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# Debt and Nonlinear Fiscal Policy: Evidence from the States

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## **Abstract**

Evidence from a half century of experience by states identifies nonlinearities in the effects of debt and fiscal policy on growth. Effects are Keynesian for low to moderate levels of debt and stimulus but anti Keynesian for sufficiently high levels of debt or stimulus. Results are broadly consistent with models by Barro (1999), Judd (1987), and others.

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## **Introduction**

Burgeoning levels of national debt, the ‘Great Recession’ and the largest peacetime fiscal stimulus in U.S. history have spurred intense interest in whether debt reduces the effectiveness of fiscal stimulus, and in particular, whether or not the effects of fiscal stimulus can be non Keynesian. Based on a half century of evidence from states, this study extends recent cross-national investigations by Reinhart and Rogoff (2010, 2011) and others. We pursue answers to three questions: 1) Does the effect of fiscal stimulus depend on the initial stock of government debt, as suggested by Judd (1987) and others? 2) Do the effects depend on the magnitude of the stimulus? 3) Even when borrowing finances spending on education and public infrastructure does the effect of stimulus decline and eventually turns negative as the level of debt rises?

### **Why Nonlinearities?**

Why might we expect nonlinear effects for fiscal policy implicit in our questions? For the first question, Judd (1987) extends the Barro (1989) model of endogenous growth to demonstrate that effects of fiscal stimulus can be either Ricardian or Keynesian, depending in part on the level of outstanding debt. For questions two and three, the Barro (1989) model predicts nonlinearities that arise from the decreasing returns and increasing opportunity cost of investments in public capital. Evidence of Barro-type nonlinearities are reported, for example, in Bania *et al* (2007). For question 2, one might also expect nonlinearity for practical reasons related to difficulties in spending a large amount of funds in productive ways in a limited amount of time. Of course, in a purely Keynesian context, how funds are spent is a secondary issue.

## **Why States?**

Sub national states of a large country offer several attributes useful in identifying nonlinear effects of fiscal policy. For example, they i) often provide substantial variation needed to identify nonlinearities, while ii) also sharing similar legal and political systems; and iii) are small economies subsumed within a large common currency area. These attributes make them a useful quasi-experimental environment in which to study the effects of fiscal policy. Even so, some attributes also limit the extent to which results can be applied in other contexts. For example, states share well-integrated, highly mobile markets for capital and labor; are not able to monetize their debt; and all but one state (Vermont) has some form of constitutional limitation on deficits.

## **Data and Empirical Specification**

We rely on data for 49 states at five-year intervals over the half century from 1957 to 2007. We omit Alaska due to the dominance of the Alaska pipeline and the consequent outlying variances in fiscal variables relative to other states. Five-year interval data allows a longer observation period than the available higher-frequency annual data, which for state and local public expenditures only begins in 1977, and has the advantage of increased power to identify middle-frequency factors related to non-cyclical, intermediate-run variations in growth.

The data for state and local government fiscal variables are taken from the Census of Governments. Related economic, demographic, and other data for corresponding years are from the Bureau of Labor Statistics or the Department of Commerce (for personal income). Table 1 reports summary statistics for the 441 observations of the five-year-interval data used to estimate equation (1).

Our baseline regression equation for the log-change in real personal income in a state is expressed by equation (1) below. We rely on a difference-in-differences empirical specification with fixed state and period effects. Thus, the specification incorporates state-specific trends for growth and period-specific effects common to all states. To address simultaneity issues, we rely on a recursive structure, with beginning-of-period predetermined explanatory variables, including the initial state unemployment rate to account for state-level cyclical influences.

$$(1) \quad y_{it} = c + c_i + c_t + b_1 d_{i(t-1)} + b_2 d_{i(t-1)}^2 + b_3 D_{i(t-1)} + b_4 D_{i(t-1)} * d_{i(t-1)} + b_5 D_{i(t-1)}^2 + BZ_{it-1} + e_{it}$$

$y_{it}$  is growth, the log-change in real personal income per capita for state  $i$  in period  $t$ ;  $c$  is a fixed intercept,  $c_i$  is a state-specific intercept common to all periods, and  $c_t$  is a period-specific intercept common to all states;  $d$  and  $D$ , respectively, are the budget deficit and outstanding debt<sup>1</sup>;  $b_s$  are coefficients for the deficit and debt variables;  $B$  is a vector of coefficients for other components of the government budget constraint, denoted by  $Z$ ; and  $e_{it}$  is a random error unique to state  $i$  in period  $t$ . All fiscal variables are expressed as percentage points of state personal income.

To account for the government budget constraint in period  $t-1$ , we include the lagged deficit and debt variables, taxes in quadratic form, and omit one element, a general cross section of expenditures and revenues not already explicitly included, such as health, welfare, education, public infrastructure, fee revenue, and federal transfers.. Hence, for linear effects, a change in any explicitly included expenditure category, requires a compensating change in an omitted category. In theoretical terms, eliminating a budget category introduces the budget constraint into

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<sup>1</sup> To avoid negative numbers for the deficit, we subtract the largest state deficit in the sample from each state's deficit, so that changes are relative to the most negative deficit.

the model, as in Barro (1989). Empirically, it avoids linear dependence among elements of the government budget constraint, as discussed in Mofidi and Stone (1990) and Bania et al. (2007).

We also incorporate a number of other control variables, including the lagged unemployment rate to account for cyclical variations, and contemporaneous federal transfers to the state (fed) to account for contemporaneous external revenue transfers.<sup>3</sup> Both the common period effects and the unemployment rate help to limit any significant autocorrelation in the residual errors, a condition necessary for the recursive identification structure to yield unbiased estimates. To gauge robustness of our primary estimates, we also include an index of the strictness of the state's constitutional budget limitations as an interaction with the deficit in estimates not reported here.<sup>4</sup>

## Results

Table 2 reports our primary estimates for the growth equation (1). The overall fit of the equation (an R-squared of 0.51) is strong for a difference equation with so little autocorrelation.

### *Fiscal terms*

The linear coefficients for deficit and debt are both Keynesian (i.e., significantly positive), but their quadratic terms are both negative, so that the linear effects are less Keynesian as the levels of stimulus and debt rise. The same is true for the significantly negative interaction between debt and the deficit. Consistent with Barro (1989) and results in Bania et al. (2007), the tax coefficients also exhibit positive linear and negative quadratic effects. Results for other fiscal variables are not of immediate interest, but are also consistent with results in Bania et al. (2007).

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<sup>3</sup> The contemporaneous budget constraint implies that a change in external revenues is offset by a compensating change in either expenditures or revenue

<sup>4</sup> The index was constructed by ACIR, the American Council on Intergovernmental Relations. ACIR (2006). Estimates are available by request from the author.

### *Robustness*

The estimates in Table 2 are not qualitatively sensitive to several alternative specifications, including controls for either the current or lagged state-level unemployment rate or for a measure of the restrictiveness of constitutional budget limitations and its interaction with our deficit measure of fiscal stimulus. In addition, tests of Granger causality yield equivalent results for the fiscal variables, including the negative interaction between debt and the deficit. Results are sensitive to omitting either the state or period fixed effects.

### **Discussion**

The pattern of coefficients for the deficit, debt, and their interaction identifies nonlinearities in the effects of fiscal policy. Effects are Keynesian for low levels of debt and moderate amounts of stimulus but anti Keynesian for sufficiently high levels of debt or stimulus.

Are these patterns relevant within the sample range of our data? At the sample minimum (near-zero) values of the deficit and debt, the marginal effects of the two are significantly positive and 'Keynesian.' At their median values however, the marginal effects are zero or near zero and 'non Keynesian.' Even more starkly, the marginal effects are negative and 'anti Keynesian' at the maximum sample values of the deficit and debt. Results based on evidence from sub national states are limited in their relevance to conclusions about effects of national policies. Even so, the nonlinearities found here are broadly consistent with theoretical results in Judd (1987) and Barro (1999). They are also broadly consistent with empirical results in Rogoff and Reinhart (2009, 2010) and Adam and Beevan (2011), though at moderate levels of debt and stimulus our results are less optimistic for Keynesian fiscal policy. Non-Keynesian effects emerge at well under the

ratio of debt to income found in Rogoff and Reinhart – i.e., at roughly 40%, less than half the Rogoff-Reinhart debt-income ratio of 90%. But at low levels of stimulus, our results are consistent with theirs; non Keynesian effects don't emerge until a debt-income ratio of 90 to 100% is reached, roughly equivalent to the Rogoff-Reinhart ratio for the emergence of non-Keynesian effects.



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**Table 1.** Summary Statistics (49 states, 1957-2007)

	GROWTH	DEFICIT	DEBT	TAXES	FED	OTHER	UR
Mean	12.09696	8.33101	17.27186	10.07454	3.56646	3.46196	5.93001
Median	11.39058	8.32130	16.62510	10.01384	3.36572	3.24844	5.58333
Maximum	30.14108	11.59415	42.69089	17.74776	7.67741	8.40369	15.45000
Minimum	-9.92664	-0.00041	4.52034	7.13326	0.91310	1.28115	2.00000
Std. Dev.	5.55975	0.99403	5.61312	1.32966	1.26775	1.26555	2.10587
# Obs.	441	441	441	441	441	441	441

Note: See text for description of data and variables.

**Table 2.** Growth and Fiscal Policy Estimates (49 states, 1957-2007)

Variable	Coefficient	Robust s. e.	t-Statistic	Prob.
C/c	-1.12033	0.01889	-5.93013	0.0000
DEFICIT(-1)	8.43557	1.90326	4.43217	0.0000
DEFICIT(-1)^2	-0.40362	0.10433	-3.86868	0.0001
DEBT(-1)	1.09612	0.41823	2.62085	0.0091
DEBT(-1)^2	-0.00880	0.00505	-1.74050	0.0826
DEFICIT(-1)*DEBT(-1)	-0.08477	0.04120	-2.05733	0.0404
TAXES(-1)	4.22053	1.72668	2.44431	0.0150
TAXES(-1)^2	-0.14133	0.08179	-1.72785	0.0848
FED(-1)	2.12859	0.50375	4.22549	0.0000
OTHER(-1)	-1.31311	0.53678	-2.44628	0.0149
Other controls	yes			
Period effects	yes			
State effects	yes			
R-squared	0.51222			
Adjusted R-squared	0.42281			
S.E. of regression	4.21929			
Sum squared resid	6604.703			
Durbin-Watson stat	2.51165			
Number of obs.	440			