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Government size, productivity, and economic growth: The post-war experience

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1. Introduction

In the second half of the post-war period, U.S. productivity growth fell dramatically. From 1947 to 1957, productivity growth averaged 3.1 percent per year. But in the most recent ten year period, productivity growth averaged less than 1.0 percent per year. Figure 1 dramatically exhibits this decline in productivity growth, plotting the ten year moving average of labor productivity growth for the post-war period.[1] To the extent that real output is simply the sum of employed factors times their productivities, this decline in productivity growth is associated with a drop, below what it would have been, in the sustained growth rate for real output. At the same time this slowdown in growth was occurring, one sector of the economy was growing rapidly: the government sector. In 1948, government expenditures represented about nineteen percent of GNP; by 1986, they exceeded thirty-five percent.[2]

In this paper, we examine the relationship between the size of the government sector relative to the economy and the levels of productivity and thus economic growth. A negative link between government size and productivity and output growth is, potentially, an important piece of the growth-slowdown puzzle. Traditional factors, by themselves, do not sufficiently explain the slowdown and an understanding of the link between government size and economic activity may help resolve the productivity mystery.[3] Baily (1984), for example, argues that the fall in productivity growth was caused by a variety of traditional factors and examines the effects of less innovation, inflation, energy prices and declining work effort in partially explaining the productivity slide.

Bosworth's 1984 study also examines the contribution of the traditional causes of a slowdown: slow capital formation, decreases in labor quality,

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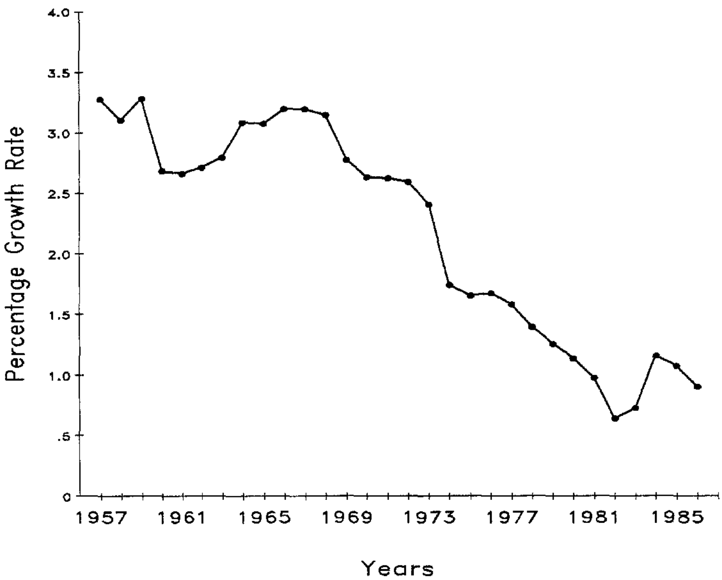

Figure 1. U.S. productivity growth rates, ten year moving averages.

increased government regulation of business, insufficient increases in research and development, problems with energy, sectoral shifts, and cyclical influences. He concludes that a substantial proportion of the slowdown in productivity growth remains an unexplained residual. We investigate whether this residual may be the dramatic growth of government activity in the post-war period. Indeed, government activity might not only be the unexplained residual, but also the determinant of many of the causes of the slowdown noted by Bosworth.

Although some previous work links the scale of government to the rate of economic growth, this paper extends that literature in several directions.[4] First, we use an explicit theoretical model to derive the equations that we estimate. This allows us to decompose the influence of government size on output growth into its separate effects on the economic base and the economic growth rate. We can also examine whether growth retardation comes through reduction in the employment of factors or reduction in the productivity of those factors. Finally, we explicitly control for the business cycle and can thus focus exclusively on the long-run effects of government growth.

In Section 2 of the paper, we present the theoretical model which serves as the basis for our empirical investigation. Section 3 discusses the econometric issues that arise in estimating the theoretical model and Section 4 presents the results of that estimation. Section 5 presents our interpretation of the econometric results and some general observations about their implications.

2. Development of the theoretical model

2.1. Output determination in the absence of government

To develop our theoretical model we begin with consideration of the level of real output at a point in time, Y_t. The level of real output can be decomposed into its cyclical and trend components. Following Lucas (1973), this decomposition can be expressed in logarithmic terms as:[5]

$$y_t = y_{nt} + y_{ct}, \tag{1}$$

where y_{nt} is the trend component of output and y_{ct} is the corresponding cyclical level. This decomposition illustrates the fact that to fully investigate the effect of the size of government on long-run growth, one must control for cyclical variations in output.

To capture these cyclical changes we apply an approach first suggested by Evans (1968). We extend Evans' approach, however, by applying a cyclical decomposition to *both* labor and capital. By extending Evans' framework, we can obtain the following specification for the level of output:

$$Y_t = A_t\, e^{\mu t}\, [K_{ct}K_{nt}]^{\upsilon}\, [L_{ct}L_{nt}]^{\omega}, \tag{2}$$

where K_{nt} and L_{nt} are the trend or long-run values of the capital stock and labor, respectively, K_{ct} and L_{ct} are the cyclical values for those variables. In log terms, this specification is:

$$y_t = a_t + \mu t + \upsilon k_{ct} + \upsilon k_{nt} + \omega l_{ct} + \omega l_{nt}. \tag{3}$$

Following Lucas, we can then express cyclical output, y_{ct}, as its deviation from trend $(y_t - y_{nt})$:

$$y_{ct} = \upsilon k_{ct} + \omega l_{ct}. \tag{4}$$

The trend or capacity level of output is then described by the other right-hand-side variables in equation (3):[6]

$$y_{nt} = a_t + \mu t + \upsilon k_{nt} + \omega l_{nt}. \tag{5}$$

Differentiating equation (5) with respect to time provides the following useful differential equation:

$$\frac{\mathring{Y}_{nt}}{Y_{nt}} = \mu + v\frac{\mathring{K}_{nt}}{K_{nt}} + \omega\frac{\mathring{L}_{nt}}{L_{nt}}. \tag{6}$$

Along the long run equilibrium growth path of the economy, the growth rate of capital equals the growth rate of output (and the long-run capital-output ratio is constant), so that:[7]

$$\frac{\mathring{Y}_{nt}}{Y_{nt}} = \frac{\mathring{K}_{nt}}{K_{nt}}. \tag{7}$$

Thus, equation (6) can be written as:[8]

$$\frac{\mathring{Y}_{nt}}{Y_{nt}} = \frac{\mu}{(1-v)} + \frac{\omega}{(1-v)}\frac{\mathring{L}_{nt}}{L_{nt}}. \tag{8}$$

For now, we assume that the growth rate in labor is constant and will be written as λ.[9] The differential equation can then be rewritten as:

$$\frac{\mathring{Y}_{nt}}{Y_{nt}} = \beta. \tag{9}$$

where:

$$\beta = \frac{\mu}{(1-v)} + \frac{\omega}{(1-v)}\lambda. \tag{10}$$

Equation (9) has as its solution:

$$Y_{nt} = \alpha\, e^{\beta t}. \tag{11}$$

where the parameter α represents the economic base and where β is the economic growth rate.

2.2. *Incorporating the effects of government activity*

We now consider the possibility that increasing levels of government activity in the economy can influence the growth path of output by altering the structure of rewards and penalties under which the economy operates. There are some basic microeconomic propositions as to what these effects might be and these can be separated into two categories: (1) those influences that pertain to the economic base, α, and (2) those influences that pertain to economic growth rate, β.

At a point in time, the economic base is determined by the rudimentary factors of production present in the economy, the extent to which these factors are employed, and the efficiency with which they are employed. The rudimentary factors themselves are taken to be exogenous, but the extent to which these factors are fully and efficiently employed may well be influenced by the extent of government involvement in the economy. In particular, if increases in the scale of government activity have a negative effect on the efficiency with which resources are used, the economic base will be eroded when government activity is increased. To the extent that government disrupts the private market by mitigating marginal pricing conditions, it will dissipate the economic base.

In addition to the growth in labor, economic growth is determined by technical change and by economic investment in human and non-human capital. Economic growth not resulting from the increased employment of factors will be determined by the propensity to innovate and the propensity to invest. These in turn will be determined by their rate of return. Government can therefore retard the economic growth rate by lowering the rate of return to innovation and investment (thus reducing the incentive to invest) and by obviating the need for investment by providing a return in lieu of the returns to investment.

In sum, both the economic base and the economic growth rate may be affected by the scale of government.[10] To capture these two effects we posit that both the base and the growth rate are functions of the size of government, as measured by the ratio of government expenditures to output. Specifically, we posit a negative relationship between the government expenditure/output ratio (G/Y) and the economic base, α, and the economic growth, rate, β:

$$\alpha_t = \chi_0[(G/Y)_t]^{\chi_1}. \tag{12}$$

$$\beta_t = \delta_0 + \delta_1 (G/Y)_t. \tag{13}$$

where χ_0 and δ_0 are positive and χ_1 and δ_1 are negative.

In the previous section, we assumed that both the base and the economic growth rate were constant. If the scale of government does affect them, however, they will not be constant through time, and we must adapt our model to allow for changes in the base and the growth rate. First, allowing only the base to vary, equation (11) becomes:

$$Y_{nt} = \alpha_t e^{\beta t}, \tag{14}$$

where α_1 is the value for the base in period t. If the growth rate can also vary, the *level* of output in period t will depend upon the current growth rate *and* the previous growth rates.[11] This implies that a more general specification of equation (11) is given by:

$$Y_{nt} = \alpha_t \, e^{\sum_{i=1}^{t} \beta_i} \tag{15}$$

Incorporating the potential effects of government scale, as specified in equations (12) and (13), yields our benchmark model for describing long-run economic growth:

$$Y_{nt} = \chi_0 \, [(G/Y)_t]^{\chi_1} \, e.^{\left\{\sum_{i=1}^{t} [\delta_0 + \delta_1 (G/Y)_i]\right\}} \tag{16}$$

2.3. Approximating permanent government expenditures

For capturing the effects of government for long-run macroeconomic policy issues, Barro (1981), Kotlikoff (1984), and others have demonstrated that the relevant government variable is permanent government expenditures. But the permanent government expenditures to output ratio, $(G/Y)_P$, is an unobservable variable and must be approximated. We choose to do so with a trend version of the (G/Y) ratio and we then use this trend value to capture the effects of permanent government spending in the following two ways.[12]

We first relate it to the economic base. As shown by Kotlikoff (1984), measuring the permanent government expenditure ratio involves accounting for projected future expenditures as well as present expenditures. We capture this implicit forecast by including the information contained in the trend level of expenditures in two parts: (1) its current level $(G/Y)_{Pt}$, and (2) its growth, $[(G/Y)_{Pt}/(G/Y)_{Pt-1}]$. Together, these two components capture the information incorporated in the current trend spending ratio for assessing both the current and the future values of the government spending ratio – an assessment equivalent to determining the permanent level of government spending. With these modifications, the economic base in period t will be given as:

$$\alpha_t = \chi_0 \, [(G/Y)_{Pt}]^{\chi_1} \, [(G/Y)_{Pt} \,/\, (G/Y)_{Pt-1}]^{\chi_2} \tag{17}$$

The second modification of the basic model related to the permanent expenditure ratio tests for the possibility that the economic growth rate can rebound from an increase in government absorption of resources and therefore, after some time, return to its 'natural' growth rate. This idea follows from the basic mechanics of the neoclassical growth model. In that model, a reduction in the capital stock only temporarily reduces the economic growth rate. A reduction in saving, for example, reduces the capital-output ratio but because capital is subject to diminishing returns, the remaining capital has a higher level of productivity. This response, in turn, causes the economic growth rate to return to its natural level. Similarly here, we wish to test if a permanent increase in the scale of government has only a temporary effect on the economic growth rate. Put another way, we investigate whether the economy can offset a one-time, permanent, increase in the scale of government.

To test this hypothesis, the model is modified to include an 'effective' government expenditure ratio, $(G/Y)_E$. At any point in time, the value of permanent government expenditures to output is comprised of the initial value of that ratio and the sum of its subsequent changes. To obtain a measure of the effective ratio, we allow the impact of any change in the ratio to decay through time. If the impact of a given increase in the size of government does dwindle with time, increases in the $(G/Y)_P$ ratio that occurred twenty years ago should not be given the same weight as similar changes that occurred just last year. Thus, the current effective ratio is simply the weighted average of previous changes, with nearby changes receiving a higher weight.

For convenience we define the one-period change in the permanent government expenditure ratio as:

$$\Delta\,(G/Y)_{Pt} = \gamma_t. \tag{18}$$

With this definition, the effective, permanent government expenditure ratio is defined as:

$$(G/Y)_{Et} = (G/Y)_{E0} + \sum_{i=1}^{t} \psi^{t-i}\,\gamma_i, \qquad 0 \leq \psi \leq 1. \tag{19}$$

The value of ψ determines the length of time that an increase in the scale of government reduces the economic growth rate. As ψ approaches one, the effects of a change in the ratio last longer, with the extreme case ($\psi = 1$) implying that all changes in the ratio have a permanent influence. To simplify the inclusion of the effective ratio in our model we employ the Koyck transformation which allows us to rewrite $(G/Y)_{Et}$ as:

$$(G/Y)_{Et} = (1-\psi)\,(G/Y)_{E0} + \psi\,(G/Y)_{Et-1} + \gamma_t \tag{20}$$

Including the two modifications discussed in this section in the output equation produces the specification of long-run output equation that can be used to empirically test the influence of the scale of government on trend output:

$$Y_{nt} = \chi_0\,[(G/Y)_{Pt}]^{\chi_1}\,[(G/Y)_{Pt}\,/\,(G/Y)_{Pt-1}]^{\chi_1}\,e.^{\left\{\sum_{i=1}^{t} \delta_0 + \delta_1\,(G/Y)_{Ei}\right\}} \tag{21}$$

2.4. Employment effects and the business cycle

Thus far, we have assumed that the rate of growth in labor, λ_t, is constant. At this point however, we relax this assumption and include λ_t in our expression for output. From equations (10) and (13), it is clear that λ_t has been subsumed in the constant part of the growth rate δ_0. In the event that the labor growth rate varies from period to period, it should be treated like the government expenditure ratio; that is, it should influence the *overall* growth rate on a period by period basis. To capture this possibility, the expression for long-run output becomes:

$$Y_{nt} = \chi_0 \, [(G/Y)_{Pt}]^{\chi_1} \left[\frac{(G/Y)_{Pt}}{(G/Y)_{Pt-1}} \right]^{\chi_2} e^{\left\{ \sum_{i=1}^{t} (\delta_0 + \delta_1 (G/Y)_{Ei} + \delta_2 \lambda_i) \right\}}, \tag{22}$$

where $\delta_2 = \dfrac{\omega}{(1-\upsilon)}$.

Finally, to determine the total level of output in a given period, the long-run component, given by equation (22) must be combined with the short-run component, given by equation (4). This provides the most general equation that determines the level of output and will serve as the basis for our empirical tests of the impact of the size of government on the level of economic activity.

$$Y_t = \chi_0 \, K^{\upsilon}_{ct} \, L^{\omega}_{ct} \, [(G/Y)_{Pt}]^{\chi_1} \left[\frac{(G/Y)_{Pt}}{(G/Y)_{Pt-1}} \right]^{\chi_2} e^{\left\{ \sum_{i=1}^{t} (\delta_0 + \delta_1 (G/Y)_{Ei} + \delta_2 \lambda_i) \right\}}, \tag{23}$$

3. The empirical model

Refinement of our theoretical model is required to derive an estimable equation. First, the model is linearized by expressing it in its logarithmic form:

$$y_t = \ln \chi_0 + \upsilon \, k_{ct} + \omega \, l_{ct} + \chi_1 \ln [(G/Y)_{Pt}] + \chi_2 \ln [(G/Y)_{Pt} / (G/Y)_{Pt-1}]$$
$$+ \sum_{i=1}^{t} (\delta_0 + \delta_1 (G/Y)_{Ei} + \delta_2 \lambda_i). \tag{24}$$

Next, we explicitly consider the labor growth rate, λ. To do so, we employ the summed labor growth rates that appear in equation (24); these growth rates can be expressed as the sum of the consecutive differences:

$$\sum_{i=1}^{t} \lambda_i = \sum_{i=1}^{t} (\Delta L_{ni} / L_{ni}). \tag{25}$$

The right-hand summation has a continuous time approximation, given by:

$$\int_0^t [(\partial L_{ni} / \partial i) / L_{ni}]di = \ln L_{nt} - \ln L_{n0}. \tag{26}$$

This value for labor growth will be entered in the output growth equation, equation (24). In addition, the log of actual employment, l_t, is simply the sum of the logs of the cyclical and trend labor. Using this definition to rewrite l_{nt} as $(l_t - l_{ct})$ and collecting terms in the labor variable yields:[13]

$$y_t = \ln \chi_0 + \upsilon k_{ct} + (\omega - \delta_2)l_{ct} + \chi_1 \ln(G/Y)_{Pt}$$
$$+ \chi_2 \ln[(G/Y)_{Pt-1}] + \delta_0 t + \delta_1 \sum_{i=1}^{t} (G/Y)_{Ei} + \delta_2 l_t. \tag{27}$$

We now consider the empirical implementation of the cyclical terms, k_{ct} and l_{ct}. These variables are included to decompose output movements into its cyclical and permanent components. The empirical variable we use to capture the effects of the business cycle on both labor and capital use is the capacity utilization rate. We chose this variable because it is closely correlated with cyclical movements in *both* labor and capital. Others authors (e.g. Campbell and Mankiw (1987)) have used the labor unemployment rate when not explicitly considering the capital stock, but the capacity utilization rate is appropriate for our purposes. Specifically, we assume that both k_{ct} and l_{ct} can be expressed as functions of the current and lagged capacity utilization rate, allowing for persistance in the business cycle effect:

$$k_{ct} = \xi_1 cp_t + \xi_2 cp_{t-1}, \tag{28}$$

$$l_{ct} = \zeta_1 cp_t + \zeta_2 cp_{t-1}. \tag{29}$$

A final consideration: The cyclical variable must be detrended. During the post-war period, capacity utilization experienced a secular decline in addition to its cyclical movements (Lucas, 1982). Because we explicitly model the long-run factors influencing economic growth, we use the capacity utilization variable only to capture cyclical movements in output. The detrended value of capacity utilization is therefore required.[14] Including the detrended capacity utilization variable in equation (27) yields the equation to be estimated:

Table 1. Estimated coefficie for equation (30)[a], dependent variable is $\Delta\ y_t$, annual data: 1949–85.

cp_t	0.041 (0.179)
cp_{t-1}	−0.016 (0.062)
$\ell n[(G/Y)_{Pt}]$	−2.335* (0.725)
$\ell n[(G/Y)_{Pt} / (G/Y)_{Pt-1}]$	−5.082* (2.638)
Time	0.635* (0.086)
$\sum_{i=1}^{t} (G/Y)_{Ei}$	−0.024* (0.003)
l_t	1.309* (0.574)
ψ	0.955
$\bar{R}^2$	0.951
s.e.e.	0.014

[a] Equation (30) includes a time trend; thus when it is estimated in first-difference form, the estimated equation includes an intercept. Moreover, the intercept is the estimated coefficient on the time trend.
* Significant at a 95% level of confidence.

$$y_t = \pi_0 + \pi_1\, cp_t + \pi_2\, cp_{t-1} + \pi_3\, \ell n[(G/Y)_{Pt}] \qquad (30)$$

$$+ \pi_4\, \ell n[G/Y)_{Pt}/(G/Y)_{Pt-1}] + \pi_5\, t + \pi_6 \sum_{i=1}^{t} (G/Y)_{Ei} + \pi_7\, l_t.$$

In this form, it is clear that simultaneity between output and employment may exist. Simultaneity arises because the level of employment and the pool of labor available (which is exogenous) are not the same thing. At times the level of employment will deviate from the labor force and these deviations may be caused by the same factors which generate output deviations. To account for this possibility, an equation for employment is estimated and the fitted values from that regression are then inserted in equation (30).

The traditional factors that determine the level of employment are the labor force (long run) and the state of business cycle (short run). The employment equation thus includes these variables but it also includes the government-scale variables. The government-scale variables are included to test if an expansion of government involvement in the economy produces a long run deviation of employment from the labor force. This would occur, for instance, if government transfers had a negative effect on instantaneous labor supply (Hausman, 1981)). Finally, to account for any growth in employment associated with exogenous factors not related to the size of the labor force, a time trend is included. The employment equation is given by:

$$l_t = \eta_0 + \eta_1 \ln [(G/Y)_{Pt}] + \eta_2 \ln [(G/Y_{Pt} / (G/Y)_{Pt-1}]$$
$$+ \eta_3 \, lf_t + \eta_4 \, cp_t + \eta_5 \, cp_{t-1} + \eta_6 \, t. \tag{31}$$

where lf_t is the log of the labor force.

4. Estimation of the model

Annual data from the post-World War II period are used to estimate the model comprised of equations (30) and (31). Sources of the data as well as data definitions are provided in an appendix available from the authors upon request. Because our model includes observations on macroeconomic variables over a relatively long period of time, the possibility of spurious regression results due to common trends or nonstationarity of the data arises. To avoid this difficulty, the data were differenced to induce stationarity.[15] The results of estimation of the output equation are presented in Table 1 and the results for the employment equation are presented Table 2.

The employment regression indicates that employment is determined by the size of the labor force and the stage of the business cycle. Government scale effects do not appear strong (although the expected negative sign does occur), suggesting that any negative economic growth effects must come primarily through retardation of productivity. The fitted values from this equation are then used to form the instrument for employment in equation (30).

The most striking results appear in the estimated output equation. First, the primary hypothesis, that the level of government activity in the economy has a negative effect on both the economic base and the economic growth rate, is supported. The estimated coefficients relating the economic base to both the permanent government expenditure ratio and the change in that ratio are negative and significant. In addition, the coefficient on the effective expenditure ratio is also negative and significant, indicating that increases in the government spending ratio have long-lasting negative effects on the trend growth rate in output. The value for ψ included in the regression presented in Table 1 is .955. This large value for ψ suggests that increases in the amount of government in-

Table 2. Estimated coefficients for equation (31)[a], dependent variable is $\Delta\ l_t$, annual data: 1949–85

$\ell n[(G/Y)_{Pt}]$	−0.221
	(0.150)
$\ell n[(G/Y)_{Pt} / (G/Y)_{Pt-1}]$	−0.441
	(0.581)
lf_t	0.711*
	(0.071)
cp_t	0.284*
	(0.018)
cp_{t-1}	0.040*
	(0.017)
Time	0.002*
	(0.001)
$\bar{R}^2$	0.970
s.e.e.	0.007

[a] Equation (31) includes a time trend; thus when it is estimated in first-difference form, the estimated equation includes an intercept. Moreover, the intercept is the estimated coefficient on the time trend.

* Significant at a 95% level of confidence.

volvement in the economy have potentially long-lasting but not permanent effects on the economic growth rate. This result, as well the results for the economic base, are robust across choices of ψ, the decay parameter.

Several other results merit discussion. The coefficients for the business cycle variables are not significantly different from zero, although this is not surprising given that the fitted value for the level of employment is also included in the equation. There is a significant amount of collinearity between the two variables, inflating their standard errors. The coefficient on the fitted employment variable is positive and significantly greater than zero, nevertheless. It is also close to one. But the estimated business-cycle and employment coefficients are not robust with respect to the choice of ψ. That is, due to multicollinearity, the estimated coefficients of these variables are not stable across alternative specifications of ψ.

To solve this problem of multicollinearity, we return to the theoretical model. From equations (8), (22), (27), and (30) recall that $\pi_7 = \dfrac{\omega}{(1-\upsilon)}$. Under constant returns to scale, however, $\omega = 1-\upsilon$ and $\pi_7 = 1$. Imposing the restriction that $\pi_7 = 1$ allows us to rewrite equation (30) as:

$$y_t - l_t = \pi_0 + \pi_1 \, cp_t + \pi_2 \, cp_{t-1} + \pi_3 \, \ell n[(G/Y)_{Pt}] \qquad (32)$$
$$+ \pi_4 \, \ell n[(G/Y)_{Pt} \, / \, (G/Y)_{Pt-1}] + \pi_5 \, t + \pi_6 \sum_{i=1}^{t} (G/Y)_{Ei} .$$

This restriction was tested by examining the coefficient on the fitted labor variable in equation (30). Even though the estimated value of π_7 varied somewhat with different values of ψ, in no estimation was it significantly different from one.

But the dependent variable in equation (32) is, in level form, simply labor productivity (Y_t/L_t). This specification has three advantages: (1) it allows us to separate those effects of government scale which retard output growth through reductions in the level of employment from those effects which work through influencing productivity; (2) it allows us to drop employment as a right-hand-side variable, eliminating the multicollinearity among the cyclical variables, and; (3) it allows us to directly use the Bureau of Labor Statistics business sector data. The BLS data eliminates the compensation of government, household, and institutional employees from total output (Y) and remove their hours from total labor hours (L). In calculating productivity, this consideration is important because, for practical purposes, it is not possible to measure the productivity of these employees. Currently, compensation of these omitted employees comprises about fourteen percent of GDP.

The results of estimating this specification are given in Table 3. The estimated coefficients reveal that there is a strong exogenous tendency of productivity to grow (as indicated by the positive intercept) but that both productivity and its growth are eroded by the growth in government. The regression also indicates that productivity is a function of the stage of the business cycle, increasing above trend during upswings and decreasing below trend during contractions. As the main focus of our analysis is determining the influence of government size on productivity and economic growth, the results relating to the government variables are discussed in detail below.

An increase in the scale of government lowers productivity. The coefficients for both the trend government spending ratio and the growth in that trend are negative and significant at high levels of confidence. These two results indicate that permanent increases in the share of output devoted to the government result in a significant erosion in productivity. A larger government sector also reduces the growth rate of productivity as indicated by the negative, highly significant coefficient of the effective government spending ratio. This negative sign, when combined with a value for ψ of .965 suggests that a growing government sector has very long-lasting negative effects on productivity growth.[16]

Recall that the positive intercept of an equation estimated with differenced data indicates that there is a positive exogenous trend growth in the dependent variable (changes in the log of productivity). Offsetting this has been the

Table 3. Estimated coefficients for equation (32)[a], dependent variable is $\Delta\ [y_t - l_t]$, annual data: 1949–85.

cp_t	0.195*
	(0.041)
cp_{t-1}	−0.054
	(0.040)
$\ell n[(G/Y)_{Pt}]$	−1.800*
	(0.229)
$\ell n[(G/Y)_{Pt} / (G/Y)_{Pt-1}]$	−2.389*
	(0.697)
Time	0.467*
	(0.022)
$\sum_{i=1}^{t} (G/Y)_{Ei}$	−0.017*
	(0.001)
ψ	0.965
$\bar{R}^2$	0.963
s.e.e.	0.015

[a] Equation (32) includes a time trend; thus when it is estimated in first-difference form, the estimated equation includes an intercept. Moreover, the intercept is the estimated coefficient on the time trend.

* Significant at a 95% level of confidence.

dramatic expansion of the government sector and we can conclude that this expansion accounts for a material portion of the productivity slowdown in the seventies and eighties. Growth in productivity that would normally have taken place has be obviated to some extent by the growth in government.

Finally, a comparison of the estimates presented in Tables 2 and 3 indicates that most of the negative influence on output growth of government growth has worked through reducing productivity rather that the reducing the employment of factors.

We conclude the presentation of results with the following caveat. The data used to estimate the equations is post-World War II, U.S. data. Thus, like most empirical studies our results cannot be generalized to all countries for all time periods. More specifically, the negative relationship between government scale and productivity that we find is relevant for current ratios of government spending (about 35%), and it is not necessarily relevant for all levels of the spending ratio. Our findings are consistent with results from international studies (e.g. Barth, Keleher and Russek (1986), Marlow (1986)) but not inconsistent with the argument that there may be an 'optimal' size of government, where the optimal scale of government is defined as the scale which maximizes output growth. The possibility of such an optimal scale of government activity is suggested by Grossman (1988) who argues that growth in government may initially have a positive impact on economic growth through the provision of Pigovian public goods, followed eventually by a negative influence as the scale of government increases. Our results, finding a negative relationship between the scale of government and economic activity, combined with the growth in the relative size of the government sector in the post-war period is suggestive that government scale is beyond that optimal point.

5. Conclusion

A substantial portion of the slowdown in productivity and economic growth in the seventies and eighties cannot be ascribed to traditional factors. We have found one potential additional source: the dramatic growth in the scale of government. Employing a theoretical model of output growth, we derive an equation which controls for cyclical influences and which permits distinguishing the effects of government growth on the economic base from the effects on the economic growth rate. We find that increases in the scale of government lead to statistically significant reductions in both the economic base *and* the economic growth rate. In addition, we find that most of this government-induced retardation of economic activity arises from reductions in productivity rather that reductions in the employment of factors.

Notes

1. In a recent analysis of this problem, Bosworth (1984) finds that the broad-based nature of the productivity slowdown is evident in all major industries except communications. In addition, another recent study finds that the slowdown after 1973 is common to all regions (Hulten and Schwab, 1984).
2. Part of this remarkable increase in government activity is due to increased government purchases of goods and services which started during the cold war period of the late 1940s and 1950s. These purchases rose from 12 percent of GNP in 1948 to about 20 percent by 1960 and have stayed at about this level. Another part of the increase has been due to increased transfer payments. These payments experienced a sharp rise after World War II as a result of veterans benefits (8 percent of GNP in the late 1940s) but fell to 4 percent of GNP in the early 1950's. Starting in the 1960s, however, these payments expanded rapidly, climbing to their 1986 level of 12 percent of GNP.
3. Interestingly, not all economists agree that there has been a decline in productivity growth. Darby (1984), for example, argues the decline is simply the result of 'statistical myopia'.
4. For example of earlier literature on this topic see: Barth, Kelleher and Russek (1986), Ram 1986) or Marlow (1986).
5. Throughout this paper, the level of a variable will be expressed as upper case letters with the corresponding logarithm expressed as a lower case letter.

6. This specification is entirely consistent with traditional neoclassical growth models. See Solow (1957).
7. For a theoretical treatment, see Branson (1979) or Diamond (1965).
8. Under constant returns to scale, $\omega = 1 - \upsilon$, and the coefficient on the growth in employment is one. The implications of this assumption for the estimation of the model will be explicitly discussed in a later section.
9. This assumption is made purely for algebraic convenience and will be relaxed before the final model is specified.
10. We measure the scale of government by measuring total government expenditures (federal, state and local) as a percentage of total economic activity (GNP). A possible problem with this aggregate ratio is that it masks differential impacts by it components. For example, Marlow (1988) addresses the disaggregation by level of government and finds that government activity tends to be larger when it is more centralized at the federal level. An alternative decomposition could be by types of government spending: consumption, investment and transfers. Peden (1987) addresses these issues. We leave this complex problem to future research and focus on the effects of changes in the total level of government activity relative to the economy.
11. To see this consider the two year case. In year 1, $Y_{n1} = \alpha_\circ e^{\beta_1}$, but in year 2, $Y_{n2} = Y_{n1}e^{\beta_2} = \alpha_\circ e^{\beta_1} e^{\beta_2} = \alpha_0 e^{(\beta_1 + \beta_2)}$. Note that we are assuming that each period, t, is one unit in length.
12. We find $(G/Y)_P$ by fitting (G/Y) to a polynomial time trend and we use a fourth-degree polynomial. The trend, values for the government expenditure ratio range from 19.33% in 1947 to 34.75% in 1986. This is analogous to 'normal' government expenditures as defined by Barro (1979).
13. The trend term enters from the fact that $\sum_{i=1}^{t} \delta_0 = \delta_0 t$. Also, l_0 is subsumed in the constant term.
14. The equation used to detrend the CP variable is given by: $CP_t = 90.823 - 0.133\ t$.
15. The data were first differenced but in both cases an intercept was included in the differenced equation. The intercept was included because each non-differenced equation included a time trend. Although the data were first differenced, a nine year span of differencing was employed. This long span of differencing was used to capture long run growth but, after estimation, the results were not different from those based on one, three, six, or twelve year spans.
16. A value of .965 for ψ arose from a grid search in which the value for ψ that minimized the sum of squared errors was chosen. In this specification, all of the estimated coefficients are robust across choices of ψ.

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