0.568		0.587		0.689	
Fraction of population aged 65 and up	0.126		0.732		0.099		0.123		0.153		0.194	

Note: All revenues and expenditure monetary values are in 2007 dollars, deflated by the CPI for all urban consumers in the United States.

Table G: *Budgetary Consequences of Changing the Age Composition of a County's Population in California in 1990, Ordinary Least Squares Estimates (MaCurdy and Nechyba's Method)*

Shift in Age Composition of Population	Effects on Expenditures			Effects on Revenues		
Old => middle-aged	Education	+	$202	IG Transfers	-	$875
	Police and Fire	+	$2,424	Own Taxes	+	$461
	Infrastructure	+	$12,192			
	Total	+	$14,818	Total	-	$414
Young => middle-aged	Education	-	$2,430	IG Transfers	-	$22
	Police and Fire	+	$2,255	Own Taxes	-	$88
	Infrastructure	+	$9,724			
	Total	+	$9,549	Total	-	$110
Young => old	Education	-	$2,632	IG Transfers	+	$853
	Welfare	-	$1,093	Own Taxes	-	$549
	Police and Fire	+	$2,010			
	Total	-	$1,715	Total	+	$304

Table H: *Budgetary Consequences of Changing the Age Composition of a County's Population in California in 2000, Ordinary Least Squares Estimates (MaCurdy and*

Shift in Age Composition of Population	Effects on Expenditures			Effects on Revenues		
Old => middle-aged	Police and Fire	+	$2,143	IG Transfers	+	$284
	Infrastructure	+	$15,820	Own Taxes	-	$8
	Total	+	$17,963	Total	+	$276
Young => middle-aged	Education	-	$3,390	IG Transfers	+	$175
	Police and Fire	+	$1,517	Own Taxes	-	$840
	Infrastructure	+	$7,408			
	Total	+	$5,535	Total	-	$665
Young => old	Education	-	$6,487	IG Transfers	-	$109
	Welfare	+	$1,395	Own Taxes	-	$832
	Police and Fire	-	$626			
	Infrastructure	-	$8,412			
	Total	-	$14,130	Total	-	$941

Table I: *Budgetary Consequences of Changing the Age Composition of a County's Population in California, Ordinary Least Squares Estimates (MaCurdy and Nechyba's Method)*

Shift in Age Composition of Population	Effects on Expenditures			Effects on Revenues		
Old => middle-aged	Education	-	$1,144	IG Transfers	-	$781
	Health	+	$13,439	Own Taxes	+	$5,601
	Police and Fire	+	$1,089			
	Total	+	$13,384	Total	-	$4,820
Young => middle-aged	Education	-	$2,126	IG Transfers	-	$3,361
	Infrastructure	+	$5,730	Own Taxes	+	$2,649
	Total	+	$3,604	Total	-	$712
Young => old	Infrastructure	+	6,336	IG Transfers	-	$2,580
				Own Taxes	-	$2,952
	Total	+	6,336	Total	-	$5,532

Table J: *Summary Statistics, United States Counties in 1990*

	Mean		Minimum		Lower Quartile		Median		Upper Quartile		Maximum	
Variable	1987	1992	1987	1992	1987	1992	1987	1992	1987	1992	1987	1992
County expenditure and revenue variables												
Population (1,000s)	77.4	81.4	0.1	0.1	10.5	10.5	22.2	22.6	53.0	56.3	8553.8	9021.9
Total expenditures ($millions)	0.227	0.266	0.001	0.000	0.023	0.024	0.049	0.056	0.124	0.142	40.903	49.032
Total revenue ($millions)	0.238	0.272	0.001	0.000	0.023	0.025	0.051	0.057	0.125	0.144	50.161	57.156
Education share (%)	0.522	0.526	0.000	0.000	0.439	0.443	0.522	0.522	0.606	0.610	0.999	0.999
Health share (%)	0.083	0.085	0.000	0.000	0.008	0.009	0.031	0.031	0.145	0.140	0.754	0.591
Welfare share (%)	0.024	0.025	0.000	0.000	0.001	0.001	0.006	0.007	0.036	0.038	0.227	0.282
Police and fire protection share (%)	0.053	0.055	0.000	0.000	0.035	0.037	0.049	0.052	0.066	0.070	0.366	0.352
Infrastructure share (%)	0.318	0.308	0.001	0.001	0.251	0.240	0.311	0.301	0.372	0.363	0.920	0.947
Intergovernmental transfers share (%)	0.435	0.437	0.012	0.000	0.333	0.336	0.433	0.432	0.539	0.534	0.907	0.897
Taxes share (%)	0.565	0.563	0.093	0.103	0.461	0.466	0.567	0.568	0.667	0.664	0.988	1.000
Education per capita (1,000s)	1.248	1.375	0.000	0.000	0.989	1.081	1.172	1.295	1.417	1.575	7.060	7.157
Health per capita (1,000s)	0.227	0.266	0.000	0.000	0.017	0.021	0.072	0.079	0.367	0.409	4.615	2.961
Welfare per capita (1,000s)	0.068	0.080	0.000	0.000	0.002	0.002	0.013	0.018	0.080	0.096	0.879	1.375
Police and fire protection per capita (1,000s)	0.132	0.152	0.000	0.000	0.079	0.089	0.113	0.132	0.162	0.188	1.437	1.238
Infrastructure per capita (1,000s)	0.834	0.887	0.001	0.001	0.491	0.520	0.714	0.756	1.005	1.070	16.504	12.178
Total expenditures per capita (1,000s)	2.509	2.760	0.218	0.247	1.836	1.990	2.295	2.530	2.932	3.258	17.941	14.381
Taxes per capita (1,000s)	1.533	1.646	0.116	0.106	0.916	1.007	1.354	1.470	1.871	2.014	13.184	24.512
Intergov. transfers per capita (1,000s)	1.051	1.146	0.095	0.000	0.770	0.846	0.960	1.039	1.210	1.332	5.128	5.676
Total revenue per capita (1,000s)	2.584	2.791	0.237	0.220	1.866	2.021	2.347	2.572	3.030	3.285	13.339	25.554
Demographic variables (as of 1990)												
Fraction of households in rural areas	0.636		0.000		0.423		0.659		1.000		1.000	
Median household income ($10,000)	2.384		0.860		1.964		2.267		2.680		5.928	
Fraction of population aged 0-20	0.311		0.179		0.290		0.307		0.330		0.555	
Fraction of population aged 21-64	0.539		0.387		0.514		0.539		0.562		0.768	
Fraction of population aged 65 and up	0.149		0.015		0.121		0.146		0.174		0.340	

Note: All revenues and expenditure monetary values are in 2007 dollars, deflated by the CPI for all urban consumers in the United States.

Table J: *Summary Statistics, United States Counties in 2000*

	Mean		Minimum		Lower Quartile		Median		Upper Quartile		Maximum	
Variable	1997	2002	1997	2002	1997	2002	1997	2002	1997	2002	1997	2002
County expenditure and revenue variables												
Population (1,000s)	85.5	92.0	0.1	0.1	10.9	11.3	23.9	25.0	60.0	62.3	9126.1	9763.8
Total expenditures ($millions)	0.298	0.362	0.000	0.001	0.029	0.032	0.650	0.074	0.167	0.202	52.215	61.454
Total revenue ($millions)	0.307	0.362	0.001	0.001	0.029	0.032	0.066	0.074	0.169	0.202	59.279	61.454
Education share (%)	0.524	0.521	0.000	0.000	0.443	0.435	0.525	0.525	0.608	0.607	0.957	0.972
Health share (%)	0.083	0.083	0.000	0.000	0.009	0.008	0.029	0.027	0.120	0.119	0.645	0.628
Welfare share (%)	0.023	0.023	0.000	0.000	0.001	0.001	0.006	0.005	0.035	0.034	0.383	0.343
Police and fire protection share (%)	0.058	0.059	0.001	0.003	0.039	0.040	0.053	0.055	0.073	0.075	0.415	0.290
Infrastructure share (%)	0.312	0.313	0.039	0.022	0.244	0.249	0.304	0.306	0.365	0.366	0.915	0.931
Intergovernmental transfers share (%)	0.441	0.453	0.007	0.004	0.347	0.358	0.440	0.451	0.539	0.553	0.901	0.927
Taxes share (%)	0.559	0.547	0.099	0.073	0.461	0.447	0.560	0.549	0.653	0.642	0.993	0.996
Education per capita (1,000s)	1.508	1.666	0.000	0.000	1.206	1.330	1.414	1.563	1.698	1.884	10.449	7.994
Health per capita (1,000s)	0.297	0.337	0.000	0.000	0.021	0.023	0.080	0.084	0.390	0.415	5.316	5.201
Welfare per capita (1,000s)	0.080	0.086	0.000	0.000	0.002	0.002	0.016	0.015	0.098	0.109	2.391	2.870
Police and fire protection per capita (1,000s)	0.175	0.197	0.003	0.007	0.105	0.123	0.151	0.172	0.214	0.244	1.981	1.987
Infrastructure per capita (1,000s)	0.986	1.079	0.038	0.034	0.600	0.677	0.842	0.966	1.201	1.296	21.420	17.079
Total expenditures per capita (1,000s)	3.046	3.364	0.262	0.263	2.232	2.471	2.783	3.136	3.586	3.973	23.401	18.353
Taxes per capita (1,000s)	1.817	1.946	0.109	0.113	1.116	1.188	1.594	1.714	2.202	2.376	17.279	20.449
Intergov. transfers per capita (1,000s)	1.293	1.468	0.052	0.085	0.967	1.089	1.181	1.342	1.510	1.707	6.923	7.857
Total revenue per capita (1,000s)	3.110	3.413	0.304	0.319	2.275	2.489	2.842	3.143	3.633	3.978	17.535	20.536
Demographic variables (as of 1990)												
Fraction of households in rural areas	0.604		0.000		0.362		0.612		0.910		1.000	
Median household income ($10,000)	3.526		1.270		2.960		3.367		3.920		8.293	
Fraction of population aged 0-20	0.296		0.173		0.276		0.295		0.315		0.518	
Fraction of population aged 21-64	0.555		0.422		0.533		0.557		0.578		0.758	
aged 65 and up	0.148		0.018		0.122		0.144		0.171		0.347	

Note: All revenues and expenditure monetary values are in 2007 dollars, deflated by the CPI for all urban consumers in the United States.

Table L: *Budgetary Consequences of Changing the Age Composition of a County's Population in the United States in 1990, Ordinary Least Squares Estimates (MaCurdy and Nechyba's Method)*

Shift in Age Composition of Population	Effects on Expenditures			Effects on Revenues		
Old => middle-aged	Education	-	$3,029	IG Transfers	+	$876
	Health	-	$603	Own Taxes	-	$479
	Welfare	-	$333			
	Police and Fire	+	$183			
	Infrastructure	-	$1,178			
	Total	-	$4,960	Total	+	$397
Young => middle-aged	Education	-	$4,546	IG Transfers	+	$661
	Health	-	$666	Own Taxes	-	$1,197
	Police and Fire	+	$341			
	Infrastructure	-	$299			
	Total	-	$5,170	Total	-	$536
Young => old	Education	-	$1,517	IG Transfers	-	$215
	Welfare	+	$278	Own Taxes	-	$718
	Police and Fire	+	$158			
	Infrastructure	+	$879			
	Total	-	$202	Total	-	$933

Table M: *Budgetary Consequences of Changing the Age Composition of a County's Population in the United States in 2000, Ordinary Least Squares Estimates (MaCurdy and Nechyba's Method)*

Shift in Age Composition of Population	Effects on Expenditures			Effects on Revenues		
Old => middle-aged	Education	-	$3,108	IG Transfers	+	$12
	Health	-	$1,257	Own Taxes	+	$172
	Welfare	-	$446			
	Police and Fire	+	$10			
	Infrastructure	-	$1,852			
	Total	-	$6,653	Total	+	$184
Young => middle-aged	Education	-	$5,062	IG Transfers	+	$447
	Health	-	$919	Own Taxes	+	$355
	Police and Fire	+	$418			
	Infrastructure	+	$710			
	Total	-	$4,853	Total	+	$802
Young => old	Education	-	$1,954	IG Transfers	+	$435
	Welfare	+	$419	Own Taxes	+	$183
	Police and Fire	+	$408			
	Infrastructure	+	$2,562			
	Total	+	$1,435	Total	+	$618

Table N: *Budgetary Consequences of Changing the Age Composition of a County's Population in the United States, Ordinary Least Squares Estimates (MaCurdy and Nechyba's Method)*

Shift in Age Composition of Population	Effects on Expenditures			Effects on Revenues		
Old => middle-aged	Health	-	$434	IG Transfers	+	$1,761
	Police and Fire	-	$186	Own Taxes	-	$655
	Infrastructure	+	$992			
	Total	+	$372	Total	+	$1,106
Young => middle-aged	Education	-	$120	IG Transfers	+	$628
	Health	+	$118	Own Taxes	-	$628
	Police and Fire	+	$230			
	Infrastructure	+	$1,630			
	Total	+	$1,858	Total	+	$0
Young => old	Education	-	$344	IG Transfers	-	$1,133
	Health	+	$552	Own Taxes	+	$27
	Welfare	-	$229			
	Police and Fire	+	$416			
	Infrastructure	+	$611			
	Total	+	$1,006	Total	-	$1,106

Appendix II. Description of Data

A. Revenue and Expenditure Data

All revenue and expenditure data for California and Unites States counties in fiscal years 1987, 1992, 1997, and 2002 originate from the Census of Governments. The Census of Governments is a survey that is conducted by the U.S Bureau of the Census of Governments every five years. The data comes specifically from one publication of the Census of Governments, Volume 4 No. 5 *Compendium of Government Finances*. (An electronic copy of the data can be obtained by calling the Census of Governments office.) In this publication, revenues and expenditure information for every county in the United States is listed. The number of counties covered varies by survey year as new county boundaries are redrawn. The U.S. census Bureau lists 3,140 counties or county-equivalent units in the United States. In generating the data set for this study, counties in Hawaii and Alaska are eliminated. In addition, counties whose boundaries are redrawn or counties that were not in existence in 1897, 1992, 1997, and 2002 are dismissed. Note that all government expenditure includes all capital outlay while revenue does not include receipts from borrowing. Debt, cash and securities of counties are not within the scope of this study. In addition, per capita expenditures and revenues figures are collected from the same source. They are labeled the same way as other variables except with the additional ending "_pc." Below are details of the expenditure and revenue data obtained. Much of the data description is taken from the Appendix section of MaCurdy and Nechyba (2001).

Direct General Expenditures

Total: Labeled with variable name "direct_general_expend" in the file received from the Census of Governments. Includes all expenditures such as payment to employees, suppliers,

contractors, beneficiaries, and other final recipients of government payments. Excludes utility expenditure, liquor stores expenditure, employee-retirement, other insurance trust expenditure, and intergovernmental expenditure.

Education: Labeled as "total_educ_direct_exp" in the data file received. Includes expenditures for provision or support of schools and other educational facilities and services, including those for educational institutions beyond the high school level operated by local governments (e.g., community colleges). Covers such related services as pupil transportation, school milk, and lunch programs and other cafeterias, health and recreational programs, and the like.

Health and hospital: Labeled as "health___hosp_dir_exp" in the data file from the Census of Governments. Includes outpatient health services, including public health administration, research and education, treatment and immunization clinics, nursing, etc.; financing, construction, and operation of nursing homes; financing, construction, acquisition, maintenance, and operation of hospital facilities; provision of hospital care; and support of public or private hospitals.

Public welfare: Labeled as "public_welf_direct_exp." Covers support of and assistance to needy persons contingent upon their needs. Includes Cash Assistance paid directly to needy persons under categorical (Old age Assistance, Aid to Families with Dependent Children, Aid to the Blind, and Aid to the Disabled.) and other welfare programs; vendor payments made directly to private purveyors for medical care, burials, and other commodities and services provided under welfare programs; welfare institutions; and any intergovernmental or other direct expenditure for welfare purposes. Pensions to former employees and other benefits not contingent on need are excluded.

Police and fire protection: The sum of variables labeled as "police_prot_direct_exp" and "fire_prot_direct_exp" in the data file received. Includes expenditures for preservation of law and order and traffic safety. Covers police patrols and communications, crime prevention activities, detention and custody of persons awaiting trial, traffic safety, and vehicular inspection. Also covers fire-fighting organizations and auxiliary services, fire inspection and investigation, support of volunteer fire forces, and other fire prevention activities, including cost of fire-fighting facilities, such as fire hydrants and water, furnished by other agencies of the government.

Infrastructure: This is a residual category created by subtracting the spending on each of the four expenditure categories from the total direct general expenditures. Represents expenditures that do not fall under the other four expenditure categories. This category covers expenditures on the general functions of government (legislative, as well as management and support); transportation (streets, highways, storm drains, street trees and landscaping, public transit, airports, ports and harbors); community development (planning, construction and engineering regulation enforcement, redevelopment, housing, employment, and community promotion); culture and leisure (parks recreation, marinas and wharfs, libraries, museums, golf courses, sports arenas and stadiums, community centers and auditoriums).

General Revenue

Total: Labeled as "general_revenue." Includes all revenue except utility, liquor stores, and employee-retirement or other insurance-trust revenue. All tax revenue and all intergovernmental revenue, even if designated for employee-retirement or local utility purposes, is classified as general revenue.

Intergovernmental transfers: Labeled as "total_ig_revenue" in data file received. Covers amounts received from the federal or state government as fiscal aid, as reimbursements for performance of general government functions and specific services for the paying government, or in lieu of taxes. Excludes amounts received from other governments for sale of property, commodities, and utility services. All intergovernmental revenue is classified as general revenue.

Total taxes: Labeled as "gen_rev_own_sources." Defined as all compulsory contributions exacted by a government for public purposes except employee and employer assessments for retirement and social insurance purposes, which as classified as insurance trust revenue. Total taxes include amounts received from all taxes imposed by a government.

B. Demographic Data

Data for explanatory variables are gathered from the 1990 and 2000 Census of Population STF3A files for United States counties, which can be found online at the U.S. Bureau of the Census website. Three age groups are constructed from the data: age 0 to 10, 21 to 64, and 65 and older. The RURAL variable refers to the share of housing units in each county that are in rural (farm or nonfarm) areas. The median income variable consists of data of the median household income for each county, in tens of thousands of 1990 or 2000 dollars.

** Note that all pecuniary values for revenues and expenditures are deflated to 1990 or 2007 dollars using the CPI (all items) for urban consumers in the United States or the western region of the country.

Bibliography

Auerbach, Alan J., and Laurence J. Kotlikoff. "The Impact of the Demographic Transition on Capital Formation," in Anna M. Rappaport and Sylvester J. Schieber, ed., *Demography and Retirement: The Twenty-First Century*. New York: Praeger, 1993. 163-82.

Becker, Gary S. "A Theory of Competition among Pressure Groups for Political Influence." The Quarterly Journal of Economics 98 (1983): 371-400.

Bergstrom, Theodore C., and Robert P. Goodman. "Private Demands for Public Goods." The American Economic Review 63 (1973): 280-96.

Bergstrom, Theodore C., Daniel L. Rubinfeld, and Perry Shapiro. "Micro-Based Estimates of Demand Functions for Local School Expenditures." Econometrica 50 (1982): 1183-205.

Bogart, William T. "Observable Heterogeneity and the Demand for Local Government Spending." National Tax Journal 44 (1991): 213-23.

Caldwell, Steven, Alla Gantman, Jagadeesh Gokhale, Thomas Johnson, and Laurence J. Kotlikoff. "Projecting Social Security's Finances and Its Treatment of Postwar Americans." Demographic Change and Fiscal Policy. Ed. Alan J. Auerbach and Ronald D. Lee. New York: Cambridge UP, 2001. 297-385.

Case, Anne C., James R. Hines, and Harvey S. Rosen. "Copycatting: Fiscal Policies of States and Their Neighbors." National Bureau of Research Working Paper No. 3020, July 1989.

Craig, Steven G., and Robert P. Inman. "Education, Welfare, and the "New" Federalism: State Budgeting in a Federalist Public Economy." National Bureau of Research Working Paper No. 1562, February 1985.

Cutler, David M., Douglas W. Elmendorf, and Richard J. Zeckhauser . "Demographic Characteristics and the Public Bundle." Public Finances 48 (1993): 178-98.

Cutler, David M., and Louise Sheiner. "Demographics and Medical Care Spending: Standard and Nonstandard Effects." Demographic Change and Fiscal Policy. Ed. Alan J. Auerbach and Ronald D. Lee. New York: Cambridge UP, 2001. 253-91.

Denzau, Arthur T. "An Empirical Survey of Studies on Public School Spending." National Tax Journal (1975): 241-49.

Denzau, Arthur, and Kevin Grier. "Determinants of Local Spending: Some Consistent Estimates." Public Choice 44 (1984): 375-83.

Echevarria, Cruz. "On Age Distribution of Population, Government Expenditure, and Fiscal Federalism." Journal of Population Economics 8 (1995): 301-13.

Fletcher, Deborah, and Lawrence W. Kenny. "The Influence of the Elderly on School Spending in a Median Voter Framework." Education Finance and Policy 3 (2008): 283-315.

Foot, David K. "Demographic Change and Provincial Government Finances: A Cause for Concern?" Provincial public finances 2 (1991): 144-63.

Gradstein, Mark, and Michael Kaganovich. "Aging Population and Education Finance." Journal of Public Economics 88 (2004): 2469-485.

Gramlich, Edward M., and Daniel L. Rubinfeld. "Micro Estimates of Public Spending Demand Functions and Tests of the Tiebout and Median-Voter Hypotheses." The Journal of Political Economy 90 (1982): 536-60.

Harris, Amy Rehder, William N. Evans, and Robert M. Schwab. "Education Spending in an Aging America." Journal of Public Economics 81 (2001): 449-72.

Inman, Robert P. "Testing Political Economy's "'As If"' Proposition: Is the Median Income Voter Really Decisive?" Public Choice 4 (1975): 45-65.

Ladd, Helen F. "Local Education Expenditures, Fiscal Capacity, and the Composition of the Property Tax Base." National Tax Journal 28 (1975): 145-58.

Ladd, Helen F., and Janet S. Hansen. Making Money Matter: Financing America's Schools. Washington, D.C.: National Academy Press, 1999.

Ladd, Helen F., and Sheila E. Murray. "Intergenerational Conflict Reconsidered: County Demographic Structure and the Demand for Public Education." Economics of Education Review 20 (2001): 343-57.

Lee, Ronald, and Shripad Tuljapurkar. "Population Forecasting for Fiscal Planning: Issues and Innovations." Demographic Change and Fiscal Policy. Ed. Alan J. Auerbach and Ronald D. Lee. New York: Cambridge UP, 2001. 7-57.

MaCurdy, Thomas, and Thomas Nechyba. "How Does a Community's Demographic Composition Alter Its Fiscal Burdens?" Demographic Change and Fiscal Policy. Ed. Alan J. Auerbach and Ronald D. Lee. New York: Cambridge UP, 2001. 101-48.

Megdal, Sharon Bernstein. "A Model of Local Demand for Education." Journal of Urban Economics (1984): 13-30.

Neufeld, John. "Tax Rate Referenda and the Property Taxpayers' Revolt." National Tax Journal (1977): 441-56.

Preston, Samuel H. "Demographic Change in the United States: 1970-2050." Demography and Retirement: The Twenty-First Century. Ed. Anna M. Rappaport and Sylvester J. Schieber. New York: Praeger, 1993. 19-48.

Poterba, James M. "Demographic Structure and the Political Economy of Public Education." Journal of Policy Analysis and Management 16 (1997): 48-66.

Poterba, James M. "Demographic Change, Intergenerational Linkages, and Public Education." The American Economic Review 88 (1998): 315-20.

Raffelhuschen, Bernd. "Aging, Fiscal Policy, and Social Insurance: A European Perspective." Demographic Change and Fiscal Policy. Ed. Alan J. Auerbach and Ronald D. Lee. New York: Cambridge UP, 2001. 202-41.

Romer, Thomas, Howard Rosenthal, and Vincent Munley. "Economic Incentives and Political Institutions: Spending and Voting in School Budget Referenda." National Bureau of Research Working Paper No. 2406, October 1987.

Rubinfeld, Daniel L. "Voting in a Local School Election: A Micro Analysis." The Review of Economics and Statistics 59 (1977): 30-42.

Ruggeri, Joe. "The Fiscal Burden of Rising Dependency Ratios." Population Research and Policy Review 26 (2007): 185-201.

Seitz, Helmut. "Fiscal Federalism and Demography." Public Finance Quarterly 35 (2007): 385-413.

Tiebout, Charles. "A Pure Theory of Local Expenditures." Neoclassical Microeconomics 2 (1988): 77-85.

Wilson, Kathryn. "[untitled]." Rev. of Demographic Change and Fiscal Policy by Alan J. Auerbach and Ronald D. Lee. Journal of Economic Literature (2002): 1265-266.