DEFENSE EXPENDITURES, ECONOMIC GROWTH, AND THE "PEACE DIVIDEND"

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Recent developments in Eastern Europe have created expectations of a "peace dividend" associated with reduced levels of U.S. defense expenditures. We present and empirically estimate a two-equation model for assessing the direct and indirect, immediate and delayed effects of changes in defense spending on economic growth in the United States.

The dramatic developments in Eastern Europe and the downgrading of the Soviet bloc's threat to Western security have created expectations of a "peace dividend" associated with massive cuts in U.S. defense spending. Secretary of Defense Dick Cheney has recently indicated his willingness to cut military expenditures drastically, while the chairman of the Joint Chiefs of Staff, General Colin Powell, proposed deep cuts in U.S. troops in Europe (*Newsweek*, 4 December 1989, p. 44). While it is still unclear whether a "dividend" will indeed be paid, most people believe that drastic changes in military spending have a direct and immediate impact on the economy. Our purpose here is to determine whether the impact of reduced levels of U.S. military spending on economic growth is (1) direct or indirect and (2) immediate or delayed.

Based on the literature on defense spending and economic performance in industrialized countries (e.g., Chan 1985, 1987; Denoon 1986; Lindgren 1984; Rasler and Thompson 1988; Smith 1980; Smith and Georgiou 1983), we hypothesize that reduced levels of military expenditures either promote growth directly or encourage investment, which in turn promotes growth. We shall summarize the theoretical basis for this argument and then offer an empirical analysis of the guns–growth thesis. We begin by explaining the links between defense spending and investment and between investment and growth.

Defense Spending and Investment

On the basis of the examination of more than a dozen studies (including Smith 1977, 1980; and Smith and Georgiou 1983), Lindgren concludes that there is a negative relationship between military expenditures and investment (1984, 376). Others similarly find that higher military spending has stifled investment while lower levels of military spending have encouraged investment (DeGrasse, McGuiness, and Ragen 1983, 73; Cappelen, Gleditsch, and Bjerkholt 1984, 368). G. Kennedy therefore concludes that the guns–investment trade-off does exist (1983, 198).

Certain scholars provide an explanation for this relationship (Smith 1980, 22–23; Huisken 1982, 6; Rasler and Thompson 1988). Private and (nonmilitary) public consumption account for more than half of the total output of the economy and are highly resistant to reductions. Accordingly, military spending and investment compete for the nonconsumption portion of the total productive capacity of the economy. Increased levels of military spending crowd out investment, while reduced levels promote investment. Moreover, nonpersonnel military expenditures and investment demands are directed at roughly the same industries (Huisken 1982, 6). Increased military demand may therefore cause supply bottlenecks that squeeze investment. Increased levels of defense spending may also entail higher taxes or government borrowing in the capital markets, funds that might have otherwise gone to investment (Chan 1985, 416), while reduced levels of military spending may lead to lower taxes or less government borrowing. Smith and Georgiou (1983) and Chan (1985) recommends the use of long time lags in empirical tests of the warfare–investment trade-off.

Investment and Growth

Investment is a crucial element of economic growth (Solow 1988; Ram 1986). According to one estimate, investment accounted for nearly one-fifth of the average 2.90-percent annual growth rate of the U.S. economy over the 1929–1982 time period (Denison 1985, 30).

Since military spending is hypothesized to have a negative impact on investment, it is expected that it will also have a negative, indirect impact on growth "by impeding the renewal and expansion of existing capital stock as well as the rate at which technical progress and innovation are spread throughout the economy" (Mosley 1985, 65). Conversely, cuts in military spending may stimulate investment, which in turn may have a positive impact on growth. P. Kennedy (1987) points out that economic growth is suffering in the United States because of imperial overstretch and increased military spending. Nardinelli and Ackerman (1976) find the effect of defense spending on net real GNP to be negative. However, as the Chan (1985) and Lindgren (1984) surveys of the empirical work on defense spending and economic growth show, the evidence for such a link is mixed: while some scholars find military expenditures to have a dampening impact on growth, others are unable to find any evidence for the guns–growth trade-off, while still others find a positive correlation—for example, from technological innovations and spin-offs (see Lindgren 1984, 380). A more recent study (Rasler and Thompson 1988) finds the trade-off to be particularly severe in the post–World War II United States. Chan therefore concludes that "the available evidence is not entirely consistent but generally it does not support the view that military spending promotes economic growth" (1987, 39). Following Smith (1980), DeGrasse, McGuiness, and Ragen (1983), Huisken (1982), and Mosley (1985), we hypothesize that to the extent that reduced levels of military spending encourage investment, they indirectly promote economic growth.

Research Strategy

To test the direct and indirect, immediate and delayed effects of military spending on economic growth we developed and empirically estimated a two-equation "indirect effects" model, representing investment and economic growth, respectively. The investment equation is based on the work of P. Clark (1979). The growth equation relies on the work of Solow (1988), Denison (1967, 1985) and Ram (1986).

The "Indirect Effects" Model

Investment. Our investment equation is a modified version of a model originally proposed by J. Clark (1917) and later modified by other economists (Chenery 1952; P. Clark 1979; and Koyck 1954). According to P. Clark (1979), this model has a superior statistical performance over other specifications and is practically estimable. Furthermore, it allows us to isolate the putative effect of military spending.

P. Clark (1979) compares five different models of investment: the generalized accelerator model, the so-called accelerator–cash flow model (see Eisner 1978), the neoclassical model (see Jorgenson 1967), the so-called modified neoclassical model based on the work of Charles Bischoff (1971), and a securities-value (Q) model (see Tobin 1969). P. Clark finds that while the neoclassical investment function, which explicitly takes into account capital cost, is theoretically appealing, it is nevertheless plagued by measurement problems. In contrast, the flexible accelerator model, which relates investment to changes (i.e., accelerations) in output over a number of time periods, performs best for both inside sample prediction and outside sample forecast (1979, 85–92).

The flexible accelerator model represents gross investment (I) as a distributed lag on national product (Y) plus depreciation, which is assumed to be a constant proportion of the capital stock (K) of the previous period:

$$I = \sum_{S=0}^{\infty} \beta_S \Delta Y_{-S} + dK_{-1}. \qquad (1)$$

The gross national product (GNP) is conventionally defined as the sum of consumption (C); investment (I); government purchases of goods and services (G); and net export, which equals total export (EX) minus import (IM). By disaggregating G into military expenditures (M) and nonmilitary expenditures (NM) and rearranging the terms, Y becomes a function of three components: production in the private sector (P), nonmilitary government expenditures (NM), and military expenditures (M).

$$\begin{aligned} Y &= C + I + G + (EX - IM) \\ &= [C + I + (EX - IM)] + NM \\ &\quad + M \\ &= P + NM + M \end{aligned}$$

By the distributive law, the first difference of Y is equal to the sum of the first differences of its three components, that is, $\Delta Y = \Delta P + \Delta NM + \Delta M$. Substituting it into equation 1 results in:

$$I = \sum_{S=0}^{\infty} \beta_S \Delta P_{-S} + \sum_{S=0}^{\infty} \beta_S \Delta NM_{-S} + \sum_{S=0}^{\infty} \beta_S \Delta M_{-S} + dK_{-1}. \qquad (2)$$

To transform equation 2 into a statistical equation for estimation, we first allowed for only a finite number of lag coefficients for each component. We then divided both sides by Y to obtain the proportion of GNP invested by the business sector (our dependent variable). This is not only more interesting theoretically, but also reduces the potential heteroscedasticity problem in this equation, since the error variance of the level of investment tends to rise in proportion to the size of the economy. Finally, we added to the right-hand side of the equation a constant term (a), and an error term (e). The resulting equation is

$$\frac{I}{Y} = a_1 + \sum_{S=0}^{n_1} b_{11,S} \frac{\Delta P_{-S}}{Y} + \sum_{S=0}^{n_2} b_{12,S} \frac{\Delta NM_{-S}}{Y}$$

$$- \sum_{S=0}^{n_3} b_{13,S} \frac{\Delta M_{-S}}{Y} + b_{14} \frac{K_{-1}}{Y} + e_1 \quad (3)$$

where I = gross private domestic investment in 1982 prices; Y = GNP in 1982 prices; $\Delta P = P - P_{-1}$, where P is private business output in 1982 prices; $\Delta NM = NM - NM_{-1}$, where NM is nonmilitary expenditures in 1982 prices; $\Delta M = M - M_{-1}$, where M is military expenditures in 1982 prices; and K = net value of capital stock in 1982 prices.

Growth. The second equation links gross investment, military spending, and other relevant variables to economic growth, which is measured by the growth rate of GNP in constant dollars. Here we extend the work done by Solow (1988), Denison (1967, 1985) and Ram (1986).

The simplest version of Denison's sources-of-growth model (1967, 1985) attributes changes in *levels* of gross output to changes in inputs of capital ($\Delta K = K - K_{-1} = I$) and changes in labor ($\Delta L$). Ram (1986) extends this model by explicitly distinguishing the government sector from the rest of the economy and therefore adds changes in government output (ΔG) as a third term in the equation. Dividing both sides of the equation by GNP of the last period transforms the left-hand-side variable from changes in output levels into economic growth rate. Ram further assumes that a linear relationship exists between the real marginal productivity of labor in a given sector and the average output per labor in the economy (1986, 193). Ram's growth equation then becomes

$$\frac{\Delta Y}{Y_{-1}} = \alpha \frac{I}{Y_{-1}} + \pi \frac{\Delta L}{L_{-1}} + \theta \frac{\Delta G}{Y_{-1}} \quad (4)$$

In order to isolate the effect of military expenditures on economic growth, we then modified Ram's equation by disaggregating government output, measured by total government purchases of goods and services, into nonmilitary and military components ($G = NM + M$). By substituting this identity into equation 4 and further hypothesizing that increased levels of military spending tend to dampen economic growth while reduced levels promote growth, the resulting statistical equation is

$$\frac{\Delta Y}{Y_{-1}} = a_2 + b_{21} \frac{I}{Y_{-1}} + b_{22} \frac{\Delta L}{L_{-1}} + b_{23} \frac{\Delta NM}{Y_{-1}} - b_{24} \frac{\Delta M}{Y_{-1}} + e_2 \quad (5)$$

where $\Delta Y/Y_{-1}$ = economic growth rate, where Y equals GNP in 1982 prices, and $\Delta L/L_{-1}$ = growth rate of employed civilian labor force.

Data

Data on GNP, the GNP implicit price deflator (1982 = 100), military expenditures, federal government purchases of goods and services, gross private domestic investment, export, import, and consumption, were taken from the Bureau of Economic Analysis' 1986 *National Income and Product Account of the United States, 1929–1982 (NIPA)*, supplemented by 1983–1987 data taken from the bureau's *Survey of Current Business* (July 1987 and July 1988). Capital stock figures were obtained from the same bureau's 1987 *Fixed Reproducible Tangible Wealth in the United States, 1929–1982*, supplemented by 1984–1987 data taken from the *Survey of Current Business* (August 1988). Data on employed civilian labor force were taken from the Bureau of Labor Statistics' *Employment and Earnings* (December 1983 and May 1989).

All data refer to the 1953–1987 time period (1953 is the first year for which data on all variables is available, and 1987 is the last). It should be pointed out that 1948–1952) data for three variables with long lags in equation 3 (i.e., military expenditures/GNP, nonilitary expenditures/GNP and private production/GNP) were also collected in order to ensure that degrees of freedom are not sacrificed and that all equations refer to the same time period. (See our discussion of the criterion for selecting the number of lags in this equation.) All data are in calendar years and in constant 1982 prices. Data in *NIPA* are reported in calendar years. The *Survey of Current Business* supplements data for these variables on a calendar year basis. Furthermore, the *NIPA* data set contains data in constant prices on most of these variables. However, *NIPA*'s data on military spending is in current prices only. The series was converted to constant 1982 dollars using the implicit price deflator for federal government purchases of goods and services, which is also reported in *NIPA*.

Data represent final outlays. While many studies of the determinants of defense budgeting in the United States have often used national defense data on different stages of the budgetary process (i.e., the services' requests, the president's budget, Congress appropriations, and Department of Defense expenditures), studies of the guns-versus-growth and guns-versus-butter trade-offs have virtually always used actual expenditures (see Mintz 1989). As Domke, Eichenberg, and Kelleher explain, "It is best to investigate final outlays—the bottom line of the ledger comprising the many alterations of the budget and its final implementation" (1983, 21). Since money authorized or awarded to national security is usually spent over a number of years, one cannot assess its impact on the economy accurately unless one examines actual expenditures. Several scholars (e.g., Griffin, Devine, and Wallace 1983) defend the use of the rate of change in spending as a proportion of the GNP. To avoid the problem of heteroscedasticity discussed earlier we measured the variables, except civilian labor force, as a proportion of GNP.

Methodology

Before turning to the results of our empirical analysis, several methodological issues should be addressed.

Estimation. The model can be estimated using single-equation estimator or by joint estimation of the entire system. The latter approach, often referred to as Zellner's (1962) "seemingly unrelated regression" (SUR) estimator, is asymptotically more efficient than the former, if the error terms of the equations are contemporaneously correlated. Judge and his colleagues point out, however, that in finite samples, greater efficiency of joint estimation can be obtained only when the contemporaneous correlation between disturbances in different equations is significantly different from zero (1985, 470; 1988, 452). Otherwise, estimating individual equations separately may be more efficient than joint estimation (see Kariya 1981, 382). Given several methodological problems detected in our model (lag structure in equation 3 and collinearity in equation 5), we decided to overcome these problems in individual equations first and only then to test whether the contemporaneous correlation of disturbances across equations was sufficiently significant to require joint estimation. Following the discussion of lag structures, collinearity, and autocorrelation we report the results of the Lagrange multiplier test (suggested by Breusch and Pagan 1980, 247).[1]

Lag Structure. Since our specification of the investment equation contains distributed lags yet there is no a priori information on the lag structure, an objective criterion is needed to determine the *number* of lags of *P*, *NM*, and *M* in equation 3. We relied on a standard information criterion suggested by Schwarz (1978) and recommended by Geweke and Meese (1981), often referred to as *SC*, to select the lag or lags to be included in the analysis beyond the current and the first lag of these variables. This criterion involves a statistic that incorporates a measure of the precision of the estimate and a measure of the parsimony of the statistical model. When a regression equation involving q parameters is fitted to data,

$$SC(q) = T \bullet \ln(\hat{\sigma}^2) + (\ln T) \bullet q, \qquad (6)$$

where T is the sample size and $\hat{\sigma}^2$ is the maximum likelihood estimate of the residual variance. The lag structure that numerically minimizes equation 6 is chosen in our case. It represents the optimal balance between precision and parsimony (Schwarz 1978).

Before calculating the *SC*s of different lag structures, we set the minimum number of lags as one and the maximum as five. In other words, the current and first lag of the three variables mentioned, plus the capital stock variable, were always kept in the equation in order to ensure the detection of their short-run impact on investment. P. Clark suggests that the accelerator effect might last up to five years (1979, 89). We therefore set the maximum number of lags to be five. (A larger number of lags would have significantly reduced the degrees of freedom in the model anyway—an increase in the maximum number of lags by one implies, for the three variables, a decrease of degrees of freedom by three.) The lag structure selected by *SC* is reported in the first column of Table 1. It should be pointed out that another popular information criterion, called (*AIC*), proposed by Akaike (1974), produced an identical lag structure.

Collinearity. Two right-hand-side variables (I/Y_{-1} and $\Delta L/L_{-1}$) of the growth equation are highly correlated, with a Pearson r equal to .90. While this may not be surprising inasmuch as the two inputs of production (capital and labor) are often used in an approximately fixed proportion (Judge et al. 1988, 862), collinearity makes it difficult to identify the separate effects of investment and labor on economic growth. This is manifested by the existence of large sample variances of the ordinary least squares (OLS) estimates of b_{21} and b_{22}. Indeed, the variance inflation factor of these coefficients is 5.5 and 5.7 respectively, an indication of severe collinearity. Although the best solution to the collinearity problem might be to introduce additional sample, this option is not feasible in this study. Consequently, we used the ridge regression estimator shown by Horel, Kennard, and Baldwin to be superior to OLS (1975, 107). We obtained a bias scale of $\hat{k}$ = .00023 and added it to the diagonal elements of the error covariance matrix of the growth equation. The results of the ridge regression estimates are reported in Table 1.

Autocorrelation. The Durbin–Watson statistic of the OLS residuals of equation 3 equals 1.12, which falls in the inconclusive region but closer to its lower bound than to its upper bound. To correct the serial correlation of the error term problem, we used generalized least squares (GLS) estimates of parameters in the investment equation.[2] Durbin–Watson statistics for equation 5 (1.91 for OLS and 1.68 for the ridge regression) indicates that no first-order autocorrelation exists in this equation.

Given the lag structure in equation 3, we assume that the disturbances of our model follow a first-order autoregression, that is, AR(1) (see Judge et al. 1985, 484):

$$e_t = Re_{t-1} + v_t,$$

where R is a two-by-two diagonal matrix with diagonal elements ϱ_1 and ϱ_2, and v_t is a vector of white noises. Since only ϱ_1 is found to be significantly different from zero, the contemporaneous disturbance covariance matrix becomes

$$E[e_t e'_t] = \begin{bmatrix} \frac{\sigma_{11}}{1 - \varrho_1^2} & \sigma_{12} \\ \sigma_{21} & \sigma_{22} \end{bmatrix}.$$

Next, we had to decide whether the model should be estimated jointly or separately. The decision lies in the contemporaneous covariance of disturbances *across* equations, i.e., σ_{12}. We therefore tested the hypothesis that $H_0 : \sigma_{12} = 0$. The Lagrange multiplier statistic, $\lambda_{LM} = 1.534$, is statistically *in*significant, for a chi-square distribution with one degree of freedom, at either the .05 or .10 level. By accepting the null hypothesis, we decided to use single-equation estimation.

Results

The results of the empirical analysis are presented in Table 1. An indirect effect of military expenditures on growth exists if the military expenditures variable in equation 3 has a statistically significant negative impact on investment, and investment has a positive and statistically significant impact on growth in equation 5. A direct effect exists if the impact of military expenditures on growth in equation 5 is negative and significant.

Turning to the investment equation, the current value of military spending and its first lag are both statistically nonsignificant.[3] However, the fifth lag of military spending as chosen by both Schwarz's and Akaike's information criteria is, as predicted, negative and statistically significant, lending support to the thesis that the impact of increased levels of military spending is to significantly decrease investment in the long run. According to Chan (1987), this is due to the tendency of policy makers to finance defense by running large budget deficits while postponing costs to future generations. These findings are robust in spite of our use of different measures of investment (i.e., fixed investment and nonresidential investment), different measures of defense spending (e.g., the interaction of military spending and defense buildups), and the use of different criteria for selecting the number of lags in the equation (i.e., *AIC* and *SC*).

Turning to the growth equation, the ridge regression estimates show that the impact of investment on economic growth is, as predicted, positive and significant (albeit only at the .10 level) and that the impact of military spending on growth is statistically insignificant, indicating that defense expenditures do not affect economic growth directly. The negative effect of military spending on economic performance is therefore mainly a result of its crowding-out effect on investment on the one hand and its inability to contribute positively to economic growth on the other. These results indicate the existence of an *indirect* effect of military expenditures (via investment) on growth and the lack of a *direct* short-term negative effect of military expenditures on growth. More importantly, they show that the impact is not immediate: only in the long run does military spending crowd out investment, which in turn reduces growth. When the interactive term of military spending and military buildup is introduced into the investment equation to account for the (final stage) of the Korean War buildup, the Vietnam War, and the Reagan defense buildup, the results are very similar,[4] indicating again the lack of a significant impact in the short run and the existence of a significant effect over the long run (on the importance of dividing the time series into subperiods of war and peace, see Hollenhorst

Table 1. The Impact of Military Spending on Investment and Growth

Variables	Regression Coefficient	Standard Error	Significance
Investment Equation			
Constant	.163	.042	$p < .01$
$\frac{\Delta P}{Y}$	.499	.053	$p < .01$
$\frac{\Delta P_{-1}}{Y}$	.410	.045	$p < .01$
$\frac{\Delta P_{-2}}{Y}$	.193	.043	$p < .01$
$\frac{\Delta P_{-3}}{Y}$	.188	.041	$p < .01$
$\frac{\Delta NM}{Y}$	-.679	.269	$p < .01$
$\frac{\Delta NM_{-1}}{Y}$	-.628	.244	$p < .01$
$\frac{\Delta NM_{-2}}{Y}$	-1.165	.295	$p < .01$
$\frac{\Delta NM_{-4}}{Y}$	-.516	.269	$p < .05$
$\frac{\Delta M}{Y}$	.133	.152	$p < .20$
$\frac{\Delta M_{-1}}{Y}$	-.074	.118	$p < .25$
$\frac{\Delta M_{-5}}{Y}$	-.262	.087	$p < .01$
$\frac{K_{-1}}{Y}$	-.008	.022	$p < .40$
Adjusted R^2 = .89, D-W = 1.81.			
Growth Equation			
Constant	-.067	*	*
$\frac{I}{Y_{-1}}$	.448	.305	$p < .10$
$\frac{\Delta L}{L_{-1}}$	.820	.314	$p < .01$
$\frac{\Delta NM}{Y_{-1}}$	1.133	.500	$p < .05$
$\frac{\Delta M}{Y_{-1}}$	.152	.303	$p < .40$
Adjusted R^2 = .66, D-W = 1.68.			

Note: Refer to p. 1286 for an explanation of the variables found in the table above.
*Inapplicable due to data transformation in ridge regression.

and Ault 1971; Rasler and Thompson 1988).

The impact of the labor force variable is significant at the .01 level. The average annual growth rate of the employed civilian labor force during the period under study is 1.8%, that is, more than two million in recent years. The addition of 150 thousand members of the armed forces to be released based on the Pentagon's most recent plan over the next *five years* to a civilian labor force of almost 115 million is therefore unlikely to have a major impact on the economy and certainly would not have an immediate effect. Cusack (1991) points out that despite the massive defense buildup of the Reagan administration, defense-related employment as a percent of the total labor force grew in the 1980s only from 5.24% to 5.68%. Other experts also agree that this is a slow process.

While these results are clearly important and we are confident about the specification of the model, the data used, and the estimation techniques, we feel we also need to share some (we think minor) weaknesses of our analysis. First, despite the use of investment and growth equations known in the economic literature to be superior to other specifications (see P. Clark 1979; Ram 1986), some of the control variables in these equations were found to be nonsignificant or not in the predicted direction. For example, the current and lagged value of nonmilitary expenditures were found to have a negative impact on private investment. This seems to coincide with the "crowding-out effect" thesis, which argues that an increase in government purchases of goods and services tends to drive up interest rates and therefore discourage investment in the private sector. But while this argument may apply to both nonmilitary and military expenditures, our analysis points to an important difference in the impact of military and nonmilitary spending on economic growth. The long-term negative effect of military expenditures on investment (equation 3) tends to persist in the economy, while the negative effects of civilian expenditures on investment (equation 3) are largely offset by their *positive* effects on economic growth (equation 5).

Second, the use of the so-called ridge regression (to overcome the problem of collinearity in the second equation), introduced a slight bias ($\hat{k} = .00023$) into the analysis of the growth equation. Ordinary least square estimates of the original equation (which contains collinearity) produced a highly significant impact of the labor force variable on growth.

Despite these limitations, we are confident that (1) the impact of military spending on growth is indirect and (2) the impact of reduced levels of military spending on growth is not immediate: rather, it takes military spending five years to influence growth significantly via investment.

Conclusions

We have attempted to examine the timing and magnitude of potential defense spending cuts on economic growth in the United States not only by studying the direct effects of military spending but by also modeling the indirect impact of military spending (via investment) on growth. A two-equation econometric model was specified and empirically estimated using data on the U.S. economy for 1953–1987.

The findings reported in this study reveal the existence of an indirect, delayed effect of military spending on growth. To be more specific, we found that in the long run lower military spending encourages investment, which in turn promotes economic growth. This effect is not immediate, however. Our analysis shows that it takes about five years for such an indirect trade-off to begin to become manifest.

Deger points out that there exist a large number of simultaneous channels by which the effects of military spending operate (1986, 113). The causal chain we have modeled is obviously only one example for such a process. Chan suggests that increased levels of defense spending may result in higher budgetary deficits, which in turn lead to higher interest rates, which in turn reduce business investment. Likewise, reduced levels of defense spending may reduce the deficit and encourage investment (1985, 420).

Ward (1984) finds that the United States reacts positively (i.e., reduces defense spending) to decreases in the level of international tension. Those who expect the "peace dividend" to be paid immediately will be disappointed, however. If there will be a "dividend," its impact on growth will be indirect and will take several years to materialize. But better late than never.

Notes

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1. While our two-equation model is conceptually hierarchical, technically, no dependent variable in one equation appears in the same form on the right-hand side of the other equation. The use of two- or three-stage least squares estimation techniques is therefore inappropriate.
2. GLS estimates of the investment equation were very similar to the OLS estimates, except that the GLS estimate of the coefficient of the fifth lag of military spending is statistically significant at the .01 level, while the OLS estimate is significant only at the .05 level.
3. The variance inflation factors of these two coefficients are 2.43 and 2.57, respectively, indicating that the statistical insignificance was not due to severe collinearity.
4. We will provide these results on request.

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