The Impact of Subnational Fiscal Policies on Economic Growth: A Dynamic Analysis Approach

Arwiphawee Srithongrung
Kenneth A. Kriz

Abstract

Much previous research has analyzed the effect of state and local taxes and expenditures on economic growth, but usually in a static manner. In this paper, we use panel vector autoregression (PVAR) to examine the effects of taxes and expenditures on state income growth. This methodology allows us to treat all variables in the model as endogenously determined. Our approach allows us to address the endogeneity problem inherent in fiscal policy research as well as to obtain results for both the short term and intermediate term (up to six years). Consistent with prevailing wisdom, taxes are shown to have a negative effect on economic growth, but the effect only is present in the short run. Public capital spending has a positive effect on growth in both the short and intermediate terms. Operational expenditures exhibit positive effects on growth over the entire analysis period. © 2014 by the Association for Public Policy Analysis and Management.

INTRODUCTION

The link between fiscal policy and economic growth has been debated by many generations of policymakers. Some parts of fiscal policy seem to be presumed by most to spur or enhance growth. To take one example, in signing into law a large cut in the state income tax, Kansas Governor Sam Brownback remarked, "Today's legislation will create tens of thousands of new jobs and help make Kansas the best place in America to start and grow a small business" (Carpenter, 2012). Other parts of fiscal policy such as spending on salaries or benefits for the poor receive far less kind comments with respect to their effects on growth. In citing their "Principles for Sound Budgeting," the Commonwealth Foundation for Public Policy Alternatives recommended in part that the State of Pennsylvania should

> Eliminate unnecessary spending. Government has no money of its own; it has only that which it first removes from the productive sector of society. Unnecessary spending means there are fewer dollars in the private sector which would be better spent, saved, or invested in the economy. (Commonwealth Foundation for Public Policy Alternatives, 2012, p. 4)

There is also nearly uniform agreement in the public and popular press that the tax increases necessary to finance additional spending are a substantial drag on growth. The debates about fiscal policy vividly demonstrate the importance of answering the question about the relationship between various aspects of the policies and economic growth. All governments—federal, state, and local—must undertake

Journal of Policy Analysis and Management, Vol. 00, No. 0, 1–17 (2014)

Published by Wiley Periodicals, Inc. View this article online at wileyonlinelibrary.com/journal/pam
DOI:10.1002/pam.21784

thoughtful policies with respect to economic growth, or they face the potential problem of a stagnant economy and lower social welfare for their constituents. Economists and policy researchers need to provide clear guidance on the effects of fiscal policy so that decisionmakers have good information on which to make these policy decisions.

Not surprisingly, the effect of fiscal policy on U.S. state economic growth has been the focus of numerous studies. It is fair to say that there have been mixed results for the impacts of both taxes and spending on growth, depending on model specifications and estimation techniques. In this paper we use a methodology—panel vector autoregression (PVAR)—that to our knowledge has not yet been used in answering this question at the state level to reexamine the effects of taxes and spending on economic growth. There are two benefits in using PVAR. First, we are able to overcome the well-documented endogeneity problem in the testing model—that economic condition affects the level of taxes and spending of government at the same time that taxes and spending affect economic condition. The standard approach to eliminate endogeneity is to use instrumental variables (IV) that are exogenously determined to purge the correlation between the model-dependent variable and the error terms (Hsiao, 1999). However, for panel data, the IV method will eliminate the endogeneity problem only when the error terms of each of the equations in the system are not correlated (Hsiao, 1999). Given that panel data contain time-invariant factors (i.e., fixed effects), the error terms will correlate across equations in the system unless latent variables (i.e., residuals of each equation in the system) are used as an instrumental variable to purge residuals correlations across system equations (see Hsiao, 1999, pp. 113–117, for a discussion of simultaneity in panel data).

PVAR treats all variables in the model as endogenously determined by other variables in the model for a certain lag period. The traditional PVAR approach uses a system estimator in which each variable in the model is determined by its own lagged value and the lagged values of other variables as well as its lagged residuals. The residuals of each variable are determined by system equations, and they are uncorrelated across equations. Thus, the major advantage of PVAR is that it purges serial correlation in each equation while not sacrificing cross-equation information (correlations). The disadvantage of the traditional PVAR approach is that the model might generate misspecification bias when there are contemporaneous effects of fiscal policies on economic growth in the same year. This is because the PVAR model is specified such that the independent variables are lagged in each equation. To correct for this potential bias, we use a methodology suggested by Blanchard and Perotti (2002) and Ilzetzki, Mendoza, and Vegh (2010) that allows for contemporaneous effects of fiscal policies on growth. This allows us to avoid the misspecification bias found in more traditional approaches.

To obtain the isolated impact of each of the fiscal variables in the model, we examine impulse response functions in which the change of one variable is calculated when all structural errors are imposed to be zero, and allow only a shock in our variables of interest calculated from the diagonal matrix of variance-covariance residuals to change from one standard deviation to the next. Impulse response functions thus trace the impact of a shock in the variables of interest on the dependent variable one at a time. In this way, PVAR allows us to understand the impact of a fiscal variable over the short term and intermediate term, analyzing the effect one period at a time. Results of more traditional models (such as 2SLS) by contrast indicate only the average effect of each fiscal policy estimated over the entire lag structure.

The contribution of this paper to the existing literature is summarized as follows. First, by using PVAR, the study adds empirical evidence to the literature for the impacts of fiscal policies on income growth at the subnational U.S. level that is free from endogeneity. Second, by using this approach, the authors are able to identify the magnitude of the response of state income to fiscal policy shocks one period at a time, while isolating the effects of other shocks created by the factors outside the growth model. This contribution is beneficial to state and local policymakers given that the effect of tax or spending changes can be forecasted more precisely for each individual year compared to the average effects of cutting taxes estimated over multiple-year periods—which are the results obtained by standard regression methods. Last, through analyzing impulse response functions, the authors can identify the duration through which each fiscal shock persists. Such information is beneficial for decisionmakers as they contemplate fiscal policy changes.

LITERATURE

The effect of taxes and spending at the state and local level on growth varies widely in the public finance literature. On the spending side, the sign and magnitude of government spending impacts on growth differ depending on model specification. Helms (1985) employed a government budget constraint modeled using weighted least-squares and least-squares calibration on panel data from 48 states during the period 1965 to 1979 and found that the coefficients of the net effects of health and hospital, local school, higher education, and other spending are 0.02, 0.01, 0.01, and 0.01, respectively. In order to maintain the budget constraint, Helms omitted sales taxes on the revenue side and welfare spending (which he defined as unproductive spending) on the expenditure side. Mofidi and Stone (1990) found that the net effects of spending on health, education, other expenditures, and unemployment insurance are as large as 5.62, 4.33, 5.49, and −4.34, respectively.[1] Tomljanovich (2004) found that the net effect of welfare spending is negative and as large as −1.15. Productive spending (which is according to Helms, all spending by governments excepting welfare) was omitted in Tomljanovich's specification. Both of these papers employ a model in log-linear form, where the dependent variable is measured through the first difference of the log of per capita real GSP in year t and year $t - 3$. Recently, Reed (2008) has found that the effect of welfare spending is 0.51.[2] His model is in a log-log form, where the dependent variable is the first difference of log of per capita real personal income in year t and year $t - 4$.

Using inductive analysis approaches, McGuire (1991) and Dothan and Thompson (2009) agree that unlike federal government, state government spending is limited by balanced budget rules, which in turn limit productive spending such as public infrastructure and education. According to these authors, the optimal state spending growth rate is the one that reflects the state long-term revenue growth rate, and an optimal spending rule would guarantee stable growth as observed in Arizona and Oregon by McGuire (1991) and Dothan and Thompson (2009), respectively. However, these observations require a series of empirical tests given that the long-run growth rate depends on technological spillovers and population growth. If their optimal spending rules are valid, then fiscal policies are not relevant in state-local economic growth.

On the tax side, Reed (2008) has shown that under a robust estimation using five-year interval differenced data, the tax burden exhibited negative effects through

[1] The coefficients of the net effects are large because their model is in log-linear form—that is, their dependent variable is the first difference of the log of full-time employment (FTE) in year t and the log of FTE in year $t{-}5$ and their independent variables are measured in terms of a fraction of taxes to personal income. When the coefficient is multiplied by 100 percent, the size of the effect is close to that of Helms.
[2] In the same study, the coefficients of taxes estimated through the model in which expenditure is omitted is as large as −1.37. Compared to this coefficient, when expenditure is incorporated, the net effect of taxes is smaller, reduced from −1.37 to −0.56. See Reed (2008, Table 1, p. 62; Table 8, p. 73).

all estimation techniques, including pool OLS with fixed state and time effects (or least-square dummy variables—LSDV), fixed effects, random effects, general method of moments (GMM), and dynamic panel data (DPD) estimation. Testing the nonlinear effects of taxes on state economic growth, Bania, Gray, and Stone (2007) found that "the incremental effect of tax financed expenditures on productive government activities is non–monotonic—initially positive (a positive linear effect), but eventually negative (a sufficiently negative quadratic effect)." (Bania, Gray, & Stone, 2007, p. 202). They further noted that unlike results from linear specifications, the nonlinear results signify that taxes enhance growth; but once the government fiscal policies crowd out private capital, growth declines.

Bania and Stone's (2008) later work provides better insight on the nonlinear effect of tax and productive spending on growth. In this work, they separately rank state revenue, expenditure, and growth rates in 2004 and then correlate the fiscal rankings with state growth rate. This exercise reveals that taxes alone do not have significant correlation with growth. However, when Bania and Stone calculate the incremental change in tax rates by 1 percent for each state and correlate it with the incremental growth rate, they find a correlation between the fiscal structure and growth. Thus, they conclude that for nonlinear effect of fiscal structure (i.e., tax and productive spending on education and infrastructure), "an increment in taxes devoted exclusively to productive services and infrastructure would yield a relatively high payoff in terms of economic growth" (p. 765).

For public capital investment, early studies (Aschauer, 1990; Costa Da Silva, Ellson, & Martin, 1986; Munnell, 1990) indicated significant and positive relationships between public infrastructure spending (or public capital stocks) and state productivity. The models in these studies did not control for simultaneous effects among dependent and independent variables (Aschauer, 1990), state and time fixed effects (Aschauer, 1990; Munnell, 1990), fixed time effects (Costa Da Silva, Ellson, & Martin, 1986), existing public capital stocks (Costa Da Silva, Ellson, & Martin, 1986; Munnell, 1990), or public capital spending levels (Aschauer, 1990). These studies obtained significant and large estimates of the effects of public capital on economic growth (with elasticity ranging from 0.15 to 1.96). Furthermore, the adjusted R^2 in these models was extremely large (about 0.99). These results likely indicated serial correlation due to unit roots in the time series data. When the flaws in these models were corrected, public capital stocks and public capital spending exhibited significant but small effects on growth (0.01 for Holtz-Eakin & Schwartz, 1995, using the nonlinear seemingly unrelated technique, and 0.02 for Lobo & Rantisi, 1999, using LSDV), or insignificant impacts on growth (in Garcia-Mila, McGuire, & Porter, 1996, using the generalized least-squares [GLS] method and the two-stage least-squares [2SLS] method, and in Moomaw, Mullen, and William, 2002, using LSDV). However, when more recent methods were used, such as the vector autoregression (VAR) technique, which corrects for simultaneous effects between dependent and independent variables due to persistent trends in the lagged residuals, Pereira and Andraz (2003) again found that public capital investment had a significant and relatively large positive impact on private output.

TESTING MODEL AND DATA

According to national income accounting concepts, the budget identity of U.S. state governments is

$$n(g + g_c) + i_e + d_s = n(l + \tau y) + i_r + d_n \tag{1}$$

where n is population; g represents productive public spending; g_c is unproductive spending including transfer payments, social security, and other welfare expenditure; i_e represents intergovernmental spending for local governments; and d_s is annual debt service. On the revenue side, l represents lump sum taxes (e.g., user fees and charges); τ is the effective tax rate on private sector output, γ; i_r is intergovernmental revenue from local and federal governments; and d_n represents new debt issuance funding expanded or new public infrastructure projects.[3] Solving equation (1) for the ratio of productive public spending to private output, we obtain

$$g/y = \tau - \frac{g_c - l}{y} - \frac{1}{n}\left[\frac{i_e - i_r}{y} + \frac{d_s - d_n}{y}\right]. \tag{2}$$

In their study on the role of budget surplus on growth, Kneller, Bleaney, and Gemmel (1999) suggested that a government's combined tax and service package (such as the one defined for state governments in equation (1), is only one variable in the growth model; other nonfiscal variables, such as resource endowment, technological advancement in the local area, time period, and labor growth rates, are inputs in the growth equation. Thus, Kneller, Bleaney, and Gemmel's (1999, p. 174) growth model is

$$\gamma = a + \sum_{ii=1}^{k} B_i Y_{it} + \sum_{j=1}^{m} \gamma_j X_{jt} + u_t \tag{3}$$

where Y are nonfiscal variables, X is a government's combined tax and spending policy, and u are error terms. Using the growth accounting provided by Kneller, Bleaney, and Gemmel (1999) and the budget constraints stated in equation (2), we rewrite equation (3) as

$$\Delta \ln \gamma_{t,j} = a + b_1 \ln k_{t,j} + b_2 \ln k_{t,j} + b_3 \tau_{t,j} + b_4 or_{t,j} + b_5 c_{t,j} + b_6 d_{t,j} + \sum_{j=1}^{m-1} bs_{it,j}$$
$$+ \sum_{j=1}^{m-1} bt_{t,i} + \varepsilon_{t,i} \tag{4}$$

where

$\Delta \ln \gamma - t, j$ is annual growth rate of per capita real personal income (log y in year t minus log y in year $t-1$), in year t for state i, ln $k_{t,i}$ is the log of annual private capital stock in year t for state i, ln $l_{t,i}$ is the log of annual labor quantity in year t for state i, $\tau_{t,i}$ is total taxes (including income, sales, and property taxes) in year t as a percentage of real per capita personal income in year $t-1$,[4] $or_{t,i}$ (omitted) is other revenue (including non-tax revenue, intergovernmental revenue, and debt proceeds) in year t as a percentage of real per capita personal income in year *t1*, $c_{t,i}$ is total government capital spending in year t as a percentage of real per capita personal income in year $t-1$, $d_{t,i}$ is total current spending in year t as a percentage of real per capita personal income in year $t-1$, $oex_{t,i}$ (omitted) is other government expenditure (intergovernmental expenditure and debt services) in year t as a percentage of real personal income in year $t-1$.

[3] Typically, the variables are standardized in per capita terms or as a percent of personal income.
[4] We followed Reed (2008) in measuring percentage of tax and spending to personal income by using the fiscal variables in year t and personal income variable in year $t-1$ given that the fiscal data were recorded according to fiscal year and the personal income data were recorded according to calendar year.

Equation (4) states that the annual growth rate of per capita real personal income is a function of private capital stock, labor force, the tax and revenue burden of the government entity, various components of government spending, and state and time fixed effects. Our formulation and data operationalization incorporate a balanced budget restriction by including all of the budget items as reported by U.S. Census Bureau's Annual Survey of State and Local Government Finances (2006, 2011) and omitting one category of revenue and expenditure to avoid perfect multicollinearity. See Appendix 5 for the data-operationalization approach we used to incorporate balanced budget restrictions in estimation.[5]

Equation (4) can be estimated by OLS, but theoretically there will be an endogeneity problem in that economic growth will determine tax and spending shares, which in turn will affect growth. To test this, we first estimated the model using OLS, fixed-effects, and two-stage least-squares (2SLS) regression models. For 2SLS, we instrument taxes, operational and capital expenditure with variables for the state poverty rate, percentage of population aged 65 and over, percentage of population aged 18 and under, percentage of legislative seats held by the Democratic Party, and a dummy variable for whether the state's governor is from the Democratic Party. These instruments were selected based on previous findings that a legislature controlled by Democrats and a Democratic governor were strongly associated with state government per capita general expenditure (Merrifield, 2000) and that a Democratic legislature significantly increases the state tax burden (Reed, 2006). Recently, Krause, Lewis, and Douglas (2013) empirically confirm that state government politics can influence tax burdens, specifically, they find that legislative tax and revenue forecasts become more conservative when the legislature is divided along partisan lines compared to those legislatures that are unified. Furthermore, citizens' tastes and preferences measured through proportion of population that is of school age and proportion of population influenced per capita state expenditure through two indicators are valid instruments for taxes and expenditure in Painter and Bae's study (2001). The results of this methodology are reproduced in Appendix 1.[6] The Sargan test statistics indicate that the instruments we chose are valid for 2SLS. However, regression diagnostics indicated that endogeneity was not completely eliminated by 2SLS. Therefore, we chose to estimate equation (4) using PVAR, a systems approach in which each of the variables in the model are estimated through the reduced form where the current and lagged differenced values of that variable and the current and lagged values of other variables in the model are explanatory variables (this approach has also been called the systems general moment method, see Arellano & Bover, 1995).

Following Blanchard and Perotti (2002) and Ilzetzki , Mendoza, and Vegh (2010), we estimated equation (4) as a system of equations:

$$AY_{i,t} = \sum_{k=1}^{K} C_k Y_{i,t-k} + Bu_{i,t} \tag{5}$$

where $Y_{i,t}$ is a vector of the endogenous variables as explained above for a given state i and time t. The matrix C_k captures the own-and-cross effects of the kth lag

[5] All appendices are available at the end of this article as it appears in JPAM online. Go to the publisher's Web site and use the search engine to locate the article at http://www3.interscience.wiley.com/cgi-bin/jhome/34787.

[6] All appendices are available at the end of this article as it appears in JPAM online. Go to the publisher's Web site and use the search engine to locate the article at http://www3.interscience.wiley.com/cgi-bin/jhome/34787.

of the endogenous variables on their current values. The matrix B is diagonal, and therefore the matrix $u_{i,t}$ is the orthogonal matrix of i.i.d residuals, such that $E[u_{i,t}] = 0$ and $E[u_{i,t}\ u'_{i',t}] = I$. The matrix A allows for simultaneous effects among the endogenous variables.

Because panel data contain fixed effects of each entity's characteristics, the residuals from each equation in the system are likely to be correlated and may result in biased coefficients. To eliminate the problem of residual correlation across equations, a mean differencing procedure (i.e., the Helmert procedure; see Arellano & Bover, 1995) was used to transform the data, and the VAR system equations are finally estimated through the systems general moment method.

The coefficients of VAR models are consistent, but the standard errors of individual coefficients tend to be inflated due to the heavy parameterization of the model. Therefore, most often the analysis of VAR models proceeds through an analysis of simulated shocks to the system using the coefficient estimates and residuals of the model (impulse response functions). We follow Blanchard and Perotti (2002) in specifying the impulse response functions as presented in equation (5) below.

$$\begin{aligned}
\gamma_t &= a_1 l_t + m_2 e_t^k + m_3 e_t^c + m_4 e_t^d + m_5 e_t^\tau + e_t^\gamma \\
\tau_t &= f_1 \gamma_t + f_2 e_t^l + f_3 e_t^k + f_4 e_t^c + f_5 e_t^d + e_t^\tau \\
d_t &= h_1 \tau_t + h_2 e_t^\gamma + h_3 e_t^l + h_4 e_t^k + h_5 e_t^c + e_t^d \\
c_t &= g_1 d_t + g_2 e_t^t + g_3 e_t^\gamma + g_4 e_t^l + g_5 e_t^k + e_t^c \\
k_t &= a_1 c_t + a_2 e_t^d + a_3 e_t^\tau + a_4 e_t^\gamma + a_5 e_t^l + e_t^k \\
l_t &= b_1 k_t + b_2 e_t^c + b_3 e_t^d + b_4 e_t^t + b_5 e_t^y + e_t^l
\end{aligned} \tag{6}$$

where $e_t^\gamma, e_t^\tau, e_t^d, e_t^c, e_t^k, e_t^l$ are uncorrelated structural shocks to per capita income, taxes, operational spending, capital spending, private stocks, and labor, respectively.

According to Blanchard and Perotti (2002, p. 1333), the specification above relies on institutional information about tax, transfer, and spending programs to construct parameters. The coefficients derived from PVAR specification by Blanchard and Perotti (2002) are assumed to capture two different effects of activity on tax, operational, and capital spending: the automatic effects of economic activity on tax and spending under existing fiscal policy rules and any discretionary adjustment made to fiscal policy in response to unexpected events within a year. The key to Blanchard and Perotti (2002) identification is that it takes policymakers and legislature at the state level more than a period to learn about personal income shock, decide what fiscal measures, if any, to take in response, pass these measures through the legislature, and actually implement them.

The order of the shocks in system equation (6) is arranged based on Stock and Watson (2001) and Love and Zicchino (2006) such that in PVAR, the variables that are the most endogenous should come first and the variables that are the most exogenous should come last in the system equation. Conceptually, labor and capital stocks are relatively exogenous variables determining growth, and private stock and labor equations are ordered as the fifth and sixth equations, respectively. Government fiscal policies of taxing and spending are the most endogenous according to the endogenous growth model, and taxes are the first equation in the system, followed by operational spending and capital spending.

Given that the taxes and spending shocks can be estimated, we can further study how the shocks affect personal income over time by arranging the order of taxes and spending so that the effects of all shocks are held constant, while allowing the shocks on the variable of interest using the estimated variance-covariance

Table 1. Summary statistics.

Variable	Mean	SD
Economic growth (annual percentage change in per capita personal income, $y_{t,i}$)	1.50 percent	2.90 percent
Private stock (percentage of personal income, $k_{t,i}$)	51 percent	19 percent
Labor force (percentage of total population, $l_{t,i}$)	53.80 percent	6.70 percent
Taxes (percentage of personal income, $\tau_{t,i}$)	10.20 percent	1.30 percent
Operational spending to income (percentage of personal income, $d_{t,i}$)	15.30 percent	2.50 percent
Capital spending to income (percentage of personal income, $c_{t,i}$)	2.60 percent	0.80 percent
Federal grant (percentage of personal income)	5.10 percent	1.70 percent
Democratic governor (instruments for 2SLS model)	0.54	0.49
Democratic legislature (instruments for 2SLS model)	0.56	0.49
Population aged 65 and over (percentage of total population, instruments for 2SLS model)	11.79 percent	2.00 percent
Population aged 5 to 18 (percentage of total population, instruments for 2SLS model)	31.78 percent	3.91 percent
Poverty rate (percentage of total population, instruments for 2SLS model)	13 percent	0.40
Real per capita public capital stock (instruments for 2SLS model)	$7,964	$1,604

Note: All fiscal variables are in constant dollars (base year 2000). $n = 1{,}968$ (41 years $\times$ 48 states).

matrixes obtained from the estimation of the VAR. For example, restricting the coefficient of taxes and other public spending to be zero one period into the future, we can obtain the contemporaneous response of personal income to capital spending shocks.

Testing data were taken from 48 continental states during the period of 1970 to 2010. Alaska and Hawaii were excluded, in keeping with other papers doing state-level analysis. The final sample size is therefore 1,968 observations (41 years $\times$ 48 states). All fiscal variables are in constant dollars with a base year of 2000. All data were time-demeaned to remove time fixed effects prior to being transformed through the Helmert mean-forwarding method (to remove state fixed effects). The time demeaning method was used to control for contemporaneous factors common across state in each year. Instead of including time dummy variables, the time-demeaning method was used in order to save degrees of freedom.

State real per capital personal income ($y_{t,i}$) was obtained from the U.S. Census Bureau's Annual Survey of State and Local Government Finances and Census of Governments (2006 and 2011). Annual state per capita private capital stock ($k_{t,i}$) was calculated by the authors using apportionment methods suggested by Garofalo and Yamarik (2002) on data from the U.S. Bureau of Economic Analysis (2006, 2011). Annual state labor quantity ($l_{t,i}$) was also obtained from the Bureau of Economic Analysis. All revenue and spending data ($\tau_{t,i}$, $c_{t,i}$, $d_{t,i}$) were obtained from the U.S. Census Bureau (2006, 2011). All fiscal variables have a one-year lag to personal income given that tax and spending data are based on the fiscal year and the personal income data are based on calendar year. Our ratio calculation strictly follows Reed's (2008) suggestion for a method to minimize measurement error due to fiscal year reporting differences. Table 1 presents summary statistics for all variables in the model.

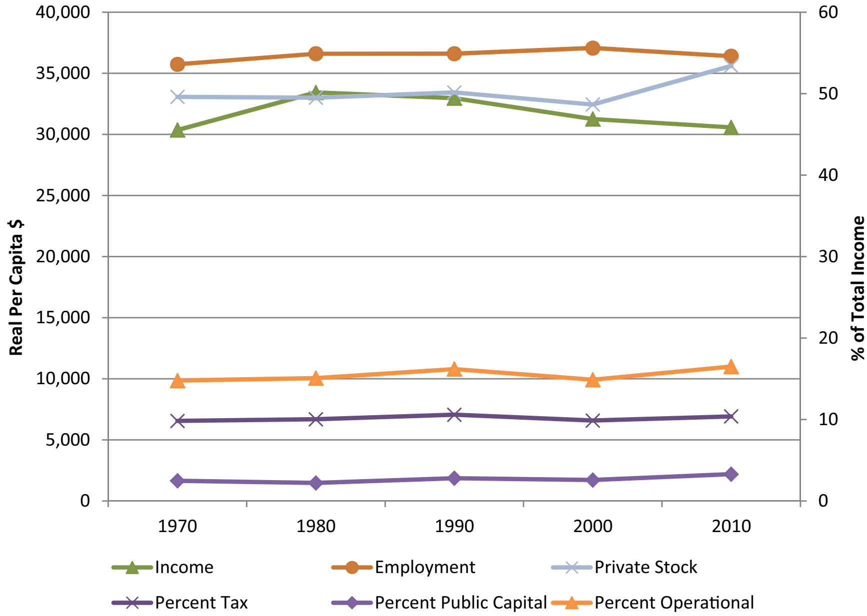


Figure 1. Annual variable means, 1970 to 2010 ($i = 48$).

Figure 1 shows the means over time of the variables that were used in the PVAR estimation. Real personal income and percent of per capital private stock to personal income demonstrate the most variability. State tax rates are relatively stable over time compared to income. Although the scale of the graph makes it difficult to see, both public capital and operational spending have slight upward trends, with operational spending rising faster than capital spending.

EMPIRICAL RESULTS

We obtained the results of the PVAR system equations and performed joint significance tests of the null hypothesis that confirmed the coefficients were zeros for all current and lagged values of one variable on another variable. Lag length tests using the Schwarz Bayesian information criteria (BIC) suggested that a one-period lag is appropriate. The F-statistic indicated that each of the variables were jointly significant for the system equations.

According to the literature on PVAR, system equation coefficients are not adequate to understand the impact of a policy variable (Kennedy, 2008). We therefore obtained the residual correlation matrix and variance decomposition, which was used to calculate the impulse response functions, which show the effects of a shock to one variable on the other variables in the system.

Table 2 presents estimates of the response of personal income growth rate to tax and expenditure changes in multiplier form (i.e., the response of per capita personal income to a one-unit change of tax or expenditure). Examining a few of the results, a \$1 increase in taxes is predicted to result in a 30-cent reduction in per capita personal income in the same year (year t) and a 15-cent reduction one year after the shock (year $t + 1$). Based on the third row of the table, tax changes have no effect on personal income two years after the shock (i.e., years $t + 2$ through $t + 5$).

As presented in Table 2, the signs of the fiscal policy variables—taxes, operational spending, and public capital spending—are opposite than those in the more

Table 2. Impulse response function for per capita personal income (in dollars) to a one-unit change in the variable indicated (various lag periods).

Dependent variable/Lag	t	$t+1$	$t+2$	$t+3$	$t+4$	$t+5$	Cumulative through $t+5$
$1 increase in annual personal income (y)	−0.08	−0.11**	−0.06**	−0.02	−0.01	0.00	−0.17
$1 increase in tax ($\tau$)	−0.30**	−0.15**	−0.05	0.02	0.06	0.08	−0.45
$1 increase in operational spending (d)	0.27**	0.21**	0.16**	0.14**	0.12**	0.12**	1.02
$1 increase in capital spending (c)	0.71**	0.43**	0.20**	0.08	0.00	−0.04	1.34
$1 increase in private stock (k)	−0.03**	−0.03**	−0.02**	−0.02**	−0.02**	−0.02**	−0.14
One-person increase in total labor force (l)	0.0002**	0.0002**	0.0002**	0.0002**	0.0002**	0.0001**	0.0011
Net effect, fiscal variables	0.68	0.49	0.36	0.14	0.12	0.12	1.91
Net effect, all variables	0.65	0.36	0.28	0.12	0.12	0.10	1.61

Note: The number in each cell indicates responses of real per capita personal income to a unit shock in the model variables listed in the first column at different periods ranging from year t to year $t+5$. A double asterisk in each cell indicates at a 95 percent confidence level that the corresponding response is not equal to zero.[7] Net and cumulative effects are found by adding significant responses for each row and column.

traditional specifications (see the results in Appendix 1 and Table A1.1).[8] This suggests that as the endogeneity problem is corrected, the signs of these key variables switch direction.

The last column of Table 2 shows the cumulative effect of taxes, operational spending, and capital spending. The results indicate that for a dollar shock in taxes, operational and capital spending, the cumulative effects of these variables across the six-year period is $0.45, $1.02, and $1.34, respectively. The cumulative effect of taxes found in this study is similar to those of the studies obtained in recent years and are very much different from those obtained in earlier studies. This implies that as the model and estimation techniques are more developed, the effects of taxes are more consistent. For example, the cumulative effect of taxes found in Table 2 is −0.45, which is close to Reed's (2008) findings in both direction and magnitude

[7] The results reported in this table are scaled to be a dollar multiplier based on the original PVAR results in a form of response to one standard deviation shocks. The original results are reported in Table A2.1 of Appendix 2. All appendices are available at the end of this article as it appears in JPAM online. Go to the publisher's Web site and use the search engine to locate the article at http://www3.interscience.wiley.com/cgi-bin/jhome/34787.

[8] All appendices are available at the end of this article as it appears in JPAM online. Go to the publisher's Web site and use the search engine to locate the article at http://www3.interscience.wiley.com/cgi-bin/jhome/34787.

(which are −0.51) and very different from Helms's (1985), Mofidi and Stone's (1990), and Tomljanovich's (2004; which are −0.1, −4.96, and +7.2, respectively). Unlike taxes, the cumulative effect of operational spending found in Table 2 (which is 1.02) is different than those obtained by other studies in terms of magnitude, but similar in terms of direction (except for Tomljanovich's, which is negative). The operational spending effects found by Helms (1985), Mofidi and Stone (1990), and Tomljanovich (2004) are 0.01 to 0.02, 4.3 to 5.6, and −1.15, respectively. The sign and magnitude differences may be due to the fact that this study compresses all operational spending in a category, while other studies separate the operational spending by function (e.g., education, welfare, health).

For policymakers, knowing the net effects of various fiscal policies is beneficial in two ways: First, the net effects help policymakers decide whether changes in fiscal policies stimulate the entire economy; second, the net effects help policymakers understand whether increasing taxes and increasing spending help or hurt the economy assuming that nonfiscal variables (private capital and labor stocks) are not directly affected by any policy change (i.e., we capture the indirect as well as direct effects of fiscal policy changes). We show the direct and indirect benefits of policy interventions in the last row of Table 2. In the same year period (the second column of the table) in which fiscal policies are changed, the positive net effect is $0.65 per dollar of intervention. Note that this effect is isolated from prior year economic growth. One year after the intervention in fiscal policies (column 3), the net effect of fiscal and nonfiscal policies is to increase state economic growth by $0.36, while two years after the intervention it is still fairly strong at $0.28. The cumulative effects of fiscal policy intervention peak within a two-year period, suggesting that proper fiscal policy can stimulate economic growth to counterbalance a stagnant private economy. For three to five years later after the fiscal policies are intervened, the net effects are negligible but still positive. This means that the net effects of fiscal policies are likely to be temporary and will not change the permanent growth path of state economies. The direct effects of fiscal policy are presented in the second to the last row of Table 2. Assuming that the nonfiscal variables (i.e., private and labor stocks) are not changed directly by policies, increasing taxes and spending enhances economic growth by about $0.68 per dollar of intervention in the current year, $0.49 in the first year after the intervention, and $0.36 for the second year. This further suggests that fiscal policies can act as economic stabilizers.

Putting the fiscal policy effects into absolute dollar terms,[9] we see that a 1 percent increase in taxes (about $314 per person) results in a $144 decrease in per capita personal income, a 1 percent increase in operational spending results in a $322 increase in income, and a 1 percent increase in capital spending leads to a $424 increase in income (see Appendix 3). [10]

Figure 2 shows graphically the dynamic responses of personal income to a 1 standard deviation shock in fiscal policies and other predictor variables along with the 95 percent confidence intervals of those responses over the six-year period (time t to $t + 5$—confidence intervals shown with gray shading). For example, the third panel of Figure 2 shows that the effect of one standard deviation shock in taxes (equivalent to a 1.3 percent tax increase) is estimated to persist for about two years and produce a total reduction of 0.59 percent in per capita personal income.

[9] This presentation was suggested by an anonymous reviewer. We thank them for their comments.
[10] All appendices are available at the end of this article as it appears in JPAM online. Go to the publisher's Web site and use the search engine to locate the article at http://www3.interscience.wiley.com/cgi-bin/jhome/34787.

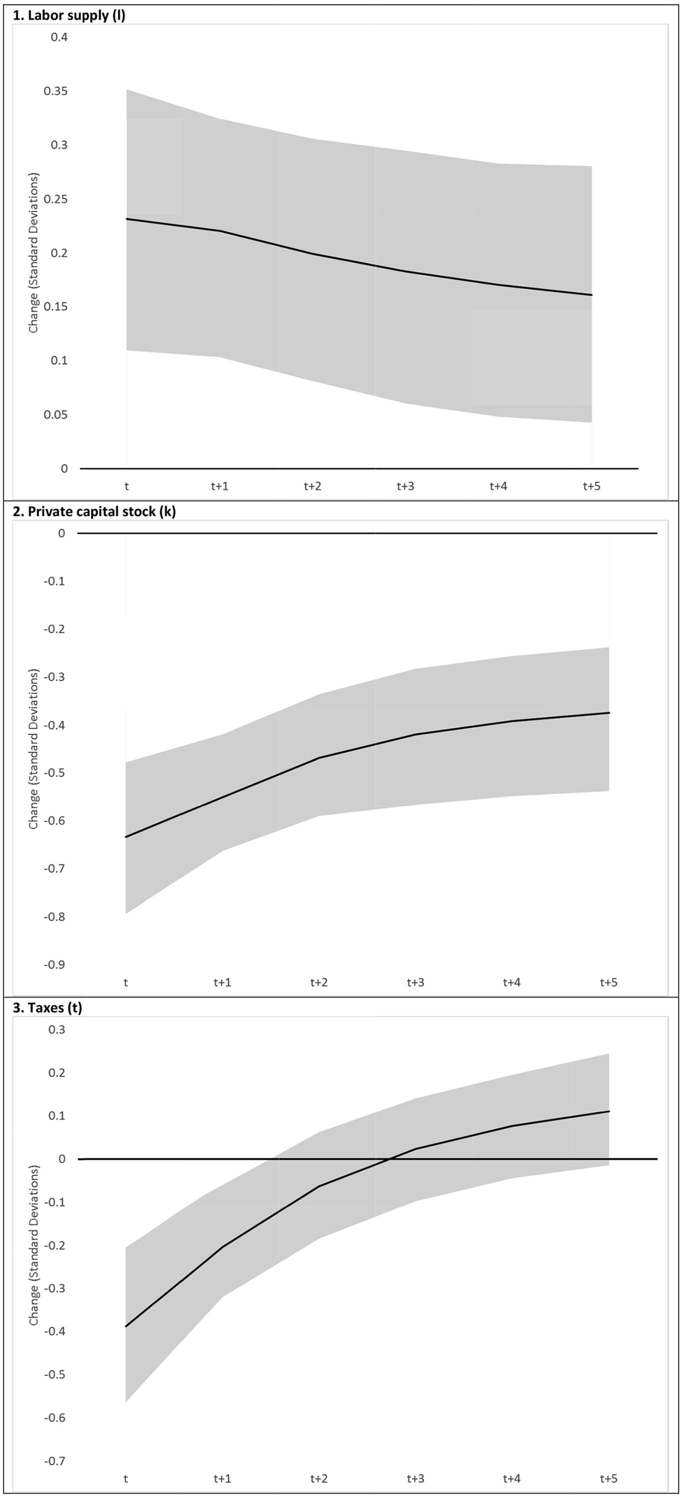
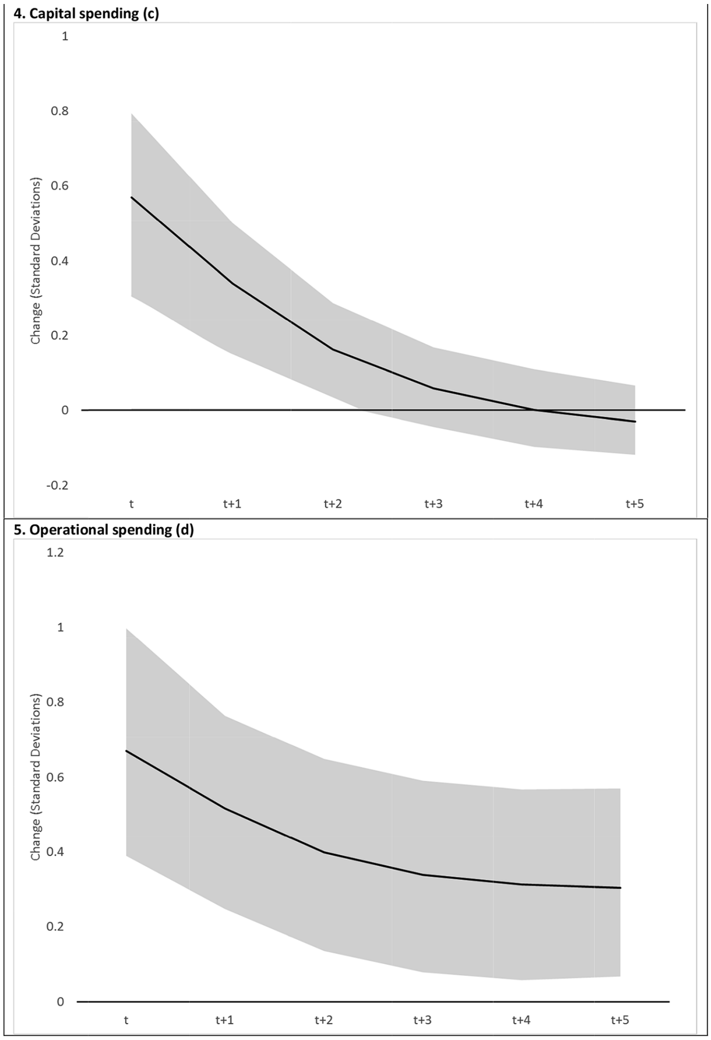


Figure 2. Response of per capita personal income to a 1 standard deviation change in the variables indicated.



Notes: Shaded region indicates the 95% confidence interval for the indicated impulse response.

Figure 2. continued.

Response of Personal Income to Changes in Taxes

Based on the point estimates and standard errors, we can estimate the response of personal income to fiscal policy shocks. Looking at the third row of Table 2, we estimate that a $1 increase in per capita total tax reduces per capita personal income by approximately $0.30 in the same year and $0.15 one year after the tax rate increase. As shown in Figure 2, the negative effect of tax on growth is not statistically significant in years $t + 2$ through $t + 5$ after the tax was introduced. Therefore, we cannot say that the effect persists over the medium term. Our estimate of the total accumulated effect of a tax increase is that it reduces per capita personal income by approximately $0.45. As shown in Table A2.1, this translates to an approximate one-half percent reduction of the annual growth rate of per capita income. This effect is relatively large compared to the size of sample mean growth rate that is only about 1.5 percent per year.

Response of Personal Income to Changes in Operational Spending

Examining row 4 of Table 2, a dollar increase in operational spending results in a \$0.27 increase in per capita personal income in the same year in which operational spending was increased. The effect of operational spending on growth is persistent throughout the six-year period. The positive effect of operational spending on growth steadily declines from year 1 through 5. As shown in Table 2, the accumulated effect of operational spending over the six-year period is estimated to be \$1.02. Therefore, the response of economic growth to changes in taxes is approximately at a dollar-to-dollar ratio.

Response of Personal Income to Changes in Capital Spending

We estimate that a dollar increase in public capital spending increases a state's economic growth by about \$0.71 in the same year as public capital spending occurs. As seen in the fifth row of Table 2, the positive effect of capital spending persists for three years. The cumulative effect of personal income with respect to public capital spending is about \$1.34 over a six-year period, which is fairly sensitive.

Robustness Checks

In order to check the robustness of our results, the authors run several alternative specifications.[11] The first robustness check involved the ordering of variables in the reduced-form residual matrix. One might be concerned that varying the order of variables in the residual matrix may affect the results. Therefore, we ran a series of models where the ordering of the fiscal variables was changed. The results indicate that the change of the orders for tax, operational and capital spending does not affect the coefficients of these variables—that is, it does not matter whether which one of each of these three fiscal variables would be the first (Table A4.1, Appendix 4).[12]

A second concern expressed about the model involved the role of federal grants in subnational public capital spending. Therefore, we reestimated a VAR system including this variable. The coefficient of the federal grant variable is not significant at the 0.05 level in all equations except the federal equation itself. This suggests that lagged federal grants explain only themselves in subsequent periods. The effects of the other fiscal variables do not significantly change compared to the results reported above.

Finally, we conducted another PVAR model in which only 44 states were included in the model; Alaska, Hawaii, Minnesota, Nebraska, South Dakota, and Wyoming were excluded. Nebraska and Minnesota were excluded because Nebraska had a unicameral legislature throughout the testing period and Minnesota had a unicameral legislature from 1970 to 1979. Wyoming and South Dakota were excluded because the data were extreme outliners judging from DFBETA statistics. The PVAR results

[11] This presentation was suggested by an anonymous reviewer. We thank them for their comments.
[12] When the exogenous variables were placed first in the estimation of the impulse response function, the coefficients changed slightly, but the qualitative results for the variables of interest remained unchanged. All appendices are available at the end of this article as it appears in JPAM online. Go to the publisher's Web site and use the search engine to locate the article at http://www3.interscience.wiley.com/cgi-bin/jhome/34787.

obtained from estimating the 44 state data are present in Table A4.2 in the Appendix.[13] The results indicate only small differences from the full sample results, and we concluded that the omission of the four states do not significantly change the average effects of fiscal policies on economic growth in the subnational level.

CONCLUSION

This study examines the effect of state and local fiscal policies on subnational economic growth using a PVAR to overcome the inherent endogeneity problem in growth models. The point estimates of the personal income responses to fiscal policy shocks obtained from impulse response table and graphs indicate that taxes have a slight negative effect on economic growth. In addition to current year effect, this tax effect is only a year lagged and is transient, rather than persistent. Operational spending has a positive effect on growth approximately at about a one-to-one ratio. The positive effect of operational spending persists through the six-year estimation period. Public capital spending demonstrates a positive effect on economic growth for two years after the investment occurs. The effect is more than a one-to-one ratio and lasts for three years including the current year. Fiscal policies appear to have a contemporaneous effect on subnational economic growth. These findings contribute to literature and practice by adding the evidence of a fiscal policy effect on growth in dynamic terms including each individual period effect, the accumulated effects of the policies, the peak effect, and the time over which the effect persists. These estimates are relatively specific compared to those results yielded from standard regression models.

Given our findings, the wisdom of cutting taxes as a way to boost a state economy must be seriously reexamined. While cutting taxes may produce a short-term boost in the economy, if those cuts are accompanied by cuts in spending (especially operational spending), the short-run gains are going to be offset and perhaps even exceeded by the drag on growth created by lower spending. Further, the assertions that spending reduces growth (which is a view that public expenditure crowds out productive private economic activity) must also be reexamined. Our results strongly support a view that spending on local public goods is complementary with private economic activity. Taking the viewpoint of a regional economic model, public spending ripples through the economy in the form of induced spending in the private sector. The real question may come down to whether public spending provides strong multiplier effects (as suggested by our results) or not. This is an area for future research, to parse our results by types of spending perhaps, or to examine the effectiveness of fiscal policy at different phases of the economic cycle.

ARWIPHAWEE SRITHONGRUNG is an Associate Professor at Hugo Wall School of Public Affairs, Wichita State University, 1845 Fairmount Street 209, Box 155, Wichita, KS 67260 (e-mail: Arwiphawee.Srithongrung@wichita.edu).

KENNETH A. KRIZ is Regents Distinguished Professor of Public Finance at Hugo Wall School of Public Affairs, Campus Box 155, 1845 Fairmount Street, Wichita, KS 67260 (email: Ken.Kriz@wichita.edu).

[13] All appendices are available at the end of this article as it appears in JPAM online. Go to the publisher's Web site and use the search engine to locate the article at http://www3.interscience.wiley.com/cgi-bin/jhome/34787.

ACKNOWLEDGMENTS

The authors wish to acknowledge Inessa Love and Lea Zicchino for providing the codes of PVAR and anonymous referees for the valuable comments and suggestions to improve this paper. Any error that remains is the authors' responsibility.

REFERENCES

Arellano, M., & Bover, O. (1995). Panel data: Another look at the instrumental variable estimation of error component models. Journal of Econometrics, 68, 29–51.

Aschauer, D. (1990). Why is infrastructure important? In A. Munnell (Ed.), Is there a shortfall in public capital investment (pp. 69–104). Boston, MA: Federal Reserve Bank of Boston.

Bania, N., & Stone, J. A. (2008). Ranking state fiscal structures using theory and evidence. Journal of Policy Analysis and Management, 27, 751–770.

Bania, N., Gray, J. A., & Stone, J. A. (2007). Growth, taxes, and government expenditures: Growth hills for U.S. states. National Tax Journal, 60, 193–204.

Blanchard, O., & Perotti, R. (2002). An empirical characterization of the dynamic effects of changes in government spending and taxes on output. Quarterly Journal of Economics, 117, 1329–1368.

Carpenter, T. (2012). Brownback signs large state tax cut. Topeka Capital-Journal. Retrieved January 5, 2014, from http://cjonline.com/news/2012-05-22/brownback-signs-large-state-tax-cut.

Commonwealth Foundation for Public Policy Alternatives. (2012). Pennsylvania state budget background & 2012 preview. Retrieved March 14, 2014, from http://www.commonwealthfoundation.org/research/detail/pennsylvania-state-budget-background-2012-preview.

Costa Da Silva, J., Ellson, R., & Martin, R. (1986). Public capital regional output and development: Some empirical evidence. Journal of Regional Science, 27, 419–437.

Dothan, M., & Thompson, F. (2009). A better budget rule. Journal of Policy Analysis and Management, 28, 463–478.

Garcia-Mila, T., McGuire, T., & Porter, R. (1996). The effect of public capital in state-level production functions reconsidered. Review of Economics and Statistics, 78, 177–180.

Garofalo, A., & Yamarik, S. (2002). Regional convergence: Evidence from a new state-by-state capital stock series. Review of Economics and Statistics, 84, 316–323.

Helms, L. J. (1985). The effect of state and local taxes on economic growth: A time series-cross section approach. Review of Economics and Statistics, 67, 574–582.

Holtz-Eakin, D. & Schwartz, A. (1995). Infrastructure in a structural model of economic growth. Regional Science and Urban Economics, 25, 131–151.

Hsiao, C. (1999). Analysis of panel data. Cambridge, MA: Cambridge University Press.

Ilzetzki, E., Mendoza, E. G., & Vegh, C.A. (2010). How big (small) are fiscal multipliers? NBER Working Papers 16479. Cambridge, MA: National Bureau of Economic Research. Retrieved December 18, 2013, from http://www.nber.org/papers/w16479.pdf.

Kennedy, P. (2008). A guide to econometrics (5th ed.). Cambridge, MA: MIT Press.

Kneller, R., Bleaney, M. F., & Gemmell, N. (1999). Fiscal policy and growth: Evidence from OECD countries. Journal of Public Economics, 74, 171–190.

Krause, G. A., Lewis, D. E. & Douglas, J. W. (2013). Politics can limit policy opportunism in fiscal institutions: Evidence from Official General Fund Revenue Forecasts in the American States. Journal of Policy Analysis and Management, 32, 271–295.

Lobo, J., & Rantisi, N. (1999). Investment in infrastructure as determinant of metropolitan productivity. Growth and Change, 30, 106–127.

Love, I., & Zicchino, L. (2006). Financial development and dynamic investment behavior: Evidence from panel VAR. Quarterly Review of Economics and Finance, 46, 190–210.

Merrifield, J. (2000). State government expenditure determinants and tax revenue determinants revisited. Public Choice, 102, 25–50.

Mofidi, A., & Stone, J. A. (1990). Do state and local taxes affect economic growth? Review of Economics and Statistics, 72, 686–691.

Moomaw, R., Mullen, K., & Williams, M. (2002). Human and knowledge capital: A contribution to empirics of state economic growth. American Economic Journal, 30, 48–59.

McGuire, T. J. (1991). State and local tax reform for the 1990s: Implications from Arizona. Journal of Policy Analysis and Management, 10, 64–77.

Munnell, A. (1990). How does public infrastructure affect regional economic performance? In A. Munnell (Ed.), Is there a shortfall in public capital investment? (pp. 69–104). Boston, MA: Federal Reserve Bank of Boston.

Pereira, A., & Andraz, J. (2003). On the impact of public investment: On the performance of U.S. industries. Public Finance Review, 31, 66–90.

Painter, G., & Bae, K. (2001). The changing determinants of state expenditure in the United States: 1965–1992. Public Finance and Management, 1, 370–393.

Reed, W. R. (2006). Democrats, republicans, and taxes: Evidence that political parties matter. Journal of Public Economics, 90, 725–750.

Reed, W. R. (2008). The robust relationship between taxes and U.S. state income growth. National Tax Journal, 61, 57–80.

Stock, J. H., & Watson, M. W. (2001). Vector autoregressions. Journal of Economic Perspectives, 15, 101–115.

Tomljanovich, M. (2004). The role of state fiscal policy in state economic growth. Contemporary Economic Policy, 22, 318–330.

U.S. Census Bureau. (2006). Annual survey of state and local government finances and census of governments, 1970–1999. [This data base is an internal file of the U.S. Census Bureau. It is an archive of the data items published in the report series, Government Finances, since 1957.]

U.S. Census Bureau. (2011). Annual survey of state and local government finances and census of governments. Retrieved December 19, 2011, from http://www.census.gov/.

U.S. Bureau of Economic Analysis. (2006). Current-cost net stock of government fixed asset tables. Retrieved May 5, 2006, from http://www.bea.gov/bea/dn/FA2004/SelectTable.asp.

U.S. Bureau of Economic Analysis. (2011). Current-cost net stock of government fixed asset tables. Retrieved December 27, 2011, from http://www.bea.gov/bea/dn/FA2004/SelectTable.asp.

APPENDIX 1: RESULTS USING TRADITIONAL PANEL DATA METHODS

Table A1.1 presents the results of the estimation of equation (4) using ordinary least-squares (OLS), the two-way fixed effects model (two-way fixed), and two-stage least-squares (2SLS). The first thing that we note about the results is inconsistency in the estimates. Only the lagged value of growth is significant and with a consistent sign across all models. There are also several variable signs that are contradictory and may not be predicted by traditional economic theory. For example, the sign of the tax variable in the OLS estimation is positive and the magnitude is relatively large, and in the other specifications the variable has a negative sign and is not significantly different from zero. The coefficients of capital and operational spending estimated by the traditional specifications are also contradictory to economic theory. The coefficients of tax variables changed from positive in OLS to negative in two-way fixed effects and 2SLS. The coefficients of operational spending changed from negative in OLS and two-way fixed effects to positive in 2SLS. These changes indicate that as we are trying to solve endogeneity by using more recent methods

Table A1.1. Model results.

	OLS	Two-way fixed	2SLS
Constant	0.123***	0.440***	0.054
	(0.025)	(0.064)	(0.033)
Lag Δlny	0.121***	0.090***	0.311***
	(0.024)	(0.025)	(0.036)
Lnk	−0.010***	−0.039***	0.005
	(0.002)	(0.006)	(0.005)
Lnl	0.012	0.061***	0.015
	(0.087)	(0.014)	(0.009)
τ	0.763***	−0.115	−0.252
	(0.121)	(0.101)	(0.25)
d	−0.388***	−0.448***	0.542
	(0.085)	0.128	(0.315)
c	−0.475***	−0.710***	−0.136
	(0.098)	0.156	(0.256)
Adj. R^2	0.981	0.784	0.116
Number of observations	1,872	1,872	1,872
Number of states	48	48	48
Observation per state	39	39	39
Error term $u_{i,t}$ are correlated with regressors in fixed effects model	—	−0.7891	—
F-test that all $u_{i,t} = 0$ in fixed effects model (H0: conditional mean error is zero)	—	1.49	—
$P > F$ stat (for fixed effect)	—	0.0180	—
Number of instruments	0	0	6
Wald chi-squared	—	—	121.23
$P > \chi^2$	—	—	0.000
Sargan test statistics for instrumental validity (H0: Instruments are valid)	—	—	2.676
$P >$ c χ^2	—	—	0.444
Test of endogeneity. H0: Variables are exogenous	—	—	19.899
$P > \chi^2$	—	—	0.000

Notes: Dependent variable: First difference of log personal income. For the 2SLS model, instrumental variables for taxes, operational and capital expenditure included state poverty rate, percentage of population aged 65 and over, percentage of population aged 18 and under, percentage of legislative seats held by the Democratic Party, and a dummy variable for the governor being from the Democratic Party.

Table A1.2. Endogeneity test for OLS model.

Variable	χ^2	*df*	*P*-value
Lag Δ lny	0.78	1	1.000
τ	4.98	1	0.154
d	122.59	1	0.000
c	259.58	1	0.000
Lnk	92.97	1	0.000
Lnl	58.30	1	0.000

Note: Szroeter's (1978) rank test for null hypothesis that variance of error term is unrelated to each variable. Null hypothesis: Variance error is not related to independent variable. Alternative Hypothesis: Variance error is related to independent variable.

Table A1.3. Endogeneity test for 2SLS model.

Variable*	Coefficients	Standard error	*P*-value
Lag Δ ln *y*	−0.113***	0.028	0.000
τ	0.333***	0.081	0.000
d	−0.730***	0.132	0.000
c	−0.139***	0.016	0.000
Ln *k*	−0.006	0.004	0.193
Ln *l*	−0.020**	0.008	0.023

Note: Dependent variable: 2SLS residuals. Joint significance test for endogenous variables, Lag Δ ln *y*, τ, *d*, *c*: *F*-statistics: 10.79, $P > \text{F} = 0.0000$.

(i.e., from OLS to fixed effects and from fixed effects to 2SLS), the coefficients of key variables are changing toward the expected signs.

The R^2 goodness-of-fit measure for the OLS model also seems unreasonably high (0.981), indicating possible violations of regression assumptions. As present in row 14 of the two-way fixed column, the correlation coefficient of the error terms in this fixed effects model is relatively large (−0.789) and negative indicating that the coefficients of the variables in the fixed effects model are biased upward due to large negative correlations in the model's residuals. The last column of the table presents the results of two-stage least-squares (2SLS). In this column, the Sargan test statistic (2.676, $P = 0.444$) and the test of endogeneity (19.899, $P = 0.000$) indicate that the instrumental variables are valid and that the model variables are endogenous. However, Table A1.3 indicates that the endogeneity problem is not alleviated by 2SLS.

Table A1.2 presents an endogeneity test for the OLS results shown in Table A1.1 above. We used Szroeter's (1978) rank test, which calculates chi-square statistics to determine whether the OLS residuals are correlated with each independent variables. As shown in the last column, the OLS residuals statistically correlate with all independent variables in the model except lagged growth rate and tax rate variables. Thus, OLS does not acceptably solve the endogeneity problem.

Table A1.3 presents similar results for the correlation of 2SLS residuals obtained from Table A1.1 and the 2SLS model's independent variables. As presented in the table, the 2SLS residuals statistically correlate with all independent variables except private stock, indicating that the 2SLS model does not satisfactorily mitigate the endogeneity problem.

APPENDIX 2: PVAR RESULTS FOR A 1 STANDARD DEVIATION SHOCK

Table A2.1. Response of per capita personal income to one standard deviation shock in fiscal policies.

Change in log y/period	t	$t+1$	$t+2$	$t+3$	$t+4$	$t+5$	Cumulative effect
$\Delta \ln y$	−0.23	−0.30**	−0.16**	−0.07	−0.02	0.00	3.25
τ	−0.39**	−0.20**	−0.06	0.02	0.08	0.11	−0.59
d	0.67**	0.52**	0.40**	0.34**	0.31**	0.30**	2.54
c	0.57**	0.34**	0.16**	0.06	0.00	−0.03	1.07
$\ln k$	−0.63**	−0.55**	−0.47**	−0.42**	−0.39**	−0.38**	−2.84
$\ln l$	0.23**	0.22**	0.19**	0.18**	0.17**	0.16**	1.15
Net effect, fiscal variables	0.85	0.66	0.56	0.34	0.31	0.3	3.02
Net effect, all variables	0.45	0.03	0.12	0.1	0.09	0.08	4.58

APPENDIX 3: EFFECTS OF FISCAL POLICIES EXPRESSED IN REAL-DOLLAR VALUES

Table A3.1 presents the results of our estimation in real-dollar-value terms. The results are calculated using the change of real per capita income from its sample mean ($31,714) and the standard deviation for each of the fiscal policies in real per capita dollar terms as presented in the first column of the table.

Table A3.1. Calculated changes in real per capita personal income (in dollars).

Change in variable/lag	t	$t+1$	$t+2$	$t+3$	$t+4$	$t+5$	Cumulative change
Standard deviation increase in per capita real personal income ($920/person)	0	−95	−51	0	0	0	−146
Standard deviation increase in per capita tax to personal income ($412/person)	−124	−63	0	0	0	0	−187
Standard deviation increase in per capita operational spending to personal income ($793/person)	213	165	127	108	98	95	806
Standard deviation increase in per capita capital spending to personal income ($254/person)	181	108	51	0	0	0	340
Standard deviation increase in per capita private stock to personal income ($6,026/person)	−200	−174	−149	−133	−124	−121	−901
Standard deviation increase in number of labor to total population (345,218)	69	69	69	69	69	35	380
Net change in real $, fiscal variables only	270	210	178	108	98	95	958
Net change in real $, all fiscal and nonfiscal variables	139	9	47	44	44	9	1,468

Note: Real per capita income is $31,714 per person from the sample mean of 48 states across the 41-year sample period (base year = 2000).

APPENDIX 4: ROBUSTNESS CHECKS

Table A4.1. Response of per capita personal income to one standard deviation shock in fiscal policies (various variable orderings).

Change in ln *y*/period	*t*	*t* + 1	*t* + 2	*t* + 3	*t* + 4	*t* + 5
Δln *y*	0.05	−0.36	−0.25	−0.13	−0.07	−0.04
c	0.48**	0.32**	0.14**	0.02	−0.03	−0.06
d	0.58**	0.49**	0.37**	0.30**	0.28**	0.27**
τ	−0.24**	−0.12	−0.01	0.06	0.09	0.11
ln *k*	−0.55**	0.53**	−0.45**	−0.39**	0.36**	−0.34**
ln *l*	0.19**	0.21**	0.20**	0.19**	0.17**	0.15**
Δln *y*	0.05	−0.36	−0.25	−0.13	−0.07	−0.04
d	0.56**	0.47**	0.36**	0.3**	0.28**	0.28**
c	0.51**	0.34**	0.16**	0.04	−0.02	0.05
τ	−0.24	−0.12	0.01	0.06	0.09	0.11
ln *k*	−0.55	−0.53	−0.45	−0.39	−0.36	−0.34
ln *l*	0.19**	0.21**	0.20**	0.19**	0.17**	0.15**
Δln *y*	0.05	−0.36	−0.25	−0.13	−0.07	−0.04
τ	−0.11	−0.2	−0.2	0.1	0.12	0.14
c	0.49**	0.32**	0.14**	0.03**	−0.03	−0.07
d	0.61**	0.5	0.36	0.28	0.26	0.25
ln *k*	−0.55	−0.53	−0.45	−0.39	−0.36	−0.34
ln *l*	0.19	0.21	0.2	0.19	0.17	0.15
Δln *y*	0.05	−0.36	−0.25	−0.13	−0.07	−0.04
τ	−0.11	−0.2	−0.2	0.1	0.12	0.14
d	0.59**	0.48	0.36	0.28	0.26	0.25
c	0.51**	0.35**	0.16**	0.04**	−0.03	−0.07
ln *k*	−0.55	−0.53	−0.45	−0.39	−0.36	−0.34
ln *l*	0.19	0.21	0.2	0.19	0.17	0.15

Note: Variable ordering according to position in table. **indicates the point estimated response that does not include the zero value in the 95 percent confidence interval.

Table A4.2. Response of per capita personal income to one standard deviation shock in fiscal policies for sample of 44 states.

Change in ln *y*/period	*t*	*t* + 1	*t* + 2	*t* + 3	*t* + 4	*t* + 5
Δln *y*	0.10	−0.52**	−0.38**	−0.19	−0.07	−0.03
τ	−0.41**	−0.26**	−0.08	0.03	0.08	0.10
d	0.70**	0.58**	0.39**	0.30**	0.28**	0.24**
c	0.49**	0.35**	0.17**	0.04	−0.02	−0.05
ln *k*	−0.55**	0.55**	−0.44**	−0.36**	−0.32**	−0.30**
ln *l*	0.14**	0.19**	0.19**	0.18**	0.16**	0.15**

Note: The following states were excluded: Nebraska, Minnesota, South Dakota, Wyoming, Hawaii, and Alaska.

APPENDIX 5: DATA OPERATIONALIZATION AND BALANCED BUDGET RESTRICTION

Table A5 presents the operationalization for the fiscal variable concepts used in the analysis. As shown in the table, all of the budget items reported in the U.S. Census Bureau's Annual Survey of State-Local Government Finance Statistics are incorporated in the theoretical and testing models, thereby creating a balanced budget restriction.

Table A5. Operationalization of fiscal variables in the estimating model.

Variable as shown in equation (4)	Variable definition	Operationalization for state-local governments' budgets as reported by U.S. Census
$\tau_{t,i}$	Total taxes	• Individual income tax • Corporation net income tax • Sales taxes • Property taxes • License taxes
$or_{t,i}$	Other revenue including nontax revenue and intergovernmental revenue (omitted	• Miscellaneous general revenue • Death and gifts • Severance • Documentary and stock transfers • Other taxes • Liquor store revenue • Utility revenue • Total intergovernmental revenue
$c_{t,i}$	Total capital spending expenditure	Total current capital spending on • education • health, hospital and human services, highways • housing • public safety • community development
$d_{t,i}$	Total operational spending including current spending, transfer payment, social securities, and welfare expenditure	Total current operational spending on • education • health, hospital and human services, highways • housing • public safety • community development Total transfers payment and income securities • public welfare • employment securities administration insurance trust expenditure • Veteran's services
$oex_{t,i}$	Other expenditures (omitted)	Current spending on • liquor store expenditure • utility expenditure • government administration • financial administration • general control • general public buildings • other and allocable expenditures • debt services and interests • total intergovernmental expenditure