Defence Spending in a Neo-Ricardian World

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This paper shows that Ricardian equivalence no longer holds once we recognize that government acts as an intermediary between generations in the provision of national defence. Consequently, the level of public debt is positively related to defence spending since this component of government expenditures insures the transferability of bequests, as well as protecting savings. It is shown that defence spending has an adverse effect on both national saving and the saving rate that has not been considered in the economic growth literature. More generally, the paper emphasizes that in developing a positive theory of taxation, the composition of government spending plays an integral role.

INTRODUCTION

The separation of government expenditures from the methods used to finance them has been an extremely useful assumption employed in economics. It has allowed economists to analyse a series of problems which would be much more difficult to study if individual taxpayers were assumed to perceive a link between the tax structure and the expenditure structure of an economy. Hettich and Winer (1988), for example, following this tradition, develop a positive theory of a tax system. This separation has been used most frequently and fruitfully to address the important question, Do fiscal deficits matter? More specifically, does the way that government finances its expenditures, between taxing and issuing public debt, matter in terms of their impact on the real economy?

Barro (1974) employed an overlapping-generations model with altruism to show that if individuals are not bequest-constrained then government bonds are not perceived as net wealth. The recipients of government transfers financed by bonds realize that their descendants will have to finance the debt through higher taxes, and so they offset the increase in public debt by increasing the size of the bequest to their children by the same amount. The effect is that interest rates, wages and the level of output of the economy are unaltered. This result, usually referred to as the Ricardian equivalence theorem, presented a challenge to the profession to find circumstances under which it would not hold and when, therefore, financing government spending with debt would have an impact on the economy.

For example, Drazen (1978) shows that this result does not hold when the returns to human and non-human capital differ, i.e. when there is some imperfection in the capital market. The most common approach used to show that Ricardian equivalence fails to holds has been to demonstrate that there are individuals who are bequest-constrained, i.e. who would like to leave negative bequests if they could, and for whom the issuing of public debt by government enables them to do so. They do not therefore increase their bequests one-for-one when public debt increases. To achieve this result, the literature in this area has seen the introduction of more sophisticated models which allow for

This paper explores this topic by departing from the assumption in previous works that a separation exists between the tax structure and the expenditure structure of a fiscal system. It does so by dropping the standard assumption that the role of government is to provide costless intergenerational transfers, generally conceived as social security, and instead defining its function to be the provider of national defence. We assume that no altruism exists on the part of children, that parents' bequest motives are operative, and that capital markets are perfect, in order to highlight the fact that Ricardian equivalence also depends upon the composition of government expenditures and not just on the existence of the former conditions. In order to compare the results with those derived previously in the literature, a standard overlapping-generations framework is used, although since the bequest motive is operative the same propositions could also be derived assuming that individuals have dynastic utility functions.

The key to the paper's results is that bequests (although operative) cannot be fully realized because there exists the possibility that international or domestic conflict may break out and that a portion of the bequest may never reach one's heirs as it may be confiscated by an adversary or lost in conflict. A component of government expenditures, defence spending, is perceived by individuals as a form of protecting against these attacks or increasing the likelihood that bequests are realized. Therefore, increases in public debt to finance defence expenditures and thereby ensure that bequests are received by future generations will not be fully offset by increases in savings. Consequently, we should expect to observe a positive correlation between increases in the size of the public debt and defence spending in countries where such a concern exists.

This contrasts with the tax-smoothing literature (Barro 1979), which suggests that optimal income taxation through time requires a smooth tax path and that unexpected events such as wars are therefore optimally financed by debt. The model presented here shows that this result holds because of the derived demand that individuals have for national security to protect the well-being of their descendants. Therefore, both temporary increases in defence spending (wars), and permanent increases during times of peace will be financed by debt. In the current climate of defence expenditure cuts by many countries following the end of the Cold War, the implication from this analysis is that the fiscal deficits of many of these will be reduced.

Another important implication from the model is that, since defence spending lowers the amount bequeathed to future generations, it lowers national savings. Since economic growth is determined largely by the accumulation of both physical capital and human capital partly financed by inter vivos transfers, defence spending can affect economic growth. Therefore, this paper can also be viewed as complementing the literature on endogenous economic growth (Romer 1986; Lucas 1988), since it has been recently shown that government policy has important implications for growth (e.g. Romer 1990; and Barro and Sala-i-Martin 1992).
In the next section, the theoretical model is developed and testable propositions derived. In Section II empirical results are presented which seem to support the model. These results show that introducing the military sector may further our understanding of economic growth. In particular, using time-series data for 11 OECD countries, we find robust results that both aggregate savings and the saving rate are reduced by defence spending. The implication from the analysis is that, not only does Ricardian equivalence depend upon the function of the state, but a more comprehensive understanding of the process of economic growth may benefit from an explicit consideration of the role that defence spending has on this process through its direct affect on savings.

I. AN INTERGENERATIONAL MODEL WITH DEFENCE SPENDING

Preferences, technology and resources

The model employed is an overlapping-generations model of finitely lived individuals developed by Samuelson (1958) and extended further by Diamond (1965). Each individual is assumed to live two periods, working during the first and retiring during the second. Generation $t$ is young (denoted by 1) in period $t$ and old (denoted by 2) in period $t + 1$. At any given moment in time, the old of generation $t$ overlap with the young of generation $t + 1$. Each individual is endowed with a unit of labour which is supplied inelastically, and each is paid a real wage of $w$. The real rate of interest is denoted by $r$ and is paid at the beginning of each period on both public debt and private debt used to finance capital accumulation, as both are assumed to be perfect substitutes in an individual’s portfolio. We assume that population is stationary and that all individuals are identical in preferences; i.e., they possess the same time-invariant utility function.

Output at time $t$, $Y_t$, is produced by means of a constant returns to scale production function

$$Y_t = F(K_t, H_t, L),$$

where $K_t$ denotes the aggregate stock of capital, $L$ is the total labour force (population of the young) and $H_t$ is the rate of labour-augmenting technological progress.

The real rate of interest and the wage rate are determined by the marginal productivity of capital and labour, respectively:

$$r_t = F(K_t, H_t, L),$$

$$w_t = H_t F_L(K_t, H_t, L).$$

All individuals of generation $t$ have their preferences represented by the utility function

$$W_t(c_t^1, c_t^2) = U(c_t^1, c_t^2) + \beta U_t^*(c_{t+1}^1, c_{t+1}^2),$$

where $c_t^1$ and $c_t^2$ are the consumption of an individual of generation $t$ while young and old, respectively; $c_{t+1}^1$ and $c_{t+1}^2$ are that of generation $t + 1$, and $U_t^*(c_{t+1}^1, c_{t+1}^2)$ is the maximum attainable utility of generation $t$’s offspring, generation $t + 1$. $U(\cdot)$ is assumed to be continuous, twice differentiable and strictly concave with marginal utility positive but decreasing in consumption.
**The role of government**

We assume that the role of government is to act as an intermediary in the provision of national defence. More specifically, upon retiring in period \( t \), the old decide not only how much to consume and bequeath to their offspring, but also how much to set aside for national defence, \( m_{t-1}^2 \). The government costlessly finances this amount by taxing the young or issuing debt. A proportion of the amount of the military good is able to be converted back to civilian purposes next period and consumed by the children of the old. The remaining part augments the arsenal of the country to provide for future national security. Formally, defence expenditures are converted to the national security of generation \( t \) via the production function

\[
\alpha_t = \alpha_t \left[ \sum_{j=1}^{t-1} (1 - \gamma_j) m_j^2 \right] = \alpha_t (M_{t-1}),
\]

where

\[
(5') \quad \frac{\partial \alpha_t}{\partial M_{t-1}} > 0 \quad \text{and} \quad \frac{\partial^2 \alpha_t}{\partial M_{t-1}^2} < 0.
\]

National security at time \( t \) is assumed to be a function of the stock of goods committed in previous periods by past generations for national security. It is assumed to be increasing in this stock but at a diminishing rate. The parameter \( \gamma_{t-1} \) is the proportion of \( m_{t-1}^2 \) that can be converted back to civilian use. For example, if \( \gamma_t = 1 \), for \( t=1,2,\ldots,t-2 \), then all military capital can be consumed, and national security at time \( t \), \( \alpha_t \), would depend only on the amount committed by the previous generation \( m_{t-1}^2 \), which is currently old; whereas if \( \gamma_t = 0 \) for all \( t \), then the amount committed for national defence by each generation is fixed; in other words, military hardware cannot be converted to civilian use but can only be used to provide national security. In this case, the amount of national security at \( t \) is a function of the amounts allocated by all previous generations, \( \sum_{j=1}^{t-1} m_j^2 \).

Although individuals have the same preferences, they do not have the same endowments across generations, and therefore the desired amounts to spend on national defence will generally differ through time. Furthermore, we make the general assumption that the fraction of the military hardware that cannot be converted back to civilian use, \( (1 - \gamma_t) \), varies through time.

The purpose of national security in the model is to protect both the savings of the young for their retirement, \( A_t^1 \), and the bequest of the old to their children, \( B_t^2 \), from confiscation by an adversarial country which may attack. More specifically, if \( m_{t-1}^2 \) is spent in period \( t \) by the old, then it serves to increase the protection of both the young’s savings and the old’s bequests into the next period, \( t+1 \). Under the assumption that military spending is used for defensive purposes if attacked, then \( 0 \leq \alpha_t < 1 \); i.e., national security protects some fraction of the total assets of both generations. For example, if a conflict were to occur at the end of period \( t \), then only some fraction of the young’s savings for retirement, \( \alpha_t A^1_t \), along with the intended bequest of generation \( t-1 \) (the old) to generation \( t \) (the young), \( \alpha_t B^2_{t-1} \), is realized. If conflict were never expected to occur, then \( \alpha_t = 1 \) for all \( t \) and the total amount saved would be \( (A^1_t + B^2_{t-1}) \). Finally, if the country adopts an offensive strategy and attacks...
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another country, and is able to confiscate enough of the other country's assets to compensate for the amount lost while doing so, then \( \alpha_t \) could be greater than one. Although I will restrict the analysis to the case where a country adopts a defensive strategy and therefore the former restriction holds, assuming the latter strategy yields the same conclusions regarding debt financing of military expenditures.³

To isolate the impact on welfare of defence spending financed by debt from the uncertainty of the timing of conflicts, assume that individuals have perfect foresight as to when an attack will occur; i.e., they know the sequence of \( \alpha_t \) for \( t \geq 1 \).⁴ Furthermore, assume that attacks occur every \( J \) periods, so that generation \( t \) expects that generation \( t + J, t + 2J, \ldots \), will be involved in a war. This implies that \( \alpha_{t+J}, \alpha_{t+2J}, \ldots \), are expected to be less than one, whereas for all other periods they are equal to unity. We assume that all weapons are expended after a war, although allowing for some to remain after a conflict does not affect the analysis. Finally, assume that no casualties result from war so that the total labour force remains intact. Permitting casualties does not alter the fundamental results but does require the introduction of an assumption regarding how the population is replenished.

Government expenditures in period \( t \) are financed by a lump-sum tax on each member of the young at the rate \( \tau_t \), and by the issuance of bonds, \( b_t \), which have a maturity of one period and pay a rate of \( r_t \). Therefore, government expenditures take two forms: expenditures on defence, and expenditures on the repayment with interest of government bonds which were issued in the previous period, \( b_{t-1} \), and which mature and carry an interest rate of \( r_{t-1} \). Therefore in period \( t \) the government's budget constraint in per capita terms is

\[
G_t = m_{t-1}^2 + (1 + r_{t-1})b_{t-1} = \tau_t + b_t.
\]

The individual's optimum

The budget constraints of generation \( t \) when young and when old if there is no war in period \( t \) are, respectively,

\[
w_t - \tau_t = c_t^1 + A_t^t,
\]

\[
[(1 + r_t)A_t^t + (1 + r_t)b_{t-1}^2] + \gamma_{t-1}m_{t-1}^2 = c_t^2 + B_t^2 + m_t^2.
\]

The budget constraints for generation \( t + J \) when young and when old when a war occurs as they turn old in period \( t + J + 1 \) are, respectively,

\[
w_{t+J} - \tau_{t+J} = c_{t+J}^1 + A_{t+J}^t,
\]

\[
\alpha_{t+J}[(1 + r_{t+J})A_{t+J}^t + (1 + r_{t+J})b_{t-1}^2] = c_{t+J}^2 + B_{t+J}^2 + m_{t+J}^2,
\]

where \( A_t^t \) is the amount of assets purchased by generation \( t \) when young to carry into retirement; \( B_{t-1}^2 \) is the amount bequeathed by generation \( t - 1 \) when old to generation \( t \), and, similarly, \( B_t^2 \) is the intended bequest of a member of generation \( t \) to generation \( t + 1 \); and \( m_t^2 \) denotes the desired defence expenditure of a member of generation \( t \) to protect his or her descendants. A similar interpretation follows for the variables of generation \( t + J \). Note that, under the assumption that all weapons are expended during war, \( m_{t+J-1}^2 = 0 \) in equation (10) and generation \( t + J \) begins the defence buildup, \( m_{t+1}^2 \) to protect against the next attack in period \( t + 2J \).

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Combining (9) and (10), we get the intertemporal budget constraint in the case that a war is expected to occur at the end of period \( t + J \):

\[
\alpha_{t+J}(w_{t+J} - \tau_{t+J}) + \alpha_{t+J}B_{t+J}^2 - \frac{c_{t+J}^1}{(1 + r_{t+J})} + \frac{B_{t+J}^2}{(1 + r_{t+J})} + \frac{m_{t+J}^2}{(1 + r_{t+J})}.
\]

The form of this budget constraint holds for generations, \( t + iJ, i = 1, 2, \ldots \), whereas for all other generations \( \alpha_i \) is set equal to unity in the above. Therefore, the young of generation \( t \) and \( t + J \) solve their respective maximization problems:

\[
\max_{\{c_t^1, c_t^2, B_t^2, m_t^2, \lambda_t^*, \lambda_t^{**}\}} W_t
\]

\[
= U(c_t^1, c_t^2) + \beta W_{t+1}^*(c_{t+1}^1, c_{t+1}^2)
+ \lambda_t^* \left[ (w_t - \tau_t) + B_{t-1}^2 + \frac{\gamma_{t-1}m_{t-1}^2 - c_t^1}{(1 + r_t)} - \frac{B_t^2}{(1 + r_t)} - \frac{m_t^2}{(1 + r_t)} \right],
\]

\[
\max_{\{c_{t+J}^1, c_{t+J}^2, B_{t+J}^2, m_{t+J}^2, \lambda^{**}\}} W_{t+J}
\]

\[
= U(c_{t+J}^1, c_{t+J}^2) + \beta W_{t+J+1}^*(c_{t+J+1}^1, c_{t+J+1}^2)
+ \lambda^{**} \left[ \alpha_{t+J}(w_{t+J} - \tau_{t+J}) + \alpha_{t+J}B_{t+J-1}^2 - \alpha_{t+J}c_{t+J}^1
- \frac{c_{t+J}^2}{(1 + r_{t+J})} - \frac{B_{t+J}^2}{(1 + r_{t+J})} - \frac{m_{t+J}^2}{(1 + r_{t+J})} \right].
\]

The first-order conditions for (13) is the constraint (11) along with

\[
\frac{\partial W_{t+J}}{\partial c_{t+J}^1} = \frac{\partial U}{\partial c_{t+J}^1} - \lambda^{**} - \alpha_{t+J} = 0,
\]

\[
\frac{\partial W_{t+J}}{\partial c_{t+J}^2} = \frac{\partial U}{\partial c_{t+J}^2} - \frac{\lambda^{**}}{(1 + r_{t+J})} = 0,
\]

\[
\frac{\partial W_{t+J}}{\partial B_{t+J}^2} = \frac{\lambda^{**}}{(1 + r_{t+J})} + \beta \lambda_{t+J+1} \alpha_{t+J+1} = 0,
\]

\[
\frac{\partial W_{t+J}}{\partial m_{t+J}^2} = \frac{\lambda^{**}}{(1 + r_{t+J})} + \frac{\beta \lambda_{t+J+1} \gamma_{t+J}}{(1 + r_{t+J})} = 0.
\]

By using the envelope theorem and recognizing that generation \( t + J \)'s decision affects directly only those of generation \( t + J + 1 \), equations (16) and (17)
become

\[
\frac{\partial W_{t+j}}{\partial B_{t+j}^2} = -\frac{\partial U}{\partial c_{t+j}^2} + \beta \alpha_{t+j+1}(1 + r_{t+j+1}) \frac{\partial U}{\partial c_{t+j+1}^2} = 0,
\]

\[
\frac{\partial W_{t+j}}{\partial m_{t+j}^2} = -\frac{\partial U}{\partial c_{t+j}^2} + \beta \gamma_{t+j} \frac{\partial U}{\partial c_{t+j+1}^2} = 0.
\]

Rearranging equations (14)-(15), we obtain the result

\[
\frac{\partial U}{\partial c_{t+j}^2} = \alpha_{t+j}(1 + r_{t+j}).
\]

Equation (18) simply states the familiar condition for an optimal consumption plan for an individual, i.e. that the marginal rate of substitution between consumption in the two periods of life should be equal to the cost. The only difference between this and the standard result is that, instead of the cost of consumption while young being \((1 + r_{t+j})\), it is now some multiple of it \(a_{t+j}\), i.e., interest is earned only on the proportion of the stock of assets that survive a conflict. As for equations \((16')\) and \((17')\), they establish the necessary conditions required to allocate assets optimally between consuming them while old or, instead, forgoing this consumption and bequeathing it to one's heirs in the form of assets or weapons, respectively.

II. IS DEBT-FINANCE DEFENCE SPENDING NEUTRAL?

From the first-order conditions and the government's budget constraint, we can arrive at an answer to whether an increase in defence spending financed by government debt will be offset by a comparable increase in savings and bequests so that defence spending is neutral. Note that conflict may be domestic in nature, e.g. armed insurrection or political unrest, or foreign as in the case of war. If the threat of conflict never existed, then \(\alpha_t = 1\) for all \(t\), and since individuals are not bequest-constrained increases in debt are offset by increases in bequest, with the implication that the issuance of debt has no real effect on the economy. In the model, a threat to the viability of bequeathing to future generations exists and therefore \(\alpha_t < 1\) in some periods.

The issue then becomes, will the old, perceiving this threat, increase their bequest in such a manner to offset the increase in \(m\), by an amount \(B_t\), thereby having no impact on the real economy? Stated another way, will the increase in defence spending financed by the issuance of bonds lead generation \(t\) to increase their bequest to generation \(t+1\) (their offspring) by the amount of the increase in tax liabilities?

In order to explore the effects of debt financing, we assume that generation \(t\) experiences a reduction in taxes (an increase in the size of the debt) and then examines whether their level of utility increases as a consequence. If so, then presumably these individuals would prefer debt financing of defence expenditures. The other possible method is to assume an exogenous increase in defence expenditures financed by debt (to be paid off by some future generation \(t+T\)) and analyse the change in utility of generation \(t\) from this policy. I assume the former policy (differential incidence), although both yield similar results.

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A welfare-maximizing individual of generation $t$ solves equation (12); or, conversely, by taking into consideration the recursive nature of the problem and substituting the constraint into the utility function of each successive generation, the individual solves

\[
\text{(19)} \quad \max_{c_t^1, c_t^2, m_t^2} \left\{ U[c_t^1, (1 + r_t)(w_t - \tau_t) + B_{t-1}^2 - c_t^1] + \gamma_{t-1}m_{t-1}^2 - B_t^2 - m_t^2 \right\}
\]

\[+ \beta \max_{c_{t+1}^1, (1 + r_{t+1})(w_{t+1} - \tau_{t+1}) + B_{t+1}^2 - c_{t+1}^1} U[c_{t+1}^1, (1 + r_{t+1})(w_{t+1} - \tau_{t+1}) + B_{t+1}^2 - c_{t+1}^1] + \cdots \]

\[+ \beta^j \max_{c_{t+j}^1, (1 + r_{t+j})(w_{t+j} - \tau_{t+j}) + B_{t+j}^2 - c_{t+j}^1} U[c_{t+j}^1, (1 + r_{t+j})(w_{t+j} - \tau_{t+j}) + B_{t+j}^2 - c_{t+j}^1] + \cdots \}
\]

By taking the derivative of the utility function of an individual of generation $t$ and using the fact that the present value of government expenditures has to be equal to tax receipts, we can determine how welfare is affected by the debt financing of defence expenditures. Formally, differentiating (19) with respect to $\tau_t$ and assuming that generation $t + T$ will pay the higher taxes to finance the additional debt yields

\[
(20) \quad \frac{dW_t}{d\tau_t} = -\frac{\partial U}{\partial c_t^2} (1 + r_t) - \beta^T (1 + r_{t+T}) \frac{\partial U}{\partial c_{t+T}^2} \frac{d\tau_{t+T}}{d\tau_t}
\]

\[+ \sum_{i=0}^{T} \beta^i \left[ \frac{\partial U}{\partial c_{t+i}^1} - \alpha_{t+i}(1 + r_{t+i}) \frac{\partial U}{\partial c_{t+i}^1} \right] \frac{dc_{t+i}^1}{d\tau_t}
\]

\[+ \sum_{i=0}^{T} \beta^i \left[ -\frac{\partial U}{\partial c_{t+i}^2} + \alpha_{t+i} \beta (1 + r_{t+i}) \frac{\partial U}{\partial c_{t+i+1}^2} \right] \frac{dc_{t+i}^2}{d\tau_t}
\]

\[+ \sum_{i=0}^{T} \beta^i \left[ -\frac{\partial U}{\partial c_{t+i}^2} + \gamma_{t+i} \beta \frac{\partial U}{\partial c_{t+i+1}^2} \right] \frac{dm_{t+i}^2}{d\tau_t}
\]

\[+ \beta^j \frac{\partial U}{\partial c_{t+j}^2} \left[ (1 + r_{t+j})(w_{t+j} - \tau_{t+j}) + B_{t+j}^2 - c_{t+j}^1 \right] \left( 1 - \gamma_{t+j} \right)
\]

\[\times \frac{d\alpha_{t+j}}{dm_{t+j}^2} \frac{dm_{t+j}^2}{d\tau_t} \]

By substituting the first-order conditions given by equations (16'), (17') and (18) into equation (20), it reduces to

\[
(20') \quad \frac{dW_t}{d\tau_t} = -\frac{\partial U}{\partial c_t^2} (1 + r_t) - \beta^T (1 + r_{t+T}) \frac{\partial U}{\partial c_{t+T}^2} \frac{d\tau_{t+T}}{d\tau_t}
\]

\[+ \beta^j \frac{\partial U}{\partial c_{t+j}^2} \left[ (1 + r_{t+j})(w_{t+j} - \tau_{t+j}) + B_{t+j}^2 - c_{t+j}^1 \right] \left( 1 - \gamma_{t+j} \right)
\]

\[\times \frac{d\alpha_{t+j}}{dm_{t+j}^2} \frac{dm_{t+j}^2}{d\tau_t} \]

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Since total government expenditures must be equal to tax receipts, i.e.

\[ \lim_{T \to +\infty} \sum_{t=1}^{T} \frac{G_t - r_t}{\Pi_{t=1}^{T} (1 + r_{t-1})} = 0, \]

we get

\[ \frac{dT_{t+T}}{dT_t} = -(1 + r_t)(1 + r_{t+1}) \ldots (1 + r_{T-1}). \]

Substituting (21') into equation (20') and rearranging yields

\[ \frac{dW_t}{dT_t} = \left[ -\frac{\partial U}{\partial a_t} (1 + r_t) + \beta(1 + r_{t+1}) \frac{\partial U}{\partial c_{t+1}^2} \right] \]

\[ + \beta(1 + r_{t+1}) \left[ -\frac{\partial U}{\partial c_{t+1}^2} + \beta(1 + r_{t+2}) \frac{\partial U}{\partial c_{t+2}^2} \right] + \ldots \]

\[ + \beta^2 \frac{\partial U}{\partial c_{t+j}^2} \left[ (1 + r_{t+j})((w_{t+j} - r_{t+j}) + B_{t+j-1}^2 c_{t+j}^2 - c_{t+j}^2)(1 - \gamma_t) \right] \]

\[ \times \frac{d\alpha_{t+j}}{dm_t^2} \frac{dm_t^2}{dT_t} < 0. \]

Noting that the terms in parentheses in the infinite series are equal to zero by the first-order conditions, we arrive at the final result:

\[ \frac{dW_t}{dT_t} = \beta^2 \frac{\partial U}{\partial c_{t+j}^2} \left[ (1 + r_{t+j})((w_{t+j} - r_{t+j}) + B_{t+j-1}^2 c_{t+j}^2 - c_{t+j}^2)(1 - \gamma_t) \right] \]

\[ \times \frac{d\alpha_{t+j}}{dm_t^2} \frac{dm_t^2}{dT_t} < 0. \]

Therefore, since a reduction in taxes or, equivalently, an increase in debt increases the welfare of generation \( t \), this generation will prefer to finance defence expenditures using debt instead of taxes. In other words, defence expenditures and debt are positively correlated. The possibility of increasing the size of the debt (i.e. for intergenerational transfers) is bounded by the level of defence spending, and therefore the potential increase in welfare is bounded. The implication is that, so long as welfare is increasing, defence spending will be financed by debt.

Note that the increase in the welfare of generation \( t \) is proportional to the impact that defence spending by them has on the national security of generation \( t + J \). The greater this impact is \( d\alpha_{t+j}/dm_t^2 \), the greater the welfare gain from debt financing. Welfare gains are also increasing in the size of the marginal propensity to consume defence by the current generation, \( dm_t^2/dT_t \).

It is important to observe that the preference for debt financing is dependent on the 'persistence' of these expenditures into the future, \( (1 - \gamma_t) \), i.e. on the fact that the generation that is attacked will be able to benefit from the current generation's military bequest. If \( \gamma_t \) is equal to one, then the current generation is indifferent to the form of financing, since their bequest in weapons is never realized by the generation that is attacked. Empirically, countries that spend a greater proportion of their defence budget on military
hardware such as tanks and aircraft should be observed to prefer debt financing.

In summary, the reason for the welfare gain from debt financing of military expenditures is that, if these increase the viability of bequests actually being received by one's children, parents view this as an additional form of 'bequest'. Therefore, parents would like a portion of the cost to be borne by future generations in the form of taxes to finance these military 'bequests'. The only instrument available to them to achieve this intergenerational transfer is debt. To contrast this with the typical Ricardian result, transfers to parents financed by deficits are enjoyed solely by the parents, and therefore parents offset this by increasing the size of their bequests so that their children do not have to pay for something they did not consume, whereas in the model presented here children enjoy the benefits of defence spending and pay for part of it through a reduction in the amount bequeathed to them by their parents. The results given by (23) are summarized as follows.

**Proposition 1.**

(a) The increase in the welfare of generation $t$ from an increase in debt is proportional to the impact that their defence spending has on the national security of generation $t + J$. The greater this impact is, $d\alpha_{t+J}/dm_t^2$, the greater the gain from debt financing.

(b) Welfare gains are also increasing in the size of the marginal propensity to consume defence by the current generation, $dm_t^2/dT$.

(c) The greater the wage, interest rate or savings of generation $t + J$, the greater the welfare gain to the current generation from switching to debt financing. Similarly, this gain is increasing in the amount bequeathed to $t + J$.

(d) Finally, this gain is decreasing in both the rate of time preference and the degree to which the resources in the defence sector can be transferred (converted) to civilian use.

### III. Empirical Evidence

The hypothesis given by (23) is that debt financing of defence spending will be preferred, whether of a permanent or temporary nature, to financing by taxation. The amount of debt that will lead to an increase in welfare is bounded by total defence outlays. Therefore, if we assume that majority rule characterizes the political process as it pertains to fiscal policy, then a political equilibrium is characterized by debt financing of any increase in defence spending which is perceived as necessary for increasing national security. This contrasts with the hypothesis implied by Ricardian equivalence, where debt financing leaves the individual's welfare unchanged, and therefore individuals are indifferent to the form of financing government expenditures. If so, no relationship should exist between the method of financing them and their level, since any proposed tax–debt combination to finance an increase in defence is equally preferred by all. So the first hypothesis we wish to test is whether the form of financing government spending is correlated with expenditure levels. More specifically, is debt financing positively related to defence spending?

Since stationarity of regressors is assumed when standard inferences are made in regression models, I first tested to see if the economic time-series used are stationary. In particular, I applied an Augmented Dickey–Fuller (ADF)
test to explore whether the annual real per capita deficit and real defence spending series have a unit root (Dickey and Fuller 1981). The resulting test statistics are reported in Table 1. The reported results use either one lag or no lags. As these results suggest, for the majority of countries deficits and defence spending appear to be non-stationary. Yet, looking at the first-differences, both series can be unanimously modelled as $I(1)$ processes.

Next, I estimated the equation

$$d_t = \beta_0 + \beta_1 M_t + \epsilon_t,$$

where $d_t$ denotes the annual real deficit and $M_t$, annual real defence spending per capita (corresponding to $(b_i - b_{i-1})$ and $m^2_t$ in the model, respectively).

Table 2 presents least-squares estimates of (24) for a sample of 11 countries. The sample time period used for each is dependent on the availability of data but is generally for the post-Korean War period. This is important because it allows us to exclude temporary spending increases motivated by the Korean War if the particular country was substantially involved, and which the optimal tax literature predicts should be financed by debt. Thus, we are examining a sample of countries that were not involved in any substantial war during the sample period and whose defence outlays are therefore part of their planned budgetary processes. The sample of countries chosen consists of current or past members of NATO. The exclusion of a member country (for example Spain and Portugal) from the sample reflects the unavailability of data for a sufficiently long period, with one exception: the United States was excluded because it was involved in several major wars during the period for which data are available, and therefore observing the expected relationship during the period may reflect tax-smoothing behaviour.

As expected, the coefficient for defence spending is positive for all countries and statistically significant for the majority. We can see that the impact of
TABLE 2
REGRESSION OF FISCAL DEFICITS (SURPLUS) ON MILITARY EXPENDITURE (ME)

<table>
<thead>
<tr>
<th>Country</th>
<th>Constant</th>
<th>ME</th>
<th>$R^2$</th>
<th>Time period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belgium</td>
<td>-321.4</td>
<td>4.50*</td>
<td>0.33</td>
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</tr>
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<td>(2.63)</td>
<td>(4.28)</td>
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<tr>
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<td>0.02</td>
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<tr>
<td></td>
<td>(1.97)</td>
<td>(0.61)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Denmark</td>
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<td>1.84*</td>
<td>0.07</td>
<td>1951-87</td>
</tr>
<tr>
<td></td>
<td>(1.78)</td>
<td>(1.91)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>France</td>
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<td>0.82*</td>
<td>0.19</td>
<td>1951-89</td>
</tr>
<tr>
<td></td>
<td>(1.58)</td>
<td>(3.14)</td>
<td></td>
<td></td>
</tr>
<tr>
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<td>0.82*</td>
<td>0.20</td>
<td>1954-89</td>
</tr>
<tr>
<td></td>
<td>(1.96)</td>
<td>(3.14)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Greece</td>
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<td>0.56</td>
<td>1957-89</td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Italy</td>
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<td>0.78</td>
<td>1952-90</td>
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<td></td>
<td>(7.90)</td>
<td>(11.7)</td>
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<td>0.55</td>
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<td></td>
<td>(5.14)</td>
<td>(6.07)</td>
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<td></td>
</tr>
<tr>
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<td>-0.36</td>
<td>0.01</td>
<td>1955-89</td>
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<tr>
<td></td>
<td>(1.52)</td>
<td>(0.76)</td>
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<td></td>
</tr>
<tr>
<td>Turkey</td>
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<td>0.08</td>
<td>1967-88</td>
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<tr>
<td></td>
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<td>(1.69)</td>
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<td></td>
</tr>
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<td>0.09</td>
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<tr>
<td></td>
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<td>(2.16)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: All variables are in constant 1985 prices in the particular country’s currency. 
$t$-statistics are in parentheses. 
*Significance at the 5% level. 
**Significance at the 10% level. 

military spending on the size of the deficits varies across country. This is expected, since Proposition 1 does not imply that they should be of similar size. In fact, coefficients that are not significantly different from zero could reflect a country’s small adjustment costs in the conversion of defence output to civilian use. It is important to note that the greatest impact on deficits based on the estimates are for Belgium, Denmark, Italy and the Netherlands; for example, an increase in defence spending leads to an increase in the size of the deficit by a multiple of 4.5 in the case of Belgium and slightly over 6 in the case of the Netherlands.

If deficits and defence spending are non-stationary, there is the danger that the results have been generated by a spurious regression. Although, as Engle and Granger (1987) observed, even though time-series data may be non-stationary in their levels, it is possible that a linear combination of the variables may exist such that a long-run relationship between them holds. Therefore, it is useful to test whether real deficits and defence spending per capita for these countries are cointegrated. The residual-based cointegration test employed is again the Augmented Dickey Fuller (ADF). The cointegration test results are reported in Table 3. As the results indicate, for six of the countries there appears to be a long-run relationship between deficits and defence spending.
To summarize, these results are consistent with the notion that defence may be viewed by the current generation as a form of ensuring the transferability of the capital stock to future generations, and therefore defence spending is not fully offset by taxes on the current generation but instead is partly financed by additional debt.

More generally, the empirical results emphasize that, in developing a positive theory of taxation, the composition of government spending plays an integral role. To explore whether this role is unique to national defence, Table 4 presents the results of regressing fiscal deficits on social security and welfare services and housing expenditures by government. The results are shown for the subset of countries where data were available. As they indicate, for half of the countries increases in social spending are associated with a decline in the deficit. If we assumed the existence of some rigidity in tax rates, then increases in government spending would be associated with increases in the deficits. At least for social spending, this does not appear to hold. As for spending by government on durable goods such as the housing stock, we find that all the coefficients are positive yet most are statistically not significant. Therefore, unlike defence spending, these other large components of government spending seem not to be associated with deficit financing as a naive theory based on the government’s one-period budget constraint would suggest.

Another possible way to test the proposition that defence spending plays a unique role is to examine whether the level of bequests are inversely related to military spending. To do so we use the level of saving as a proxy for the level of bequests. Saving reflects both a life-cycle motive and an inter vivos transfer and bequest motive. The range of importance of each motive varies considerably with recent estimates by Gale and Scholz (1994) finding bequests to be at

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**Table 3**

Cointegration Tests Results: Augmented Dickey-Fuller (ADF) Tests

<table>
<thead>
<tr>
<th>Country</th>
<th>ADF(2)</th>
</tr>
</thead>
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<td>Belgium</td>
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<tr>
<td>Canada</td>
<td>-3.83**</td>
</tr>
<tr>
<td>Denmark</td>
<td>-3.79*</td>
</tr>
<tr>
<td>France</td>
<td>-4.59*</td>
</tr>
<tr>
<td>Germany</td>
<td>-3.02</td>
</tr>
<tr>
<td>Greece</td>
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<td>Italy</td>
<td>-2.20</td>
</tr>
<tr>
<td>Netherlands</td>
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</tr>
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<td>Norway</td>
<td>-3.23**</td>
</tr>
<tr>
<td>Turkey</td>
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</tr>
<tr>
<td>UK</td>
<td>-1.43</td>
</tr>
</tbody>
</table>

Notes: Critical values are taken from MacKinnon (1990).
* Significance at the 5% level.
** Significance at the 10% level.

### Table 4

**Regression of Fiscal Deficits (Surplus) on Social Security and Welfare Services (SSWS) and on Housing and Community Amenities (HCA)**

<table>
<thead>
<tr>
<th>Country</th>
<th>Constant</th>
<th>SSWS</th>
<th>HCA</th>
<th>AR(1)</th>
<th>DW</th>
<th>Time period</th>
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<td>1.65</td>
<td>1971–89</td>
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<td></td>
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<td>(0.22)</td>
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<td>(3.68)</td>
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</tr>
<tr>
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<td>3.10</td>
<td>0.91</td>
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<td></td>
</tr>
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<td>(3.35)</td>
<td>(13.6)</td>
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</tr>
<tr>
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<td>(2.69)</td>
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<td>(10.48)</td>
<td>(0.97)</td>
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</tr>
<tr>
<td>Italy</td>
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<td>1971–90</td>
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<td>(6.75)</td>
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</tr>
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<td>(2.34)</td>
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<td>(0.33)</td>
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<td>(5.61)</td>
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<td>(0.26)</td>
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</tr>
</tbody>
</table>

**Notes:** All variables are in constant 1985 prices in the particular country's currency. t-statistics are in parentheses.


least 51% of net worth accumulation. Estimates by Kotlikoff and Summers (1981) are even higher, with Modigliani (1988) finding much lower ones. Consequently, saving is a better proxy for bequests as the importance of life-cycle considerations diminishes.

We therefore estimate the following by OLS:

\[(25) \quad S_t = \gamma_{10} + \gamma_{11} M_t + \gamma_{12} S_{t-1} + \gamma_{13} Y_t + \varepsilon_{it},\]

where \(S_t\) denotes the aggregate level of real saving at time \(t\) and \(Y_t\), output as measured by either real GNP or GDP. I use lagged saving in order to use the additional information already contained in assets, i.e. to capture the effects of other variables that are important and presumably are already incorporated at time \(t-1\) by individuals (Deaton 1992). The variable GNP is included to incorporate the effects on saving from innovations to income which are transitory.

As the results presented in table 5 indicate, the coefficients all have the expected signs. Furthermore, the coefficients for lagged saving and GNP are economically significant; i.e., they are consistent with the permanent income hypothesis. Since the Durbin–Watson statistic requires that no lagged
### Table 5
回归实证的总储蓄（$S_1$）对实际军费开支（$ME_t$），滞后的储蓄（$S_{t-1}$）和实际GNP（$Y_t$）

<table>
<thead>
<tr>
<th>国家</th>
<th>恒定项</th>
<th>$S_{t-1}$</th>
<th>$ME_t$</th>
<th>GNP</th>
<th>$R^2$</th>
<th>LM</th>
<th>时间段</th>
</tr>
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</tr>
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<td>(5.83)</td>
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<td>(1.87)</td>
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<td>(1.70)</td>
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<td>(1.09)</td>
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</tbody>
</table>

**Notes:** 所有变量均以该国1985年的常数价格表示。t-statistics are in parentheses.
* Significance at the 5% level.
** Significance at the 10% level.
° Denotes the failure to reject the hypothesis of second-order autocorrelation.
Sources: International Monetary Fund, International Financial Statistics; SIPRI Yearbook, World Armaments and Disarmament; OECD, National Accounts.

重要的是，军事支出的系数符号为负，这表明国防开支减少了国家储蓄。另一方面，统计显著性在一般接受的水平上很高。统计量的大小也表明，由于支出的增加而增加的支出。这个结果倾向于支持这样一个假设，即国家在国防支出增加时减少继承，但一般而言，增加的次数会明显大于前者。更有趣的是，这些估计值还表明，增加国防开支的国家的国防支出对经过调整的消费有最大的不利影响。比利时、丹麦、荷兰和法国。正如表2中的结果所示，前三个国家也是那些国防支出对经过调整的消费有最大影响的国家。

最后，为了进一步研究这一点，我们估计了以下回归方程

\[
S_t = \gamma_0 + \gamma_1 M_t + \gamma_2 S_{t-1} + \gamma_3 Y_t + \epsilon_{2t}.
\]

In this equation, $s_t$ denotes a country's saving rate and $\times M_t$, the share of military spending in GNP. The results are presented in Table 6. These are again found

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### Table 6

REGRESSION OF SAVING RATES ($s_t$) ON THE SHARE OF MILITARY SPENDING IN GNP ($x_{ME}$), LAGGED SAVING RATE ($s_{t-1}$) AND REAL GNP ($Y_t$)

<table>
<thead>
<tr>
<th>Country</th>
<th>Constant</th>
<th>$s_{t-1}$</th>
<th>$x_{ME}$</th>
<th>GNP</th>
<th>$R^2$</th>
<th>LM</th>
<th>Time period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belgium</td>
<td>16.8</td>
<td>0.66</td>
<td>-3.18</td>
<td>0.00009</td>
<td>0.85</td>
<td>1.88</td>
<td>1954-89</td>
</tr>
<tr>
<td></td>
<td>(4.11)</td>
<td>(7.55)</td>
<td>(3.68)</td>
<td>(3.35)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canada</td>
<td>5.78</td>
<td>0.71</td>
<td>-0.42</td>
<td>-0.0006</td>
<td>0.53</td>
<td>5.62</td>
<td>1952-90</td>
</tr>
<tr>
<td></td>
<td>(2.76)</td>
<td>(6.12)</td>
<td>(1.82)</td>
<td>(1.86)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Denmark</td>
<td>13.0</td>
<td>0.80</td>
<td>-2.60</td>
<td>-0.0001</td>
<td>0.85</td>
<td>2.07</td>
<td>1953-89</td>
</tr>
<tr>
<td></td>
<td>(1.71)</td>
<td>(8.51)</td>
<td>(1.44)</td>
<td>(1.82)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>France</td>
<td>11.5</td>
<td>0.75</td>
<td>-0.62</td>
<td>-0.0001</td>
<td>0.92</td>
<td>3.92</td>
<td>1960-90</td>
</tr>
<tr>
<td></td>
<td>(2.1)</td>
<td>(5.53)</td>
<td>(0.65)</td>
<td>(1.47)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Germany</td>
<td>7.10</td>
<td>0.82</td>
<td>-0.54</td>
<td>-0.0002</td>
<td>0.89</td>
<td>0.39</td>
<td>1962-90</td>
</tr>
<tr>
<td></td>
<td>(2.08)</td>
<td>(8.54)</td>
<td>(0.96)</td>
<td>(2.03)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Greece</td>
<td>7.26</td>
<td>0.88</td>
<td>-1.32</td>
<td>-0.00005</td>
<td>0.81</td>
<td>2.24</td>
<td>1959-89</td>
</tr>
<tr>
<td></td>
<td>(1.28)</td>
<td>(10.7)</td>
<td>(2.12)</td>
<td>(0.76)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Italy</td>
<td>9.47</td>
<td>0.74</td>
<td>-0.93</td>
<td>-0.0006</td>
<td>0.89</td>
<td>1.61</td>
<td>1953-90</td>
</tr>
<tr>
<td></td>
<td>(1.98)</td>
<td>(8.92)</td>
<td>(0.97)</td>
<td>(2.42)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Netherlands</td>
<td>16.4</td>
<td>0.71</td>
<td>-1.80</td>
<td>-0.0017</td>
<td>0.84</td>
<td>1.80</td>
<td>1961-89</td>
</tr>
<tr>
<td></td>
<td>(1.32)</td>
<td>(4.76)</td>
<td>(0.99)</td>
<td>(1.28)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Norway</td>
<td>13.2</td>
<td>0.50</td>
<td>-1.04</td>
<td>-0.0009</td>
<td>0.57</td>
<td>7.36</td>
<td>1952-90</td>
</tr>
<tr>
<td></td>
<td>(3.07)</td>
<td>(3.97)</td>
<td>(1.25)</td>
<td>(2.58)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turkey</td>
<td>7.87</td>
<td>0.64</td>
<td>-1.31</td>
<td>0.00001</td>
<td>0.62</td>
<td>3.77</td>
<td>1961-88</td>
</tr>
<tr>
<td></td>
<td>(1.95)</td>
<td>(3.74)</td>
<td>(1.77)</td>
<td>(1.97)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UK</td>
<td>12.3</td>
<td>0.61</td>
<td>-0.68</td>
<td>-0.002</td>
<td>0.74</td>
<td>2.42</td>
<td>1951-88</td>
</tr>
<tr>
<td></td>
<td>(2.36)</td>
<td>(4.60)</td>
<td>(1.71)</td>
<td>(2.43)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: $t$-statistics are in parentheses.
Sources: International Monetary Fund, International Financial Statistics; SIPRI Yearbook, World Armaments and Disarmament; OECD, National Accounts.

The estimates obtained for the lagged saving rate are all positive and highly significant. The estimates are all less than one, as expected. As for the coefficient for GNP, all are negative (except Turkey) and a majority are statistically significant. The implication is that, as a country's level of output grows, its saving rate declines. This is consistent with some form of convergence of growth rates if we assume that these results hold for countries at different stages of economic development. Further exploration of this issue is beyond the scope of this paper.

### IV. Summary

Generally, the role of government in overlapping-generations models with bequest motives has been to provide intergenerational transfers such as social
security. This paper instead assumed that the government’s role is to act as an intermediary between generations in the provision of national defence. Once this function of government is recognized, Ricardian equivalence no longer holds. Consequently, the level of public debt should be positively related to defence spending, since this component of government expenditures ensures the transferability of bequest, as well as protecting savings. These results hold in a model where there is no uncertainty regarding the timing of conflicts or war and where, therefore, they are not dependent on individual’s income streams being uncertain. Nor do the results depend on the assumptions that individuals are bequest-constrained or that they care about their parents and therefore that intergenerational transfers result from strategic behaviour or that capital markets are imperfect. None of the above conditions is assumed to exist.

The empirical evidence seem to support this proposition. Using time series for a sample of 11 countries, a positive relation between deficits and defence spending is observed. More importantly, it is found that both the aggregate level of savings and the saving rate are reduced substantially by military spending. As a result, we should expect to find that deficit financing has real effects on the economy of those countries in the sample where a strong relationship is found, namely affecting interest rates, and therefore rates of capital formation, GDP, as well as economic growth. Finally, in the current climate of defence expenditure cuts by many countries as a consequence of the end of the Cold War, the implication derived from this analysis is that the fiscal deficits of these countries will be reduced in the future.

ACKNOWLEDGMENTS

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NOTES

1. I assume that this military good has the characteristics of a private good to simplify matters in the discussion; yet making it a public good does not alter the analysis, since individuals are all assumed to have identical preferences.
2. This could also be interpreted as the amount of depreciation between periods.
3. The amount of military spending by an adversary \( M_f \) is viewed as a parameter, and therefore we are implicitly analysing the dynamics of this economy along a Nash equilibrium path in a game in \( M \) and \( M^* \).
5. Ignoring any general equilibrium effects, although since we have assumed identical preferences and endowments these would affect all individuals of a given generation in the same way.
6. There is a yet unresolved debate on whether governments violate intertemporal solvency, i.e. whether government debt is unbounded or deficits are non-stationary. For a survey of the literature and empirical evidence on the US deficit, see Tanner and Liu (1994).
7. Since the primary result of this paper is theoretical, no attempt has been made to use and compare the various other cointegration test procedures. One would expect that ‘searching’ through these others would yield results at least as conclusive.
8. Cointegration test results show that the residuals of both saving regressions are stationary. These, as well as the time-series characteristics of the other variables, are available upon request from the author.
9. Other forms of government expenditures, e.g. investment in infrastructure, if perceived by parents as increasing either the returns to capital or the level of wealth of their descendants, may have similar effects.

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REFERENCES


