

**Taxes, Government Expenditures, and State Economic Growth:  
The Role of Nonlinearities**

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June 2006

v1.5

Abstract

Barro's (1990) model of endogenous growth implies that economic growth will initially rise with an increase in taxes directed toward "productive" expenditures (e.g., education, highways, and streets), but will subsequently decline. Previous tests of the model, including Barro (1989, 1990) and recently Bleaney *et al* (2001), focus on whether the *linear* incremental effect of taxes is positive, negative, or zero, with substantial evidence for all three conclusions. In this study, we test for nonlinearity directly by incorporating nonlinear effects for taxes, and based on U.S. states find that the incremental effect of taxes directed toward productive government expenditures is initially positive, but eventually declines. U.S. states on average appear to under invest in expenditures on productive government activities.

## 1. Introduction.

Do taxes and government expenditures enhance or impede economic growth? This question lies at the heart of public finance and taxation policy, both at the national and sub-national levels. In an extensive summary of empirical studies of the effects of taxes on economic growth, Poot (2000) finds that most estimates are either insignificant or negative, though a small number are positive. Similarly, estimates of the effects of government investment expenditures on economic growth also tend to be insignificant, though a few studies find positive effects, particularly for expenditures on education and human capital.

Recently, Bleaney *et al.* (2001) test a Barro (1990) style endogenous growth model for OECD countries over the period 1970-95, extending tests in earlier Barro (1989, 1990) cross-country studies. Based on a full specification of the government budget constraint, including distinctions between productive and nonproductive government expenditures, their results are consistent with the endogenous growth model, in that taxes reduce the *long-run* growth rate and productive government expenditures increase it, all else the same.

While the studies surveyed by Poot and the recent Bleaney *et al* study are based primarily on cross-country data, there are also a number of cross-state (or cross-county) studies for the United States, including for example Helms (1985), Mofidi and Stone (1990), and more recently, Mark *et al* (2000) and Holcombe and Lacombe (2004). Helms and Mofidi-Stone find that taxes spent on “productive” government investments tend to enhance growth, while Holcombe-Lacombe and Mark *et al* find that increases in taxes tend to impede growth. Which conclusion is correct?

Ironically, the Barro-style model of endogenous growth (e.g., Barro 1990) suggests that all could be right, depending on the level of taxes, composition of expenditures, and other factors. In Barro's model, increases in taxes can enhance, have no effect on, or impede growth depending, in particular, on the initial level of taxes and how the tax revenues are spent. For example, an incremental dollar of tax revenue spent on productive government services has a much more positive effect on growth in the Barro model when taxes are initially low than when they are already high.

Surprisingly, no study, at least to our knowledge, has attempted to disentangle the nonlinearities predicted for the effects of taxes on economic growth.<sup>1</sup> This is the task we set out for ourselves in this paper. Relying on data for 49 of the 50 U.S. states (Alaska is excluded), our results enable us not only to reconcile some of the conflicting findings of positive, insignificant, or negative effects from other studies, but also to assess the extent to which U.S. states have tax and expenditure structures conducive to economic growth.

We argue that a well-specified examination of the long-term effects of state and local taxes and expenditures on the growth in state per capita income requires, at a minimum, that: i) the nonlinearities inherent in Barro-style models of endogenous growth be incorporated; ii) the government budget constraint be fully specified, i.e., all revenues, expenditures and deficits/surpluses be specified, explicitly or implicitly, since the effect of an additional dollar of tax revenue presumably will vary depending on what it is used for (Helms 1985, Mofidi-Stone 1990); iii) unobserved differences across states, which are likely to be correlated with both the dependent and independent variables, be accounted for (Mofidi-Stone 1990, Mark *et al* 2000); and iv) the period of analysis be

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<sup>1</sup> Aschauer (1997) and Kalaitzidakis and Kalyvitis (2005) incorporate nonlinear effects for public capital, but not taxes.

sufficiently long and the dynamics adequately specified to ensure that steady-state effects are identified separately from shorter term, cyclical effects (Mofidi-Stone 1990, Bleaney *et al* 2001, and Gray and Stone 2006).

Our findings suggest, consistent with Barro-style models, that increases in taxes spent on public infrastructure and other productive investments increase the growth rate of state real personal income per capita, but at a declining rate, so that the impact of taxes depends both on where they are spent, as well as on the initial level of taxes. We also provide empirical assessments of the extent to which state and local taxes and corresponding public investments are optimal, too low, or too high in terms of growth in state real personal income per capita.

In section 2, we set out the theoretical context for our empirical specifications, and describe the data we use and the estimation strategies we employ in section 3. In section 4, we present the empirical estimates, along with a number robustness tests. In section 5, we assess the implications of the nonlinear tax effects for whether or not tax and expenditure structures are conducive to economic growth. In a final section, section 6, we summarize our findings and offer some suggestions for future directions.

## **2. Theoretical background**

Unlike the neoclassical growth model, where fiscal effects alter the *level* of the long-run output path, the endogenous growth model permits fiscal effects to alter the *slope* of the long-run output path, as illustrated for example in Barro (1990). Here, we employ an adaptation of the Bleaney *et al.*(2001) presentation of the Barro and Sala-i-Martin (1992, 1995) model of endogenous growth. This adaptation is also used in Gray

and Stone (2006) to examine the issue of Ricardian equivalence for sub-national states.

There are  $n$  producers, each producing output ( $y$ ) according to the production function:

$$y = Ak^{(1-a)}g^a \quad (1)$$

where  $A$  is a positive constant,  $k$  is private capital,  $g$  is a publicly provided input, and  $a$  is a parameter between 0 and 1. The government funds its budget in each period with a proportional tax on output at the rate  $r$  or an equivalent amount of borrowing ( $-b$ ), where  $b$  is the budget surplus. For current purposes, we approximate all state and local taxes as a proportional tax.<sup>2</sup> The government budget constraint is therefore:

$$ng + C + b = rny \quad (2)$$

where  $C$  is government-provided consumption (or “non-productive”) goods.

Barro and Sala-i-Martin show that with an isoelastic utility function the long-run growth rate in this model ( $V$ ) can be expressed as:

$$V = w(1-r)(1-a)A^{1/(1-a)}(g/y)^{a/(1-a)} - u \quad (3)$$

where  $w$  and  $u$  are constants reflecting parameters in the utility function.

Equations (2) and (3) together are typically used to motivate a static or dynamic *linear* regression equation, despite the nonlinearity of eq. (3). Here, however, we specify the potentially nonlinear effects of taxes arising from the Barro model by incorporating both a linear and a quadratic term for taxes in our regression equation, i.e., by including both  $r$  and  $r^2$ .

One avoids perfect multicollinearity in such a regression by omitting at least one element of equation (2), the linear government budget constraint, from the estimating

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<sup>2</sup> Bleaney *et al.* distinguish between distortionary and nondistortionary taxes, whereas here, for simplicity, we treat all state and local taxes as distortionary. Kneller *et al.* (1999) find that results tend not to be sensitive to distinctions in the definitions of distortionary versus nondistortionary taxes.

equation (c.f., Helms 1985 and Mofidi and Stone 1990). In this case, coefficients on the remaining elements are interpreted as the net effect of simultaneous unit changes in the relevant variable and in the omitted variable (or a combination of omitted variables, if more than one is omitted), as implied by equation (2).

To illustrate, assume that only productive government expenditures ( $g$ ) are omitted, consistent with the theoretical specification in Barro (1990), as in the static equation below:

$$V = T_0 + T_1 r + T_2 r^2 + T_3 (b/ny) + T_4 (C/ny) + T_5 z + e \quad (4)$$

The  $T$ 's represent fixed coefficients,  $z$  represents an auxiliary control variable (or set of variables), and  $e$  represents a stochastic term. The state fiscal variables are all scaled to output to permit direct comparisons of the coefficients.<sup>3</sup>

Consistent with the Barro model, the linear coefficient on taxes ( $r$ ) should be positive, since an increase in taxes is implicitly spent on productive government expenditures, while the quadratic coefficient on  $r^2$  should be negative, since it reflects the decreasing contribution of higher taxes and productive government expenditures to economic growth. The positive linear effect dominates when government is small, while the negative quadratic effect dominates when government is large. The coefficient on the budget surplus relative to output ( $b/ny$ ) should be negative, since an increase in the budget surplus is implicitly taken from productive government expenditures.<sup>4</sup> The coefficient on nonproductive expenditures relative to output ( $C/ny$ ) should be negative,

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<sup>3</sup> We focus only on the nonlinear tax effects (and implicitly the nonlinear effects of productive governmental expenditures) and ignore nonlinearities in the relatively small budget surplus or deficit and nonproductive government expenditures, since estimates of coefficients for the latter are insignificant.

<sup>4</sup> Bleaney *et al* typically exclude nonproductive not productive expenditures, so the expected coefficient on taxes in their specifications is negative, rather than positive. The two specifications are fully equivalent and can be mapped one to the other.

all else the same, as it reflects the effect of a unit shift of expenditures from productive to nonproductive government expenditures.

### **3. Data and Empirical Methodology**

Our measure of  $V$ , the dependent variable, is GROWTH, the (log) growth in state real personal income per capita.<sup>5</sup> The key fiscal variables are TAX, the ratio of all state and local taxes and related revenues to state personal income, TAXSQ, the square of TAX, SURPLUS, the ratio of the state budget surplus to state personal income, H&W, the ratio of health, welfare, and other transfer payment expenditures in the state to state personal income, and PROD, the corresponding ratio of productive government expenditures to state personal income. PROD includes expenditures on highways, education, and other related expenditures.

In addition, we employ a number of state-level time-varying controls in various specifications, including the ratio of unemployment insurance (UI) expenditures to state personal income, the unemployment rate, the proportion of the population age 18 to 64, and the proportion of union members in the labor force.<sup>6</sup> We find, as in Bleaney *et al*, that two-way fixed effects for both country (in our case, state) and period are important, so all specifications include two-way fixed effects.

Our data for state fiscal variables and unemployment insurance expenditures are from the Census of Governments at five year intervals from 1962 through 1997.<sup>7</sup> Related economic, demographic and other data for corresponding years are obtained from the

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<sup>5</sup> Ideally, one would use real gross state product per capita, but this series does not extend back as far.

<sup>6</sup> Consistent with other studies (e.g., Helms 1985 and Mofidi-Stone 1990), we treat UI expenditures as outside regular fiscal structure of state and local governments, in part because it is largely driven federally.

<sup>7</sup> The first of the U.S. Census of Governments surveys in our sample is actually for 1963, but our other data are aligned with 1962 to be consistent throughout with the subsequent five-year intervals for the Census of Governments.

Current Population Reports for age composition of state population, from the Bureau of Labor Statistics for the state unemployment rate, from Hirsch *et al.* (2001) for the proportion of nonagricultural wage and salary employees in the state who are union members, and the Department of Commerce for state real personal income per capita.<sup>8</sup> We exclude Alaska, since the variance in its state fiscal variables is extreme relative to the other 49 states, due in part to the Alaska pipeline.

Thus, we have data for 49 states at five-year intervals from 1962 to 1997, a total of 392 cross-section, time-series observations. Only 343 observations are available for use in the estimations, since the calculation of lags requires an initial year of data. Annual data are available consistently at the state level only beginning in the 1970s, so we focus on the longer sample period, based on five-year intervals, to better identify long-run effects.

Table I presents summary statistics for our key dependent and explanatory variables: GROWTH, TAX, TAXSQ, SURPLUS, H&W, and PROD. The latter two are our measures of nonproductive and productive government expenditures, respectively. Note that PROD necessarily equals the difference between TAX, on the one hand, and SURPLUS and H&W, on the other. The average value for GROWTH for the *five-year* data interval is approximately 13%, roughly 2.5% per annum. The average ratio for TAX is about 17.4%, which consists of 0.3% for SURPLUS, 3.3% for H&W, and 13.8% for PROD.

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<sup>8</sup> Use of personal income, rather than gross state product, enables us to extend our sample period as far back as 1962, when state fiscal variables are also available, but at this writing, we do not yet have fully complete data more recent than 1997. Union density estimates by state were “backcast” for 1962 based upon proximate data by state and national data for union density.



We take the following approach in specifying the dynamics for the growth equation. First, we assume *a priori* that the current five-year growth rate is unaffected by contemporaneous fiscal variables, but is a function of the fiscal variables from the previous five-year period. Thus, for example, real personal income growth per capita between 1962 and 1967 may be influenced by the values of TAX, TAXSQ, SURPLUS, and H&W in 1962, but is unaffected by the values of these variables in 1967. Mofidi and Stone (1990) successfully employ this recursive approach for five-year data for states. Bleaney *et al.*(2001) find evidence of slightly longer adjustment for OECD countries, about eight years, so we test for the significance of effects of additional lags of the fiscal variables.

In addition, we explore the sensitivity of our results to the explicit inclusion of a lagged dependent variable and instrumental variable methods. Dynamic fixed-effects models can generate biased and/or inefficient parameter estimates arising from the (explicit or implicit) presence of the lagged dependent variable. In our case, the number of periods is well below the number of states included, so the Arellano-Bond style generalized method of moment (GMM) estimates are appropriate. The GMM estimator uses (first-differenced or orthogonalized) lagged values of the dependent variable and the exogenous regressors as instruments.

#### **4. Regression & GMM Results**

Table II presents various regression and GMM instrumental variable estimates for our equation for GROWTH, which again is the log-change in state real personal income per capita (times 100). For all estimates, the fiscal variable in the government budget constraint omitted from the estimated equation is PROD, the ratio of state and local

expenditures on highways, education, and other related items to personal income per capita (times 100). Hence, our model predicts a positive coefficient on TAX, a negative coefficient on TAXSQ, a negative coefficient on SURPLUS, and a negative coefficient on H&W – since these reflect the net effect of simultaneous unit changes in the relevant regressor and the omitted variable PROD, productive government expenditures.

Column (1) of Table II presents a baseline specification with lagged TAX, SURPLUS, and H & W as regressors and two-way fixed effects for period and state, but without the inclusion of the nonlinear effect of TAXSQ. We also include lagged auxiliary controls at the state level to control for potentially confounding effects, especially short-term cyclical influences. The auxiliary variables added are lagged values for the ratio of unemployment expenditures to state personal income per capita, the unemployment rate, the percentage of the working age (18-64) population, and the percentage of union membership in the labor force. Coefficients for these controls are omitted in the tables for brevity. These coefficients enter significantly at the five percent level, but have little effect on the coefficients of the state fiscal variables. Robust (panel corrected) standard errors are in parentheses, which correct for heteroskedasticity, autocorrelation, and contemporaneous correlations.<sup>9</sup>

As predicted by the endogenous growth model, the coefficient on TAX(-1) (0.867) is significantly positive at the five percent level, and the coefficient on SURPLUS(-1) (-1.138) is significantly negative. While the coefficient on H&W(-1) (-0.553) is negative, it is not significantly so. Overall, the fit of the equation (R-squared of 0.464) is relatively good for a growth equation with no lagged dependent variable.

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<sup>9</sup> Estimations are performed in EViews 5.1. The robust standard errors, in this case Period SUR, are described in *EViews 5: User's Guide* (2004, p. 887).

Taken at face value, these estimates suggest that increases in taxes spent on productive government expenditures will increase growth in state real personal income per capita income, regardless of the initial level of taxes.

We should note at this point that negative, insignificant, or positive effects of taxes are easily induced in alternative specifications of column (1), depending on which expenditure category is omitted and on whether period and state fixed effects are incorporated into the specifications. In that sense, much of the mystery in conflicting estimates for the effects of taxes in previous studies may be dispelled, even without appealing to the tax nonlinearities implied by the Barro model.

Returning to our main story, though, we turn to column (2) of Table II, which now incorporates the nonlinear effect of TAXSQ(-1) predicted in the Barro model. We again find significantly positive effects for TAX(-1), with a coefficient of 2.662, but see that this positive linear effect is mitigated by a significantly negative nonlinear effect, since the coefficient for TAXSQ(-1) is -0.041. Results for other variables are similar to those in column (1). Unlike the estimates of the linear tax model in column (1), the estimates of the nonlinear tax model in column (2) indicate that the effect of increasing taxes to spend on productive government expenditures declines with the level of taxes.

In column (3) of Table II, we add contemporaneous as well as lagged values of the auxiliary control variables, which may err on the side of over-controlling for contemporaneous factors. The contemporaneous control variables (again, omitted for brevity) do enter significantly at the five percent level, but the coefficients on TAX(-1) and TAXSQ(-1) remain significantly positive (2.023) and negative (-0.024), respectively. Note that with the contemporaneous auxiliary control variables included, the coefficient

on H&W(-1) (-1.542) is now significantly negative, indicating a significant difference in the effect of increasing spending on this category at the expense of productive government activities. Of course, the objectives for expenditures on the latter are typically unrelated to economic growth, but the negative coefficient in column (3) highlights the potential tradeoff in terms of growth.

In column (4) of Table II, we add the lagged value of the dependent variable (i.e., GROWTH(-1)) and present estimates based upon the Arellano-Bond GMM instrumental variables estimator.<sup>10</sup> This estimator uses appropriately lagged values of the dependent variable and of the other regressors as instruments, so it is appropriate only when the number of periods is small relative to the number of cross-sectional units. While the coefficient on the lagged dependent variable is significantly negative, as expected, it is relatively small (-0.198), and the TAX(-1) and TAXSQ(-1) coefficients, again, remain significantly positive (2.009) and negative (-0.032), respectively. Near the bottom of the table, the J-statistic (31.815) for the validity of the over-identifying restrictions fails to reject their validity at the five percent level ( $p=.449$ ).

In other results (not presented here), we explore two robustness tests of our results. First, we add second-period lags of the fiscal variables (i.e., TAX, TAXSQ, SURPLUS, and H&W) to specifications in columns (1) through (3), which do not enter significantly at the five percent level. Hence, the dynamics do not appear to extend significantly out to 10 years. Next, we explore the sensitivity of the results in all four columns to the definitional relationship between the lagged personal income variable implicit in GROWTH and in the denominator of the lagged fiscal variables. To do this,

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<sup>10</sup> GMM estimates are obtained using E-Views 5.1, with fixed period effects, an orthogonal transformation for cross-section effects, and robust Period SUR standard errors.

we omit the first period lag and add instead the second-period lags of the fiscal variables. These now enter significantly, in the absence of the first-period lags, and their coefficients are only marginally smaller in absolute value than those for the first period lags. Hence, spurious definitional correlations between the measures of GROWTH and the lagged fiscal variables appear modest.

### **5. Assessing nonlinear tax effects**

Our key result is that the incremental effect of taxes directed toward productive government activities and investments is initially positive, but eventually declines with the level of taxes. This conclusion is directly consistent with the Barro (1990) model, where Barro explains (1990, pp. S123-4) that if governments increase taxes close to the level of maximal growth, then growth rates and tax (or productive public expenditure) shares would evidence little or no correlation, but would show a positive (or negative) correlation if governments are choose too little (or too much) of productive public services, relative to the maximum growth rate. In the Barro (1990) model, the maximum growth rate also corresponds to the relevant welfare maximum along a balanced growth path, but Barro and others have noted factors that can disrupt this correspondence (e.g., Greiner and Hanusch 1998).

In any event, the level of tax and productive public expenditure shares relative to the maximum growth rate provides a useful benchmark. We can examine this question in the context of our results by noting that the partial derivative of eq. (4) with respect to  $r$  is  $T_1 + 2T_2 r$ . This derivative, the incremental effect of an increase in  $r$  (the tax share directed toward productive government expenditures) is positive (or negative) if, relative

to maximum growth, taxes directed toward productive public expenditures are too low (or too high), but is zero if consistent with maximum growth.

The maximum growth value of  $r$  if directed toward productive government expenditures is  $(-T_1/2T_2)$ , i.e., where  $T_1 + 2T_2 r$  is zero. The point estimate for  $(-T_1/2T_2)$  in the column (4) specification is 30.908.<sup>11</sup> Evaluating the expression  $(T_1 + 2T_2 r)$  at the sample mean for  $r$  of 17.422 yields a significantly positive estimate of 0.877 (p value=0.002). This estimate suggests that on average over the sample period, tax expenditures on productive public services were significantly below the level consistent with maximum state growth. At two standard deviations above the mean of 17.422 (or 23.396), the estimate of the incremental effect of  $r$  declines to 0.489 (p value = 0.058), which is no longer significantly positive at the five percent level and consistent, at least statistically, with maximum growth. At the maximum value for  $r$  in the sample of 36.100, the incremental effect turns negative at -0.336 (p value=.441), but not significantly so.

The incremental effect of a change in taxes if spent on “nonproductive” government expenditures, e.g., health and welfare, will be less positive. At the sample mean for  $r$  of 17.422, for example, the incremental effect is numerically near zero (0.166), and insignificant (p value = 0.580), rather than significantly positive. This pattern suggests one possible explanation for the apparent under spending on productive government expenditures. If in order to spend incremental tax revenues on productive activities at least a portion of the increase is also typically spent on health and welfare, for political reasons, equity concerns, or other factors, the average state may appear to

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<sup>11</sup> Evaluations for columns (2) and (3) are roughly similar throughout, with the exception of the significantly negative coefficient for H&W(-1) in column (3).

under spend relative to maximum growth due in part to the inability to direct incremental expenditures solely to economically productive activities.

Note that the incremental effect of  $r$  if spent on nonproductive public activities differs from the incremental effect of switching expenditures from productive to nonproductive categories with taxes held constant. The latter is given for the case of health and welfare expenditures by the coefficient on  $H\&W(-1)$ , which is negative, but significantly so only in column (3).

## **6. Conclusion**

Surprisingly, studies have neglected to test directly the prediction from Barro's (1990) model of endogenous growth that growth will initially rise with increases in taxes directed toward productive government activities, but will subsequently decline. Other studies, including Barro (1989, 1990), typically focus on whether the *linear* incremental effect of taxes spent on productive government activities is positive, negative, or zero, with substantial evidence for all three conclusions.

In this study, we specify both linear and quadratic effects for taxes, which are implicitly spent on productive government activities, and find significant support based on U.S. states for the nonlinearity predicted by the Barro model: the incremental effect of taxes is initially positive (a positive linear effect), but eventually declines (a negative quadratic effect). This result stands in contrast to other studies based on linear models that find positive linear effects of taxes spent on productive activities. In those studies, the positive effect, if taken literally, implies that the government can raise the tax rate to 100%, while continuing to increase economic growth.

Overall in our sample, the average state appears to be under investing tax revenues in productive government services, relative to the maximum growth rate, but at two standard deviations above the mean tax rate, this is no longer the case. Even so, we are hesitant to place too much interpretation on our particular results. The apparent under spending on productive activities by the average state may arise, for example, if it is difficult to spend increased tax revenues exclusively on productive expenditures.



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Table I Summary statistics (U.S. states, 1962-1997)

Variable	Definition	Mean	Std. dev.	Minimum	Maximum
GROWTH	log change in state real personal income per capita (times 100)	13.036	6.126	-8.554	29.081
TAX	ratio of state & local taxes to state personal income per capita (times 100)	17.422	2.987	10.792	36.110
TAXSQ	TAX squared	322.048	120.789	116.459	1303.932
SURPLUS	ratio of state & local Budget surplus to state personal income per capita (times 100)	0.311	1.020	-2.419	8.617
H&W	ratio of state & local expenditures on health, welfare, and other transfers (times 100)	3.278	1.028	1.365	6.850
PROD	ratio of state & local expenditures on high-ways, education, and other related areas (times 100)	13.834	2.351	9.104	26.346

Notes: Data are for 49 of the 50 states in the U.S. (Alaska is excluded) from 1962 to 1997 in five-year intervals. See text for sources and further details.

Table II Regression and GMM Estimates (robust standard errors)

Variable	(1)	(2)	(3)	(4-GMM)
Constant	26.919 (22.435)	7.013 (22.139)	-14.180 (16.437)	
TAX(-1)	0.867** (0.339)	2.662** (0.691)	2.023** (0.521)	2.009** (0.590)
TAXSQ(-1)		-0.041** (0.014)	-0.024** (0.010)	-0.032** (0.012)
SURPLUS(-1)	-1.138** (0.473)	-0.981** (0.470)	-0.987** (0.335)	-0.712** (0.330)
H&W(-1)	-0.553 (0.767)	-0.853 (0.760)	-1.542** (0.552)	-0.791 (0.577)
GROWTH(-1)				-0.198** (0.051)
Fixed period effects	yes	yes	yes	yes
Fixed state effects	yes	yes	yes	yes
Lagged controls	yes	yes	yes	yes
Current controls	no	no	yes	yes
R-squared	0.464	0.477	0.760	0.728
J-statistic				31.815
nobs	343	343	343	245

\*\* significant at the five percent level.

Notes: Dependent variable is GROWTH (see Table I). Data are for 49 of the 50 states in the U.S. (Alaska is excluded) from 1962 to 1997 in five-year intervals. See text for sources and further details. Robust (panel-corrected, period SUR) standard errors are in parentheses, which correct for heteroskedasticity, autocorrelation, and contemporaneous correlation. The J-statistic is a test of the validity of the over-identifying restrictions in the GMM instrumental variables estimates in column (4).