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The Effects of Demographic Changes on State Fiscal Balances in the U.S.

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EFFECTS OF DEMOGRAPHIC CHANGES ON STATE FISCAL BALANCES IN THE U.S.

by

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ABSTRACT

The Effects of Demographic Changes on State Fiscal Balances in The U.S.

by

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The share of the population that is 65 or older keeps on rising over the years in the U.S. According to the 2017 US population projection, the rate of growth of older population is much faster than other age groups. The growing aging population will affect the economy in many ways, especially in fiscal balance of regional governments. The main goal of the study is to examine the fiscal implication of increasing old-age population in U.S states. The old-age dependency ratio is used to measure aging population, which derived by diving the population 65 years and over by the 18 to 64 years population and multiplying by 100. The old-age dependency ratio increases government spending on primary education, public welfare (Medicaid), health and hospital, and highways and roads. The old-age dependency ratio increases property tax and corporate income tax while it has negative effects on individual income tax, other tax (taxes on motor vehicle licenses), charges (tolls on highway, tuition paid to state universities etc.), and all other revenue. All told, a one percent point increases in the old-age dependency ratio would decrease state fiscal balance by $104/person.

ACKNOWLEDGMENTS

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INTRODUCTION

The population of the U.S. has been aging. Ten years ago, the share of the US population 65 or older was 12.5%. According to the US Census Bureau population estimates, this figure has jumped to 15% over the last ten years and it is projected to reach around 21% in the next 20 years. According to the US 2017 National Population Projection, the year 2030 marks an important demographic turning point. By 2030, all baby boomers will be older than age 65. Table 1 summarizes the future demographic changes in the U.S. (U.S. Census Bureau, 2017). As shown in Table 1, the rate of growth of the older population is much faster than that of the other age groups. By 2035 immigration is expected to overtake the natural increase in population (the excess of birth over deaths) as the major driving force of population growth for the nation, primarily due to aging in the population (U.S. Census Bureau, 2017). Population growth in the U.S. will slow down beyond 2030 and the country will become demographically more racially and ethnically diverse. Despite the slow growth beyond 2030, the U.S population is projected to grow by 81 million people by 2060, surpassing 400 million people by 2060.

Table 1. Projected Age Groups and Composition of the Population 2020 to 2060

	Population (million)						Change from 2016 to 2060	
	2016	2020	2030	2040	2050	2060	Number	percent
Total population	323.1	332.6	355.1	373.5	388.9	404.5	81.4	25.2
Under 18 years	73.6	74.0	75.7	77.1	78.2	80.1	6.2	8.4
18 to 64 years	200.2	202.6	206.3	215.6	225.0	227.8	29.4	14.7
65 years and over	49.2	56.1	73.1	80.8	85.7	94.7	45.5	92.3

Source: U.S. Census Bureau, 2017 National Population Projections

The U.S. National Population Projections

Vespa, Armstrong, and Medina (2018), made the following U.S. population projection;

- In the next four decades, the U.S. population will grow to 405 million in 2060 (Table 1),
- The U.S. population will grow by an average of 1.8 million people per year between 2017 and 2060,
- The rate of population growth is slowing. Since 2010, the rate of population growth has slowed, however, the rate is expected to fall to 1.8 million people per year between 2030 and 2040 and continue falling to 1.5 million per year between 2040 and 2060, and
- Beginning in 2030, net inter-national migration is expected to overtake natural increase as the driver of population growth in the U.S. As baby boomers age into retirement, the number of deaths is projected to rise faster than the number of births. As a result, the population will grow slowly naturally, leaving international migration to overtake natural increase as the as the leading cause of population growth, even as migration levels remain the same.

According to Vespa, Armstrong, and Medina (2018), the U.S. population will be aging:

- The US 65-and-older population is projected to double in size from 49 million in 2017 to 95 million people in 2060 (Table 1). The share of people 65-and-older will grow from about 15 percent to 17 percent between 2017 and 2020, and
- Population 85 years and older is expected to double by 2035 (from 6.4 million to 11.8 million) and nearly tripled by 2060 (to 19 million people).

Population Aging and Fiscal Balance

Demographic changes, especially aging population will modify the structure and the size of public expenditures and revenues. As Zokalj (2016, pp. 384-385) explained, the obvious change in public

expenditures is age-related expenditures such as pensions, medical care and long-term care. Indirectly, the increase of elderly population may influence other budgetary categories as well such as expenditures for education. It is expected that the increase in the elderly cohort, by decreasing the pupil-to-teacher ratio, will bring into consideration the efficiency of allocating the current level of expenditures for education. Public revenue will change as well. The revenues accumulated through the sales tax are affected by changes in aggregate consumer behavior and the revenues from personal and corporate income taxes are influenced as a result of the shifts in the labor market. McKee (2002) stated that the fiscal future of the U.S. is under pressure as much of the federal government budget is allocated to old-age entitlement programs such as Medicare and Social Security.

Research Objective

The main objective of this research is to investigate the impact of population aging in the U.S. on public expenditure and revenues in the U.S. states. There have been numerous similar studies across countries, especially EU, but there is no study at the U.S. state level to author's best knowledge. The main research question is whether population aging has an impact on certain categories of the public budget, as well as the overall budget balance. The results of the study will provide us the insights of population aging and fiscal pressure in the U.S., which might be useful for the policy reforms responding to the fast aging population.

LITERATURE REVIEW

Though the rate of population growth has slowed in recent times, the age structure of the population is changing. While elderly population is rising, young population is falling, although different countries and regions of the world are at varying stages of this transition. The elderly population in developed countries is rising faster than in developing regions such as Africa and the Middle East. The relationship between demographic changes, population growth, and a public finance has been a subject of extensive research. Previous studies have established that an increase in the elderly share of the population influences per-capita GDP through the labor market, savings and inflation (Cutler, Elmendorf and Zeckhauser, 1993; Hondroyiannis and Papapetrou, 2000; Sanz and Velazquez, 2007).

Empirical Evidence on Macroeconomic Variables

Modeling the budgetary situation at different levels of government in Germany, Hofmann et al. (2008) found that subnational governments can capture the benefits of demographic change while shifting the burdens onto higher levels, particularly the national government. Demographic change may have differential impacts on state governments vis-à-vis those at the federal level. Lee and Edwards (2001) studied the uncertain demographic futures and government budget in the U.S. They employed stochastic projections of the budgets for the federal and state governments, disaggregated by programs. Their findings revealed that demographics influences the outcome of budget of seven categories of tax payment through age specificity. Their result also showed a strong negative correlation between young age-oriented programs and old-age-oriented programs. Seitz and Kempes (2007) analyzed the impact of population aging on federal budget in Germany. They concluded that the local, state, and the federal level of Government are affected quite differently by changes in the number and demographics of the population. This according to their study has

the potential to cause vertical fiscal imbalance across various levels of government. As to whether the distribution of revenue across different layers must be adjusted to accommodate demographic changes, Lazar, St-Hilaire and Tremblay (2003) raised such question in their paper.

Kim and Lee (2007) studied the relationship between demographic changes, savings and current account in East Asia using a vector-autoregressive model. Their findings reveled that the dependency rate especially the elderly dependency rate is negatively correlated with savings rates and current account balances. The results of their study imply that in the future aging population in East Asia will have a significant impact on global capital flows and current account imbalances. IMF (2004) reported that finances of government in advanced countries will be strained by population aging especially pension and health care systems. Higgins (1998) addressed the relationship between age distribution, national savings and current account balance. The results showed a negative relationship between demographics and national savings , and international capital flows. Savings rate is lowered as both the young and the old-age dependency ratios increase. He also pointed to differential effects on savings and investment. Deaton (1992) offered judgement concerning the empirical literature on demography and saving rates. Other research findings have revealed the effect or impact of aging population on other macroeconomic variables such as GDP per capita, savings, and inflation. This impact has been found by other studies to depend on the kind of empirical model(exogenous vs endogenous) and other accounting effect.

Prettner and Prskawetz (1995) detect a positive impact of the elderly population on per capita growth using an endogenous economic growth models developed by Romer(1990). Although fertility has a negative effect on per capita output growth, the positive longevity effect was found to dominates the negative fertility effects in case of endogenous framework. Jones'(1995) on the other hand concluded that the positive impact of aging population on per capita growth depends on variations in fertility and mortality. Hviding and Merette (1999) using an

exogenous growth model detected a negative correlation between aging population and public finances. Fougere and merrette(1999) extended previous research works by using endogenous growth model. The results of their study showed a positive impact of the elderly population on economic growth through human capital investment. Recent study by Acemoglu and Restrepo (2017) showed no evidence of negative relationship between population aging and slower GDP per capita growth across countries. Brooks et al. (2003) discovered from their research study on population aging and global capital flow in parallel universe that retirement saving by aging baby boomers will increase the supply of capital substantially above investment in both the European Union and North America, causing both regions to export large amount of capital to Africa. Most studies on demographic effects on savings, investment, capital flow and current account balance were conducted on countries or on regions of the world.

Empirical Evidence on Fiscal Impact

Policy makers base their estimates of future cost and benefits using population projections. These practices could only be considered as conditional forecast. Without adjustments for an increased proportion of the population above 65, these projections may understate cost and overstate revenue projections.

Yashiro (1997) captured the fiscal implications of Japan's aging population to other Asian countries by adapting an equilibrium model. He concluded from his study that transfer of income between generations increases with an increase in the elderly population and thus, increases the fiscal burden. An increase in the elderly population shrinks the workforce and this leads to lower savings ratio. Grubber and Wise (2001) compared the retirement system in nine OECD using data across the nine countries. They discovered from their study on OECD countries that the current retirement system in these countries is not sustainable vis-a viz low fertility rate, longevity and

higher old-age population. A 10% increase in the elderly population will result in 5% increase in expenditure on the elderly population. While the aggregate expenditure on older people increased, expenditure per an older individual was found to decline. In modern times, work on the impact of demographic transition in the U.S. was first conducted by Auerbach and Kotlikoff (1985) using a perfect foresight life cycle simulation model. For the social security system to be sustainable , they proposed an increase in payroll tax, substantial improvement in social security and cuts in benefits. Later studies by Auerbach et al.,(1989) on Japan, Germany, Sweden and United States produce similar results.

Kudrna et al.,(2015) developed a small open economy, overlapping generation model (OLG) to study the effects of demographic shift in Australia. Their findings show a shift in demographics towards aging population will result in change in the tax base from labor income to capital asset and consumption. Change in structure of demography leads to significant rise in old-age-related spending programs such as health, Medicare and pension. They suggested that for government to offset these spending, government would have to either cut other expenditures by around 32% or increase consumption taxes by 28 percent by 2050. Increase in fertility rate and immigration were deemed to be ineffective to solve this issue. King and Jackson (2000) developed a model with an alternative assumption that captures the effects of aging population on economic growth and government fiscal balance in Canada. They argue that population aging alone will not be the major challenge to public finance. They suggested for government debt reduction in the short term which will serve as a leverage in the long run.

According to Mateo Zokalj (2016) health economics is the only specific category of public expenditure that the impact of population aging has been investigated most. Keehan .S. P et al., (2004) used trend analysis on seven age groups to estimates the effect of demographics on the national health account. They concluded that among children age 0 to 18, adults from 19 to 64 and

the old-age 65 and above, the elderly have the highest per capita expenditure on health care almost four times of population under 65. Matteo and Matteo (1998) examined the evidence on the determinants of Canadian provincial government health expenditure from 1965 to 1991 using a pooled time-series. Their findings reveal that the major determinant of real per capita government health expenditure over that time period are real provincial per capita income, and provincial population age 65 and over. Matteo (2005) expanded the previous work by including state level data for U.S. along with provincial level data for Canada. The outcome revealed a positive impact of an increase in the elderly share in models without time vriables.less impact was realized when time variant variables were added to the model.

Meijer et al. (2010) examined the implications of aging population on health expenditure by using both epidemiological and health economics methodology. According to their findings, population aging is the most significant driver of health expenditure growth and medical technology. Xu et al. (2011) use data from 143 developing countries to examine the determinant of health care expenditure. The 143 countries were grouped based on income. Static and dynamic models were applied using fixed effect and system-GMM estimator. The static model results show a positive impact of population aging on health care expenditure in lower -middle income countries. The dynamic model showed an insignificant result. Callen, Batini, and Spatafora (2004) examine the impact of demographic aging on some economic indicators such as budget balance-to-GDP ratio. The outcome of their study revealed a significant negative effect of the share of elderly population on budget balance for a sample of 115 countries between the period of 1960-2000. Lee, Yoon, and Kim (2014) analyzed the impact of demographic aging on OECD countries. Their result was consistent with previous studies. The findings show that the elderly share of population has a greater positive impact on public expenditure than revenue. This confirms the overall negative

impact on budget balance. However, Chen (2004) work discovered a weak and negative effect of population aging on budget balance in developing nations.

DATA

For this study, 48 U.S. States were sampled (Alaska, Hawaii, and Washington DC are excluded). The sample period covers 12-year period from 2004 to 2015. The final data set has 576 observations (48 states × 12 years).

Expenditure and Revenue

Public expenditure and revenue data are compiled from Tax Policy Center, Urban Institute and Brookings Institution (https://www.taxpolicycenter.org). Tax Policy Center provides tax information compiled from variety of sources including Internal Revenue Service (IRS), the Congressional Budget Office, the Department of the Treasury, the Federation of Tax Administrators, the Urban Institute, Brookings Institution, the Joint Committee on Taxation, and the Organization for Economic Cooperation and Development. Using the state and local general revenue and expenditures data tables, we constructed

- Fiscal balance in billion dollars = difference between total revenue and total expenditure in corresponding fiscal year,
- Fiscal balance per capita in dollars = difference between total revenue per capita and total expenditure per capita, and
- Fiscal balance in percent of state personal income = fiscal balance in billion dollars × 100 / state personal income.

These three variables are the primary dependent variables. Table 2 presents the basic statistics of the variables used in the study including general revenue and expenditure. As shown in Table 2, revenue is slightly higher than expenditure.

Table 2. Public Expenditure, Revenue and Fiscal Balance in U.S. States

Variable	Mean	St. Dev.	Min	Max
Revenue (billion dollars)	49.58	60.08	4.35	419.03
Expenditure (billion dollars)	49.17	49.17	4.16	412.79
Revenue per capita (dollars)	7,890	1,701	5,294	15,370
Expenditure per capita (dollars)	7,733	1,464	5,120	14,322
Fiscal balance (billion dollars)	0.418	3.292	-24.605	28.950
Fiscal balance per capita (dollars)	157	491	-793	3,725

Source: Revenue and expenditure data are compiled from Tax Policy Center; fiscal balance are authors' calculation

We expect there exists heterogeneity in data because the U.S. state are different in size, population, and tax system. To see the dynamic nature and heterogeneity in revenue, expenditure, and fiscal balance, Figure 1 is generated. The solid lines in Panel A and B in Figure 1 are the average of fiscal balance in billion dollars and per capita dollars. Points above zero indicate fiscal surplus whereas points below zero indicate fiscal deficit. Fiscal deficit of California over the sample period was substantial; larger than 20 billion dollars during 2008-2009 financial crisis. New York had had fiscal surplus during the sample period; in recent years, fiscal surplus reached up close to 30 billion dollars. Note that per capita state revenue in New Your in 2015 was $14,499 and per capita public expenditure was $13,033 which makes per capita fiscal balance being $1,466/person. Considering New York population of about 20 million in 2015, it is not unreasonable number. Figures in Appendix provides means of state level revenue, expenditure and fiscal balance.

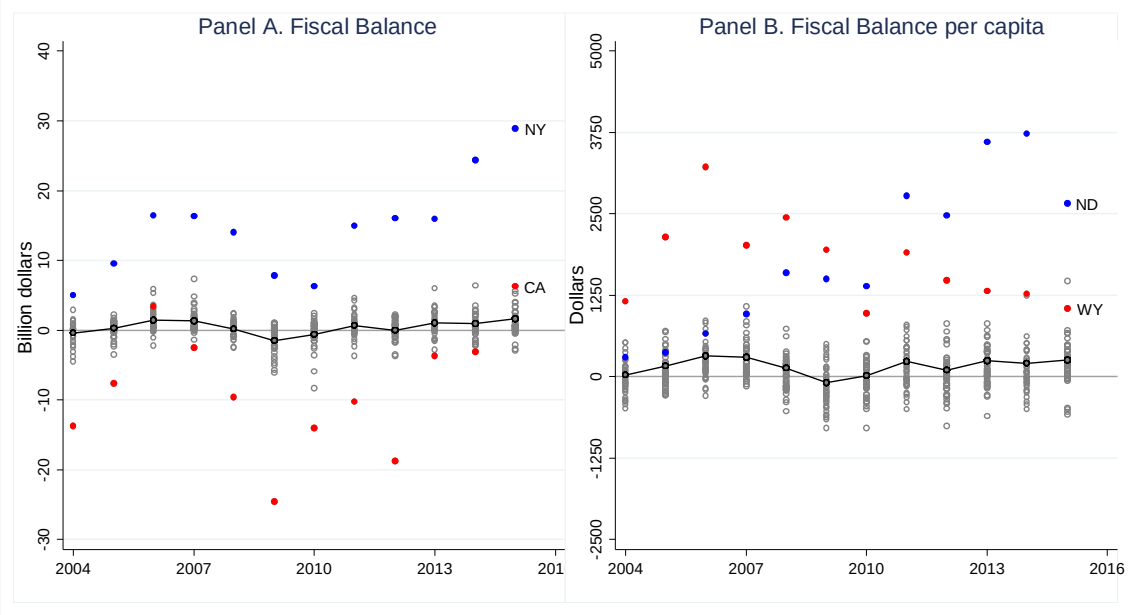

Figure 1. Fiscal Balance and Dependency Ratios
Source: Authors' calculation using public revenue and expenditure data from Tax Policy Center

Dependent Ratios

The old-age dependency ratio is used to measure aging population, which derived by diving the population 65 years and over by the 18 to 64 years population and multiplying by 100 (Vespa, Armstrong, and Medina, 2018). Old-age dependency ratio indicates the dependent population's potential burden on the working-age population. The youth dependency ratio, defined as the number of children under 18 for every 100 adults aged 18 to 64, also introduced to control any impact of it on fiscal balance in the U.S. states. The dependency ratios are compiled from the U.S. Census Bureau, available at http://www.usa.gov/federal-agencies/u-s-census-bureau. Table 3 presents the basic statics of the dependent ratios. Like fiscal balance, there exists heterogeneity across states (Figure 2). As shown in Figure 2, the old-dependency ratio keeps increasing monotonically during the sample period (solid line in Panel A in Figure 2). Florida has the highest old-age dependency ratio while Utah has the lowest old-age dependency ratio.

Table 3. Old-age and Young Age Dependent Ratio

Variable	Mean	St. Dev.	Min	Max
Old-age dependency ratio (%)	21.59	2.99	13.60	32.30
Youth dependency ratio (%)	37.99	3.58	26.20	52.90

Source: authors' calculation

In case of youth dependent ratio, we observe negative trend in the sample period, which reflects the recent lower fertility rate. Utah has substantially high youth dependency ration, over 50% during the sample period. Vermont has the lowest youth dependency ration around 30%.

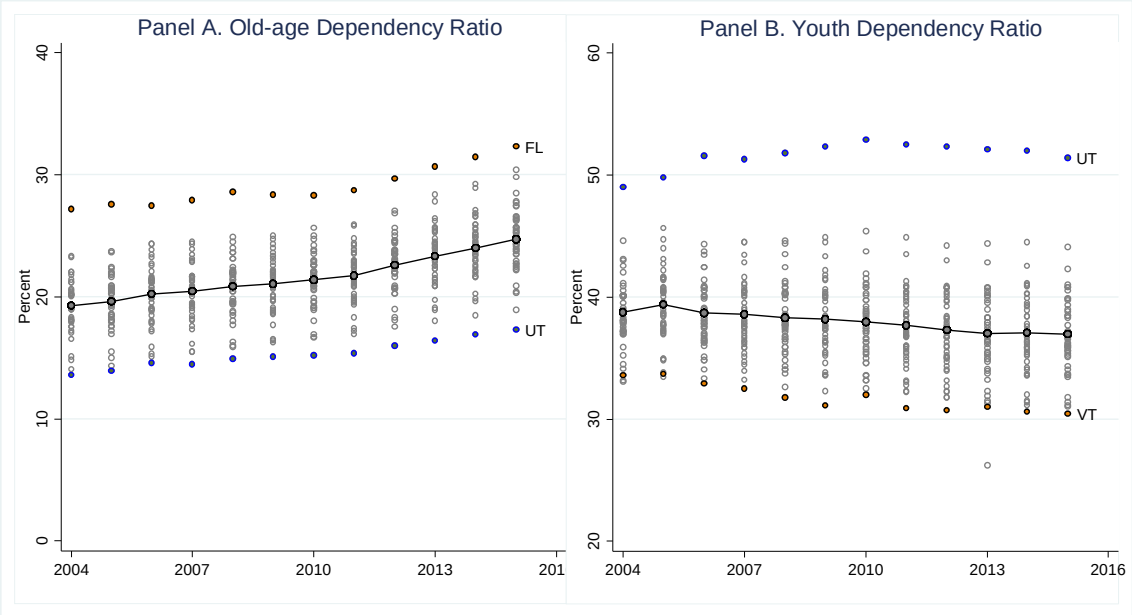

Figure 2. Dependency Ratios in Percent
Source: US Census Bureau

Additional Explanatory Variables

Other than dependency ratios, unemployment rate, population density, 2008-2009 financial crisis dummy, and trend variable are collected or constructed. It is believed that unemployment may increase fiscal balance due to the spending on safety-net program like unemployment insurance. In addition, the unemployment rate controls the economic cycle effects on government finances. Unemployment rate is compiled from the Bureau of Labor Statistics and is available at https://www.bls.gov/. Population density is measurement of population per unit area (square mile). It is calculated as the ratio of population of people living in an area per the land area. Population density is used as a proxy of infrastructure of the region, intensity of public services, and housing density, which affect public revenue and expenditure. Financial crisis dummy controls any abnormal activities during 2008 and 2009 when the U.S. economy experienced great recession. During this time, the unemployment rate increased to 10% and GDP decreased substantially by roughly 5% (US Department of the Treasury, 2012). Table 4 presents a summary of the additional explanatory variables included in the analysis.

Table 4. Other Explanatory Variables Statistics

Variable	Mean	St. Dev.	Min	Max
Unemployment rate (%)	6.21	2.13	2.59	13.61
Population density (persons/square mile)	214	559	5	12,121
Financial crisis	0.17	0.37	0	1
Trend	6.50	3.46	1	12

Source :Unemployment rate https://www.bls.gov/; Population density is author's Calculations

Fiscal Balance and Old-age Dependency Ratio

Figure 3 presents two scatter diagrams between fiscal balance in billion dollars and fiscal balance per capita in dollars against the old-age dependency ratio. It is hard to see any relationship between fiscal balance and the old-age dependency ratio from the scatter diagrams. We will utilize the dynamic panel analysis to find the interrelation between them as will be discussed in the next section.

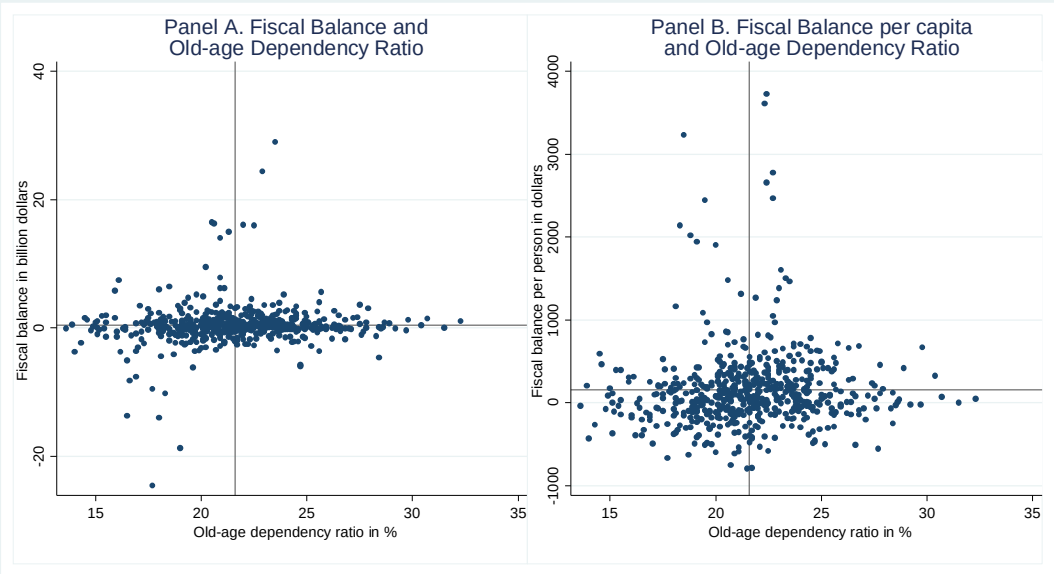

Figure 3. Scatter Diagrams between Fiscal Balance and Dependency Ratios
Source: Tax Policy Center and US Census

DYNAMIC PANEL MODEL

It is justifiable to assume that fiscal balance is persistent meaning that current revenue and expenditure are somewhat dependent on previous period. It is hard to believe that public revenue and expenditure will experience major changes in the short time of period. This assumption makes the dynamic panel model preferred over the static model as discussed in Zokalj (2016). The inclusion of lagged dependent variable, fiscal balance, may provide an adequate characterization of dynamic adjustment process. Bond (2002) pointed out that allowing for dynamics in the underlying process may be crucial to obtain consistent estimates of other parameters even though the lagged dependent variable is not of direct interest.

The general linear dynamic model takes this form:

$$y_{i,t} = \mu + \gamma y_{i,t-1} + \boldsymbol{\beta}\mathbf{x}_{i,t} + \varepsilon_{i,t}\,, \tag{1}$$

where *i* denotes state (i = 1, …, 48) and *t* denotes time periods (t = 2004, …, 2015). The variable $y_{i,t}$ represents the dependent variables, for example, fiscal balance in state *i* in year *t*; $\mathbf{x}_{i,t}$ represents the vector of explanatory variables including old-age and youth dependent ratios; $\boldsymbol{\beta}$ is the vector of parameters of interest. The error term $\varepsilon_{i,t}$ is assumed to be identical and independently distributed over time with zero mean and constant variance. The parameter α_i represents the unobserved individual-specific time-invariant effect which allows for heterogeneity across the states.

Estimating equation (1) faces the endogenous issue because of the presences of the lagged dependent variable, $y_{i,t-1}$, on the right-hand side which is correlated with the error term. In this case the standard panel data estimator is not consistent even if the ε_{it} is not serially correlated (Baltagi, 2005). The issue with the correlation could be resolved by taking first differences which

tends to eliminate the individual specific effect parameter. The first differenced dynamic model looks like this:

$$y_{i,t} - y_{i,t-1} = \gamma\left(y_{i,t-1} - y_{i,t-2}\right) + \boldsymbol{\beta}(\mathbf{x}_{i,t} - \mathbf{x}_{i,t-1}) + (\varepsilon_{i,t} - \varepsilon_{i,t-1}) \quad (2)$$

$$\rightarrow \quad \Delta y_{i,t} = \gamma \Delta y_{i,t-1} + \boldsymbol{\beta}\Delta\mathbf{x}_{i,t} + \Delta\varepsilon_{i,t}$$

and use $\Delta y_{i,t-2}$ as an instrument for $\Delta y_{i,t-1}$. The instruments will not be correlated with $\Delta\varepsilon_{it}$ as long as the ε_{it} are not serially correlated (Anderson and Hsiao, 1981).

Arellano and Bond (1991) proposed a generalized method of moments (GMM) procedure, which is extended in Arellano and Bover (1995), to estimate equation (2). It is more efficient than the Anderson and Hsiao (1981) estimator by using additional instruments and all the available moment conditions. Blundell and Bond (1998) exploited the initial condition in generating efficient estimator of the model and suggested a system GMM estimator. The system GMM estimator is shown to have substantial efficiency gains over the first-difference GMM. The system GMM is used to estimate equation (2) in this study.

EMPIRICAL RESULTS

In order to examine the impact of the old-age dependency ratio on the fiscal variables, we estimated equation (2) using the data discussed in Data section using the system GMM. Table 5 reports the estimation results with three models depending on the dependent variable. Model 1 estimates the impact of the old-age dependency ratio on the fiscal balance in billion dollars, Model 2 uses fiscal balance per capita dollars as the dependent variable, and Model 3's dependent variable is fiscal balance as percent of State personal income. Note that, as shown in Table 5, Arellano-Bond test (Arellano and Bond, 1991) is testing for zero autocorrelation in first-differenced errors. By construction, the first-differenced errors are first-order serially correlated, i.e., order 1 should be rejected. Arellano-Bond test fails to reject the serial correlation with order 2 and it indicates that the moment conditions used in estimation are valid. All the parameters in Table 5 are statistically significant and have expected signs. The estimates for the lagged dependent variables are significant at 1% for all three models with a value between 0.52 and 0.54. It could be inferred from the results that the 2008 and 2009 financial crisis had the largest negative impact on fiscal balance.

The parameter estimates for old-age dependency ratio are negative in all three models. In Model 1, it is estimated to be -0.43, which means that a one percentage point rise in old-age-age dependency would result in $0.43 billion decrease in fiscal balance (move toward fiscal deficit). It is equivalent to about $83/person (Model 2) or 0.11 percent point (Model 3). Youth dependency ratio also has a negative impact on fiscal balance as a higher youth population would decrease fiscal balance. As shown in Table 5, it is estimated to be $0.381 billion, $59/person, or 0.13 percent point.

Table 5. Fiscal Balance Estimation Results using System GMM

Variables	Model 1 Fiscal Balance in Billion Dollars	Model 2 Fiscal Balance Per Capital in Dollars	Model 3 Fiscal Balance in Percent of State Income
Lagged dependent variable	0.5269***	0.5157***	0.5428***
	(0.003)	(0.022)	(0.003)
Old-age dependency ratio	–0.4260***	–82.580***	–0.1099***
	(0.020)	(10.76)	(0.014)
Youth dependency ratio	–0.3808***	–59.458***	–0.1275***
	(0.015)	(6.11)	(0.011)
Unemployment rate	–0.4564***	–44.799***	–0.0776***
	(0.008)	(3.79)	(0.005)
Population density	0.0003***	0.038***	0.0001***
	(0.0001)	(0.001)	(0.0001)
Financial crisis dummy	–2.2458***	–238.340***	–0.6325***
	(0.034)	(11.08)	(0.015)
Trend	0.1831***	26.083***	0.0030***
	(0.008)	(5.09)	(0.007)
Constant	26.0010***	4289.348***	7.9687***
	(0.879)	(418.57)	(0.647)
N used	528	528	528
Number of groups	48	48	48
Arellano-Bond test[note]			
Order 1	–1.823 [0.068]	–3.001 [0.003]	–3.479 [0.001]
Order 2	0.354 [0.723]	1.678 [0.093]	1.398 [0.162]

Robust standard errors are reported in parentheses; *, **, *** indicate the significance at 10%, 5% and 1%, respectively.

Note: Arellano and Bond test statistics (Arellano and Bond, 1991) with a p-value in the bracket, which is testing for zero autocorrelation in first-differenced errors. By construction, the first-differenced errors are first-order serially correlated (order 1 should be rejected); if serial correlation in the first-differenced errors higher than 1, it indicates that the moment conditions used in estimations are not valid.

It is natural to ask how dependency ratios affect state government revenue and expenditure. As Zokalj (2016, pp. 384-385) explained, the obvious change in public expenditures is age-related expenditures such as pensions, medical care and long-term care. Indirectly, the increase of elderly population may influence other budgetary categories as well such as expenditures for education. It is expected that the increase in the elderly cohort, by decreasing the pupil-to-teacher ratio, will bring into consideration the efficiency of allocating the current level of expenditures for education. Public revenue will change as well. The revenues accumulated through the sales tax are affected by changes in aggregate consumer behavior and the revenues from personal and corporate income taxes are influenced as a result of the shifts in the labor market. To answer these questions we ran regressions of each government revenue category such as property tax revenue, sales tax revenue, income revenue on demographic variables. In a similar fashion, equations of public expenditure categories are estimated, for example, education, public welfare expenditure, and health and hospitals. Figure 4 presents the estimation results graphically. Note that all the revenue and expenditure categories are dollars per person.

Panel A in Figure 4 presents the impact of the old-age dependency ration on government revenue. It is positive and statistically significant on property tax and corporate income tax. This is so because most seniors have accumulated enough wealth over their lifetime in the form capital assets, bonds, stocks and savings. Most seniors own large homes and other businesses and investment. A one percent point increases in the old-age dependency ratio would increase roughly $35/person of state revenue. On the other hand, the old-age dependency ratio has negative effects on individual income tax, other tax (taxes on motor vehicle licenses), charges (tolls on highway, tuition paid to state universities etc.), and all other revenue. This is because while most seniors are “house rich”, they may be “cash poor” because they are living on reduced income . From the graph a one percent point increase in the old-age dependency ratio would decrease state revenue by

$139/person. All told, a one percent point increases in the old-age dependency ratio would decrease state revenue by $104/person.

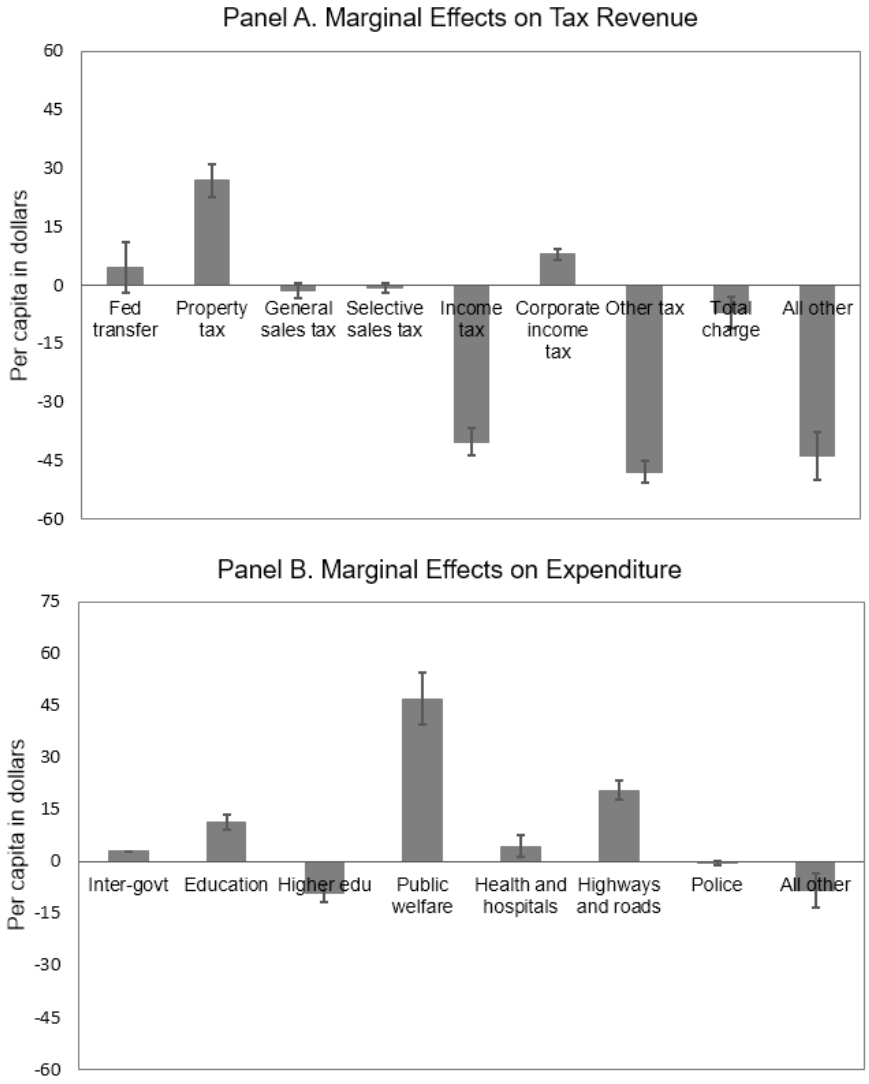

Figure 4. Impact of Old-age Dependency on Government Revenue and Public Expenditure

Panel B in Figure 4 illustrates the impact of the old-age dependency ratio on public expenditure. Aging population increases public welfare (spending on Medicaid, temporary assistance for needy families, supplemental security income) and health and hospitals expenditure (spending on community and public health programs, government-owned hospitals and payments to private hospitals). Interestingly, the old-age dependency ratio increases spending in elementary and secondary education. Zokalj (2016) pointed out that the increase in elderly population, by decreasing the pupil-to-teacher ratio, will bring more expenditures for education. The old-age dependency ration increases highways and roads (spending on operation, maintenance and construction of highways, streets, roads, sidewalks, bridges and related structures) as well, which was not expected. Aging population decreases spending on higher education, which is hard to explain. All told, a one percentage point rise in the old-age dependency ratio makes state to spend $68/person more. Combining changes in government revenue, a one percentage point increase in the old-age dependency ratio would result in $172/person changes in state fiscal balance, which is a bit larger than the estimates of $83/person in Model 2 in Table 4.

SUMMARY AND CONCLUDING REMARKS

Demographic change occurs with aging population. Aging population leads to increase in the share of the elderly population due to longevity accompanied by decline in fertility rate. According to the 2017 US population projection, if the current trend persists the demographic profile will change dramatically by the middle of the century. The U.S. population will rise to 404 million in 2060 and 23% of population will be 65 years and older. The old-age dependent ratio will be 41%, substantially higher than the 2015 average ratio of 25% across the sates. We expect that government budgetary projections to increase over the years due to the rapid increase in the elderly population. Since there are no unanimous criteria for economists and policy makers to determine how exactly aging population affect state budgets, we examine the relationship between the aging population and fiscal balances across the U.S. states.

The dataset for the study spans from 2004 to 2015 (12 years) with observations for 48 states in the U.S. The dependent variables are 1) fiscal balance in billion dollars, 2) fiscal balance per capita, and 3) fiscal balance as a percent of state personal income. The explanatory variables are in three categories namely demographic changes represented by the old-age dependency ratio and youth dependency ratio and other control variables represented by unemployment rate, population density, and dummy for great recession in 2008 and 2009. As reported in Table 5 with the system-GMM method, the old-age dependency ratio has negative impacts on all of fiscal balances; a one percentage point increase in the old-age dependency would result in $0.426 billion decrease in fiscal balance (move toward fiscal deficit), about $83/person (Model 2), or 0.11 percentage point more of state personal income. With regards to other control variables, the youth dependency ratio, unemployment rate, population density, and financial crisis dummy are all significant and have expected signs.

The old-age dependency ratio increases government spending on primary education, public welfare (Medicaid), health and hospital, and highways and roads. The old-age dependency ratio increases property tax and corporate income tax while the old-age dependency ratio has negative effects on individual income tax, other tax (taxes on motor vehicle licenses), charges (tolls on highway, tuition paid to state universities etc.), and all other revenue (Figure 4). All told, a one percent point increases in the old-age dependency ratio would decrease state revenue by $104/person.

It is imperative for state and federal governments to pay more attention to demographic changes and make budgetary projections in the medium-term. The empirical findings in this study have provided the evidence to support policies to mitigate fiscal deficit with aging population. Suggesting any tax reform or relevant policies to mitigate impact of aging population may be beyond the scope of this study. However, we strongly recommend policy makers to develop pragmatic policy measures aimed at reducing government deficit.

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APPENDIX

Figures for state revenue, expenditure and fiscal balances are reported in Appendix.

Figure 5. Revenue in Billion Dollars over the Sample Period

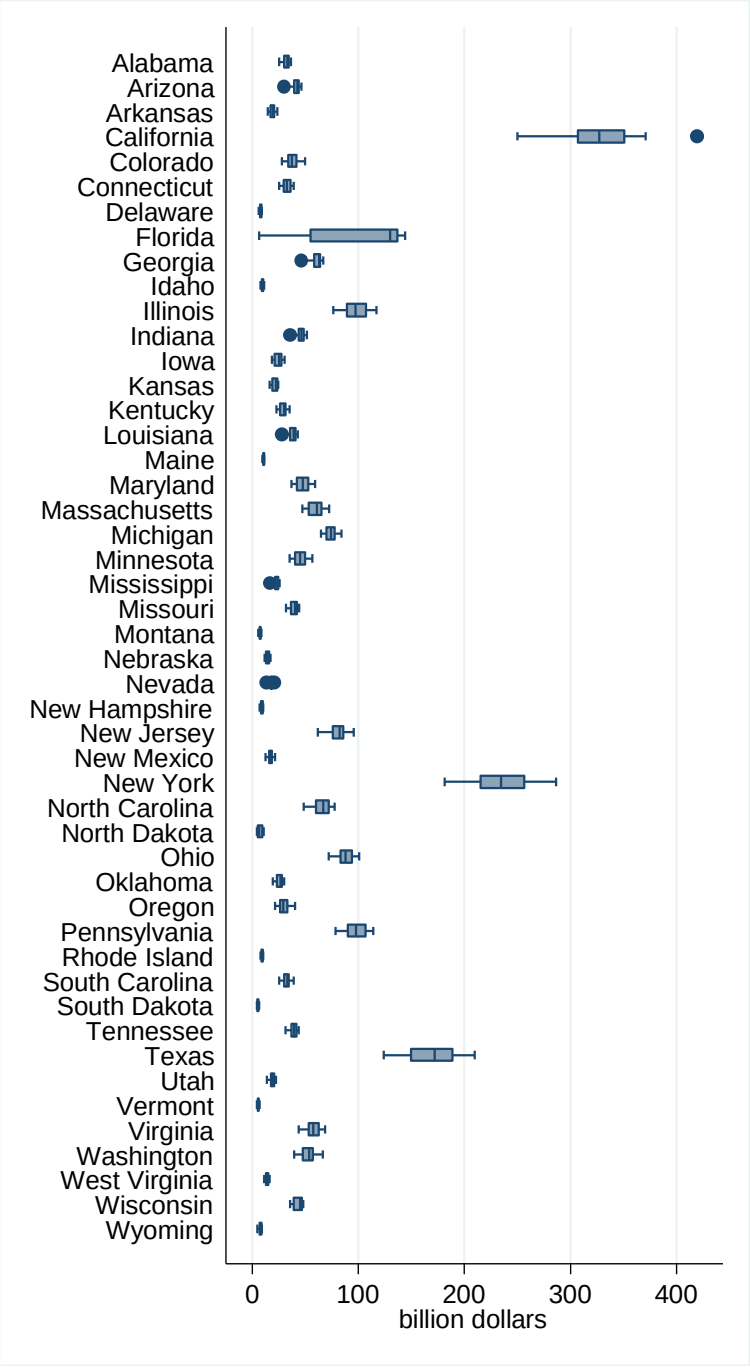

Figure 6. Expenditures in Billion Dollars over the Sample Period

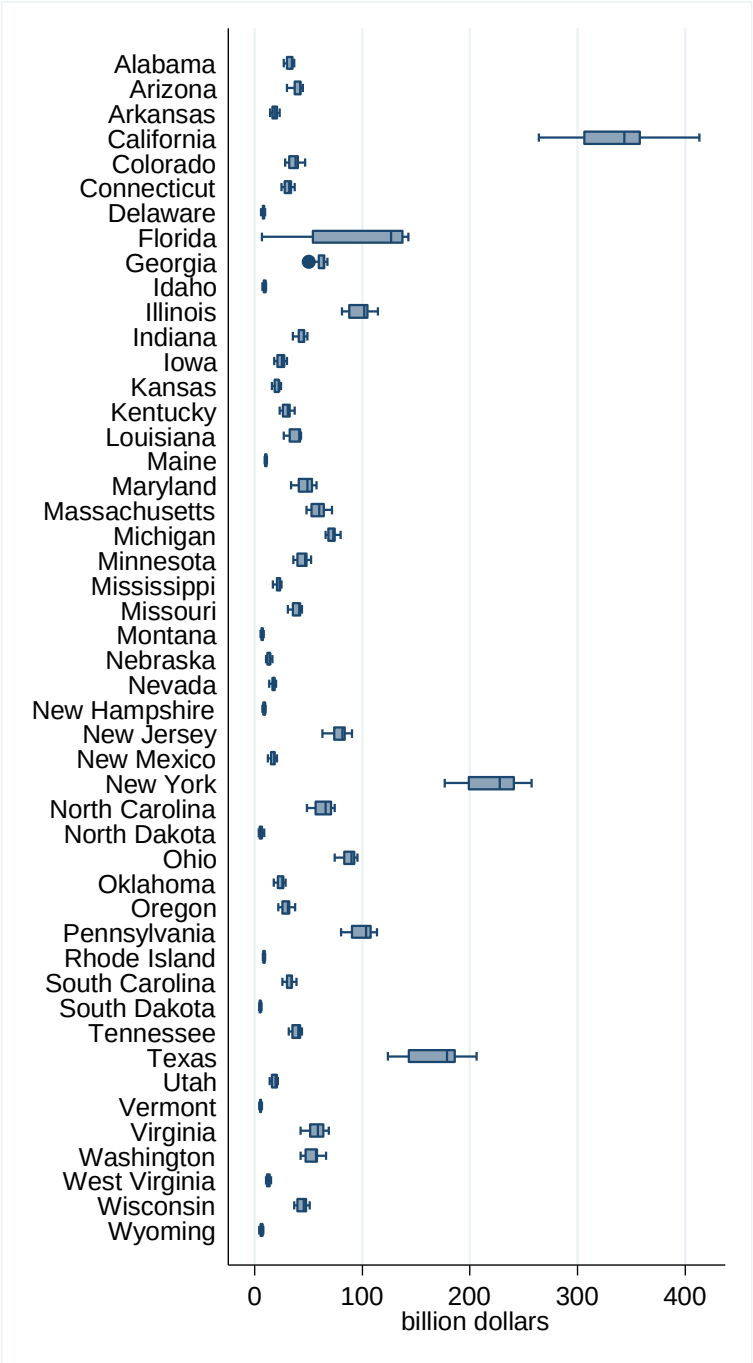

Figure 7. Fiscal Balance in Billion Dollars over the Sample Period

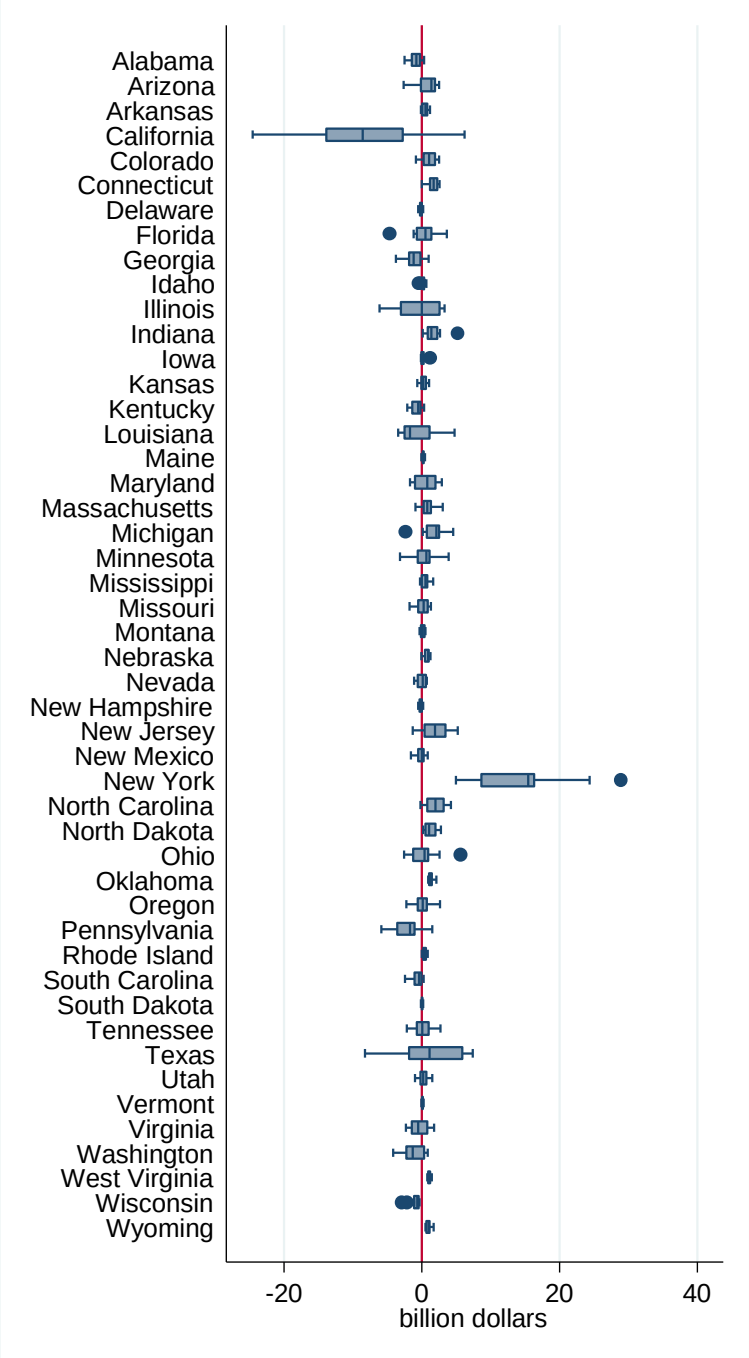

Figure 8. Revenue per Capita in Dollars over the Sample Period

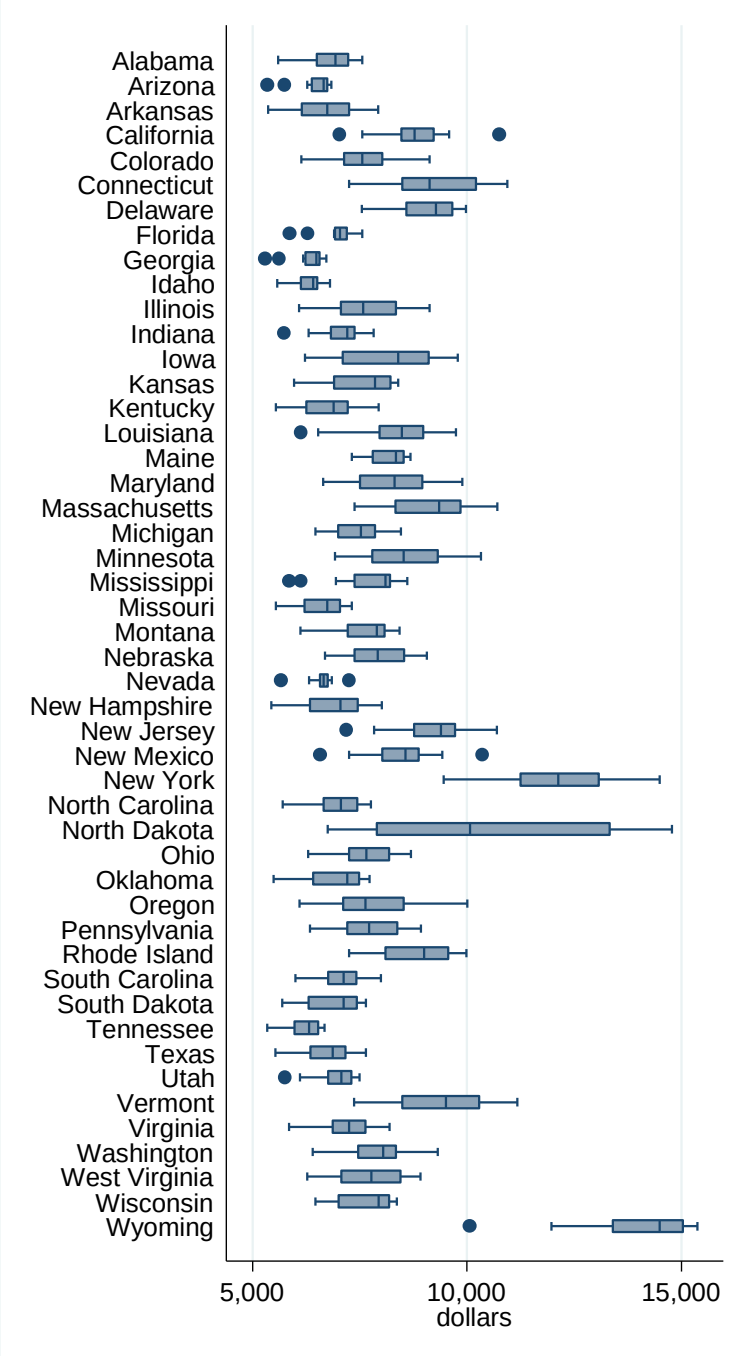

Figure 9. Expenditure per Capita in Dollars over the Sample Period

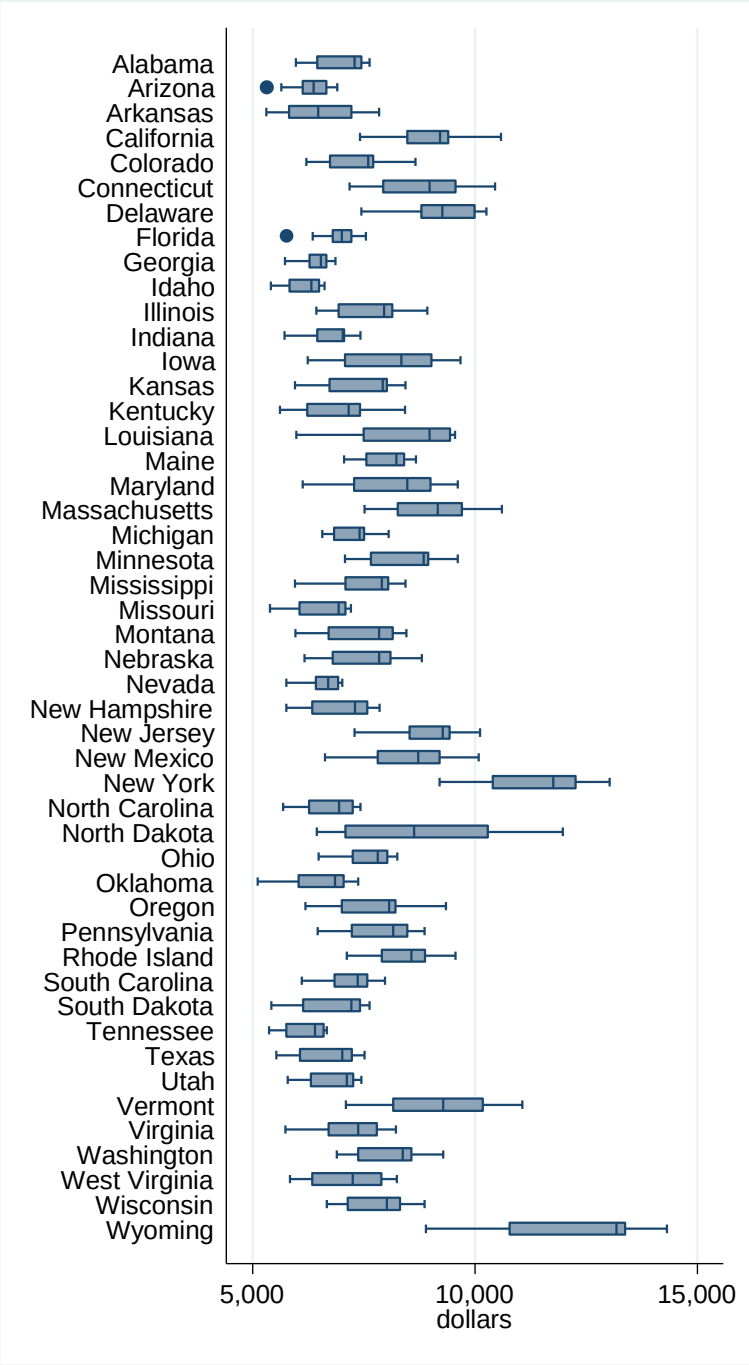

Figure 10. Fiscal Balance per Capita in Dollars over the Sample Period

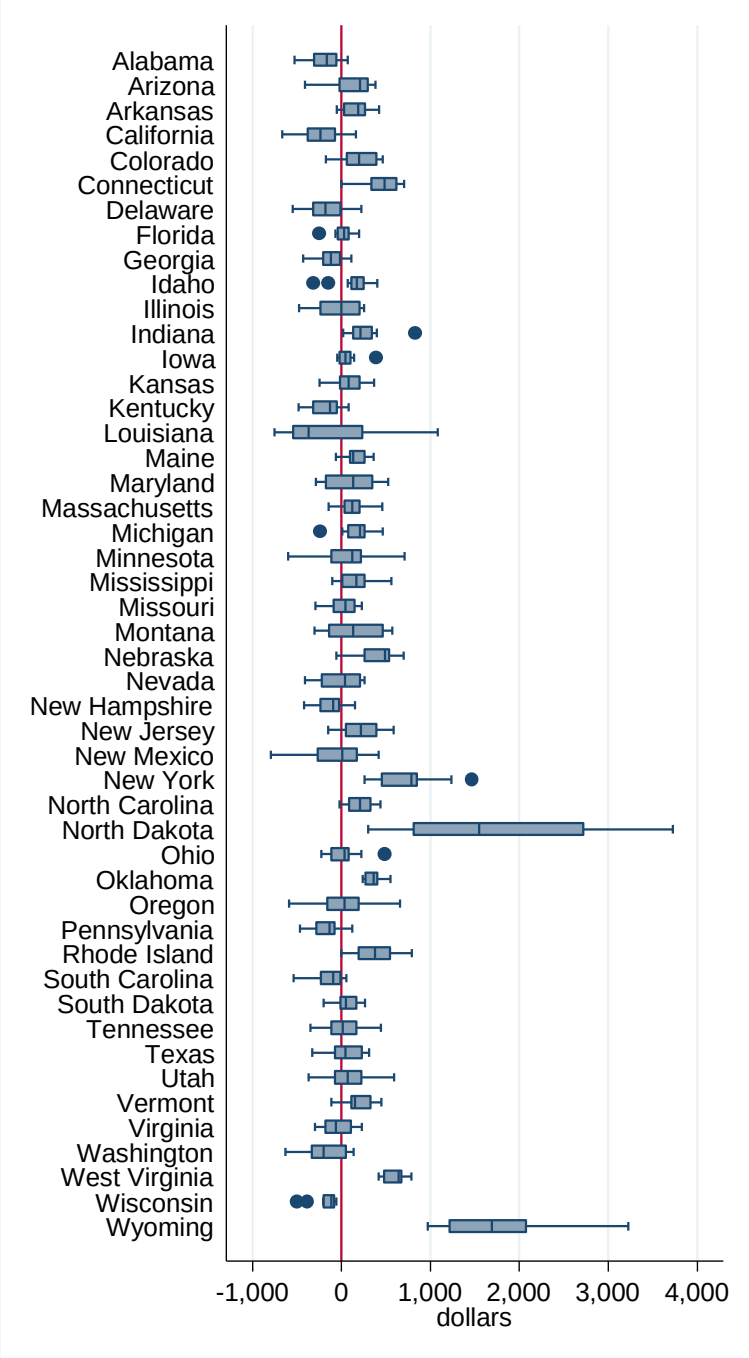

Figure 11. Old-Age Dependency Ratio (%) over the Sample Period

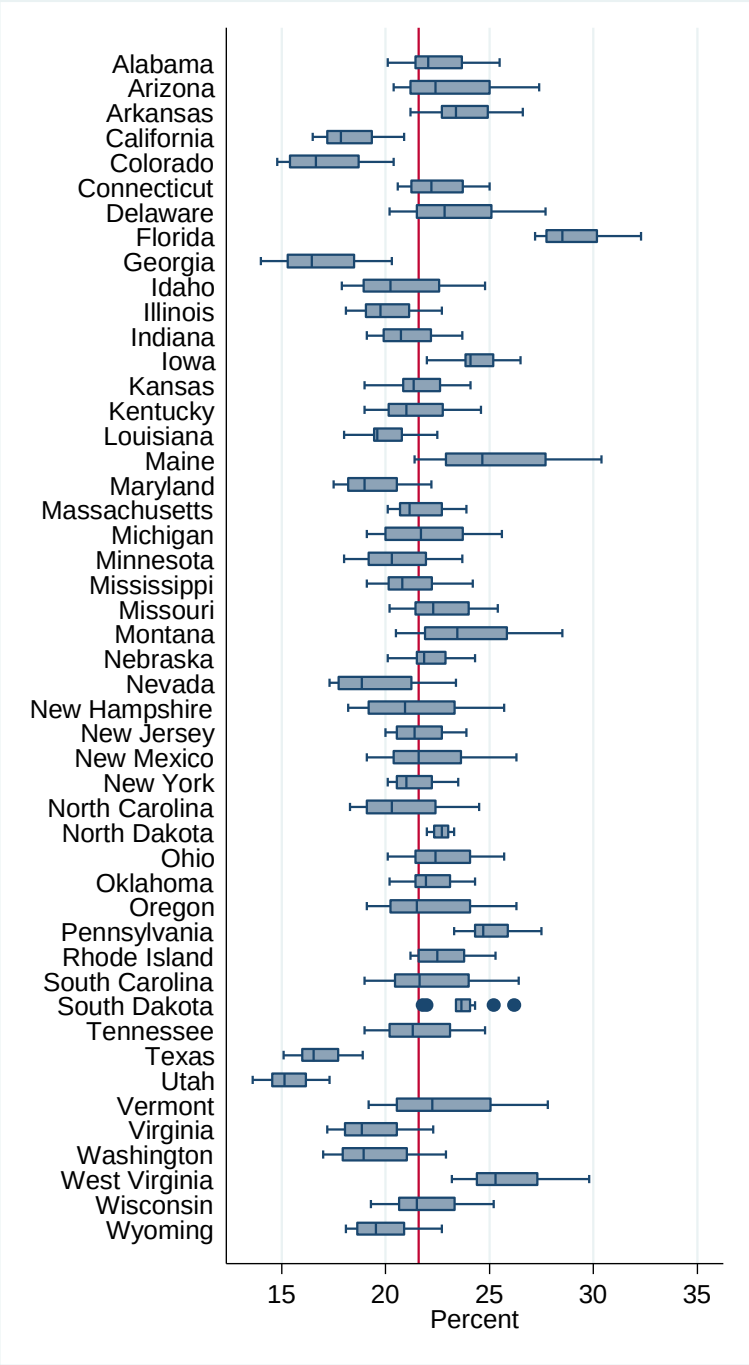

Figure 12. Young Age Dependency Ratio (%) over the Sample Period