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Taxes on Capital Accumulation and Economic Growth

by

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Abstract

This paper investigates the effect of taxation on capital accumulation using an endogenous growth model with an altruistic-bequest motive. When bequests are not operative, an increased tax on human capital may not reduce the rate of economic growth, while a tax increase on physical capital will reduce the growth rate. If bequests are operative, a tax on life-cycle capital will not affect the growth rate, while a tax increase on transfer capital will reduce the growth rate. This paper also examines how to attain the first best solution given its operative assumptions.

Key words: bequest taxation, economic growth, intergenerational transfer

JEL classification numbers: H2, H3

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1. Introduction

There are two types of capital from the viewpoint of their origin; life cycle capital (capital accumulated from life cycle behavior) and transfer capital (capital deriving from intergenerational transfers). We observe in the real economy large intergenerational transfers, e.g., educational investment and physical bequests, (see Kotlikoff and Summers (1981)). It is hence important to analyze the effect on economic growth of taxing these two types of capital accumulation. Furthermore, it is generally believed that increased taxes on capital income (i.e., taxation on capital accumulation) reduces economic growth. It should be noted that the effect on capital accumulation is not necessarily the same as the effect on the rate of economic growth. In order to explore this point, models of endogenous growth, which explicitly distinguish transfer capital from life-cycle capital, will be useful.

Recently, several papers, applying overlapping generations models, have addressed endogenous growth. Jones and Manuelli (1990) showed that an income tax-financed redistributive policy can be used to induce positive growth. Azariadis and Drazen (1990) and Caballe (1991) presented models of endogenous growth in which the accumulation of human capital is subject to externalities. Caballe (1991) has shown that lump-sum intergenerational transfer policies will be ineffective when altruistic bequests are fully operative. He then investigated the effect of several fiscal policy experiments for both bequest-constrained economies and unconstrained ones. His analysis is the closest in spirit to this paper. In contrast, we model the human-capital accumulation process so as to obtain clearer results with regard to any externality effects associated with it. Finally, in this line of literature, Buiter and Kletzer (1993) investigated international productivity growth differentials by incorporating human capital accumulation[1].

This paper incorporates into an endogenous growth model with an altruistic bequest motive three types of taxes on capital: a tax on life-cycle physical capital income, a tax on human capital income, and a tax on transfer physical capital or bequetsts. The analytical results depend on whether bequests are operative or not. When bequests are not operative and the externality effect of human capital is small, the laisse-faire growth rate may well be too high. An increased tax on human capital income (a wage income tax) may raise the rate of economic growth, while a tax increase on life-cycle physical capital income (an interest income tax) will reduce the growth rate. If bequests are operative, the laissez-faire growth rate is too low. A tax on life-cycle capital income will not affect the growth rate, while an increase in taxes on transfer capital income (a wage income tax and a bequest tax) will reduce the growth rate.

This paper is organized as follows. Section 2 presents an overlapping-generations model with endogenous growth. Section 3 compares the competitive laissez-faire growth rate with the efficient one. Section 4 investigates the effect on economic growth of taxation on capital accumulation, and also examines how to attain the first best solution. Finally, in section 5, we present our conclusions.

2. Endogenous Growth Model

2.1 Technology

A common feature of recent models of endogenous growth is the presence of constant or increasing returns in physical capital and human capital. Firms act competitively and use a constant-returns-to-scale technology.

$$Y_t = AK_t^{1-\alpha} H_t^{\alpha} \tag{1}$$

where Y is output, K is physical capital, and H is human capital. A is a productivity parameter which is taken here to be multiplicative and is used to capture the idea of endogenous growth a la Rebelo (1991).[2]

2.2 Three-period overlapping generations model

As the vehicle of exposition, consider a three-period overlapping generations model similar to Batina (1987), Jones and Manuelli (1990), Caballe (1991), Marchand, Michel and Pestieau (1992), and Buiter and Kletzer (1993). The number of households of each generation, n, is normalized to one[3]. In period t-1, when the household of generation t is young, the parent of generation t-1 can choose to spend private resources other than time on human capital formation, B_{t-1}, and physical savings (bequests), M_{t-1} ,for his child.

The stock of human capital used in employment by generation t during period t, H_t, is assumed to be a sum of a function of transfer input, B_{t-1} and the average level of human capital achieved by the previous generation, $\hat{H}_{t-1}$.

$$\hat{H}_t = (1-\delta)H_t + \overline{H}_t \tag{2}$$

where $\delta = 1 - \frac{1}{n}$. $\overline{H}_t$ is the ratio of the others' human capital to the total number of people[4]. n is the total number of individuals of each generation. The first term reflects the effect of his own human capital on the average human capital and the second term reflects the effect of the others' human capital on the average level. When $n \to \infty$, he would not recognize the externality effect of his own capital, and hence the externality effect of human capital is perfect. When $n = 1$, he considers his own capital and the average level as equivalent; the externality effect is absent.

Thus, δ may be regarded as the degree of externality. This extra term, $\hat{H}_{t-1}$, embodies the kind of externality similar to Romer's (1986) and Lucas' (1988), and reflects the fact that production is a social activity.

Thus we have

$$H_t = \hat{H}_{t-1} + B_{t-1} \tag{3}$$

All human capital is inherited either genetically or through education expenditure B by parents. The externality effect in the accumulation of human capital is not fully considered by parents when they decide how much to invest in their children's education.

During middle age, generation t's household choices concern how much to consume c_t^1, how much to save for the old age s_t, how much to save for his child, M_t, and how much to spend on human capital formation of his child, B_t. The entire endowment of labor time services, in efficiency units H_t, is supplied inelastically in the labor market and wage income $h_t H_t$ is obtained.[5] h_t is the wage rate. He also receives physical bequests, $(1+r_t)M_{t-1}$. r_t is the interest rate. In the last period of life (the "old age" of "retirement"), households do not work or educate themselves. They consume c_{t+1}^2.

The government imposes taxes on capital accumulation and tax revenues are returned as a lump sum transfer to the same generation. This is a standard assumption of the differential incidence. Otherwise, the tax policy would include the intergenerational redistribution effect such as debt issuance or unfunded social security.

Thus, the middle-age budget constraint is given by

$$c_t^1 + s_t + B_t + M_t + \theta_B h_t H_t + \theta_M (1+r_t) M_{t-1} = h_t H_t + (1+r_t) M_{t-1} + R_t^1 \tag{4-1}$$

Substituting (3) into (4-1), we have

$$c_t^1 + s_t + M_t + H_{t+1} + \theta_B h_t H_t + \theta_M (1+r_t) M_{t-1} = (\hat{H}_t + h_t H_t) + (1+r_t) M_{t-1} + R_t^1 \tag{4-1}'$$

The old-age budget constraint is given by

$$c_{t+1}^2 + \tau r_{t+1} s_t = (1+r_{t+1}) s_t + R_{t+1}^2 \tag{4-2}$$

where θ_B is a tax on income from human capital (a wage income tax), θ_M is a tax on physical bequests, and τ is a tax on income from life-cycle physical capital (an interest income tax), R_t^1 is a lump sum transfer on the middle in period t, and R_t^2 is a lump sum transfer on the old in period t.

The government budget constraint is given by

$$R_t^1 = \theta_B h_t H_t + \theta_M (1+r_t) M_{t-1} \tag{5-1}$$

$$R_{t+1}^2 = \tau r_{t+1} s_t \tag{5-2}$$

Taxes on human capital accumulation are represented by taxes on wage income: $\theta_B h_t H_t$'. Note that from (2) $H_t = \hat{H}_t$ holds in the aggregate economy.

The feasibility condition in the aggregate economy is given by

$$c_t^1 + c_t^2 + K_{t+1} + H_{t+1} = Y_t + K_t + H_t \tag{6}$$

Physical capital accumulation is given by

$$s_t + M_t = K_{t+1} \tag{7}$$

Recall that both life cycle saving and bequests provide funds for physical capital accumulation in the aggregate economy. Note that human capital accumulation is given by (2) and (3). The rates of return on two types of capital are respectively given by

$$r = \partial Y / \partial K = A(1-\alpha)k^{-\alpha} \tag{8-1}$$

$$h = (Y - rK) / H = \partial Y / \partial H = A\alpha k^{1-\alpha} \tag{8-2}$$

where $k = K/H$ is the physical capital-human capital ratio.

2.3 Altruistic bequest motive

An individual born at time t-1 consumes c_t^1 in period t and c_{t+1}^2 in period t+1 and derives utility from his own consumption.

$$u_t = \log c_t^1 + \varepsilon \log c_{t+1}^2, 0 < \varepsilon < 1 \tag{9}$$

ε reflects the private preference of old-age consumption or life cycle savings. For simplicity, we assume a log-linear form throughout this paper. The qualitative results would be the same in a more general functional form.

In the altruism model the parent cares about the welfare of his offspring[7]. The parent's utility function is given by

$$U_t = u_t + \rho U_{t+1} = \log c_t^1 + \varepsilon \log c_{t+1}^2 + \rho U_{t+1} \tag{10}$$

$0 < \rho < 1$. ρ reflects the parent's concern for the child's well-being.

3. Economic Growth and Efficiency

3.1 The first best solution

We first analyze the growth path which would be chosen by a central planner who maximizes an intertemporal social welfare function. The objective of the planner at time t is the same as that of the altruistic individual, "head of dynasty", living at time t. Since that the planner does not discriminate between H_t and $\hat{H}_t$, the maximization problem faced by the planner is

$$Max \sum_{t=0}^{\infty} \rho^t u_t \qquad \text{subject to (6)}$$

Solving for c_t^2 in (6) and substituting in the objective function, we obtain the following first order conditions for planner's optimization problem by taking the derivatives with respect to c_t^1, K_t, H_t, respectively.

$$1/c_t^1 = \varepsilon(1+r_{t+1})/c_{t+1}^2 \tag{11-1}$$

$$1/c_t^1 = \rho(1+r_{t+1})/c_{t+1}^1 \tag{11-2}$$

$$r_t = h_t \tag{11-3}$$

Along with the transversality condition

$$\lim_{t\to\infty} \rho^t K_t / c_t^1 = 0 \tag{11-4}$$

(11-1,2,3,4) imply that the economy moves right from the first period on a path of balanced growth. The optimal growth rate, γ *, is given by

$$\gamma^* = \rho(1+r^*) \tag{12}$$

where r^* is given by

$$r^* = h^* = A\alpha k^{*1-\alpha}, \quad and\ k^* = \alpha/(1-\alpha). \tag{13}$$

3.2 Optimizing behavior in the market economy

An individual born at time t must solve the following maximization problem, after choosing s_t, H_{t+1}, and M_t given $\overline{H}_{t+1}$ in (2). Substituting (2)(4-1)' and (4-2) into (10), we have

$$\begin{aligned} U_t = {} & \log[\hat{H}_t + (1-\theta_B)h_t H_t + (1-\theta_M)(1+r_t)M_{t-1} - H_{t+1} - s_t - M_t + R_t^1] + \\ & \varepsilon \log\{[1+(1-\tau)r_{t+1}]s_t + R_{t+1}^2\} + \rho\{\log[(1-\delta)H_{t+1} + \overline{H}_{t+1} + (1-\theta_B)h_{t+1}H_{t+1} + \\ & (1-\theta_M)(1+r_{t+1})M_t - H_{t+2} - s_{t+1} - M_{t+1} + R_{t+1}^1] + \varepsilon \log\{[1+(1-\tau)r_{t+2}]s_{t+1} + R_{t+2}^2\} + \rho U_{t+2}\} \end{aligned} \tag{14}$$

The optimality conditions with respect to s_t, H_{t+1}, and M_t are

$$1/c_t^1 = [1+(1-\tau)r_{t+1}]\varepsilon / c_{t+1}^2 \quad (15\text{-}1)$$

$$1/c_t^1 = \rho[1-\delta+(1-\theta_B)h_{t+1}]/c_{t+1}^1 \quad (15\text{-}2)$$

$$1/c_t^1 \geq \rho(1-\theta_M)(1+r_{t+1})/c_{t+1}^1 \quad \text{with equality if } M_{t+1} > 0 \quad (15\text{-}3)$$

s cannot be zero. Otherwise, c^2 would be zero, a fact which is inconsistent with optimizing behavior. H also cannot be zero since Y would be zero and, again, this would be inconsistent with optimizing behavior . However, M could become zero. If the private marginal return of educational investment is higher than the private marginal return of bequests at $M=0$, the intergenerational transfer is operative only in the form of human capital investment.

3.3 The case where physical bequests are zero

Suppose the government does not levy any taxes; $\tau = \theta_B = \theta_M = 0$. If $1\text{-}\delta + h > 1+r$ at $M = 0$, we have the corner solution where bequests are zero. We have from (4-2) and (15-1)

$$s = c^1\varepsilon \quad (16)$$

Substituting (16) into (4-1)', we have

$$H_{t+1} + (\frac{1}{\varepsilon}+1)s_t = (1+h_t)H_t \quad (17)$$

On the other hand, from (15-2) we have in the steady state[8]

$$H_{t+1} = \rho(1-\delta+h_t)H_t \quad (18)$$

Hence, considering (7)(17) and (18) the steady-state physical capital human capital ratio $\hat{k}$ is uniquely given as a solution of (19).

$$1+(\frac{1}{\varepsilon}+1)k=\frac{1+h}{(1+h-\delta)\rho} \tag{19}$$

LHD of (19) is increasing with k, while RHD of (19) is decreasing with k. When ε increases, LHD decreases, so that $\hat{k}$ increases. When ρ decreases, RHD increases, so that $\hat{k}$ increases.

On the other hand, considering (8-1) and (8-2), $1-\delta+h > 1+r$ at $M = 0$ if and only if

$$A\alpha\hat{k}^{-\alpha}(\hat{k}-\frac{1-\alpha}{\alpha})>\delta \tag{20}$$

Or

$$\hat{k}>\tilde{k},\quad where\ \tilde{k}\ satisfies\ A\alpha k^{-\alpha}(k-\frac{1-\alpha}{\alpha})=\delta \tag{21}$$

When there are less incentives to leave bequests, we may well have the corner solution of $M = 0$. The larger ε and the smaller ρ, it is more likely to have inequality (21).

The laissez faire growth rate is given by

$$\gamma_{M=0}=\rho(1-\delta+A\alpha\hat{k}^{1-\alpha}) \tag{22}$$

where $\hat{k}$ is given by (19). An increase in the intragenerational preference for life cycle capital ε will raise the physical capital-human capital ratio $\hat{k}$, leading to a higher rate of return on human capital and higher economic growth. An increase in the intergenerational preference ρ has two effects. It will stimulate the intergenerational transfer from the old to the young, inducing high growth. On the other hand, it will reduce $\hat{k}$ and the rate of return on human capital, h, retarding economic growth.

Considering (19) and (22), we have

$$\frac{\partial \gamma}{\partial \rho} = (1+h-\delta)\frac{(1+h-\delta)[(1+h)(1-\rho)+\rho\delta-(1-\alpha)h]}{\delta(1-\alpha)h+[(1+h)(1-\rho)+\rho\delta](1+h-\delta)} \quad (23)$$

Thus, if $\frac{1+\alpha h}{1+h-\delta} > \rho$, then $\frac{\partial \gamma}{\partial \rho} > 0$ (and vice versa). In other words, if α and δ are high, it is likely to have $\frac{\partial \gamma}{\partial \rho} > 0$. However, it should be stressed that $\frac{\partial \gamma}{\partial \rho} < 0$ is also possible. In the bequest constrained economy, an increase in the parent's concern for the child's welfare does not necessarily raise the growth rate.

Since $1-\delta+h>1+r$, $h > r$. Hence $r < r^*=h^* < h$. It is possible that $1-\delta+h>1+h^*$. In such a case $\gamma_{M=0} > \gamma^*$; the laissez-faire growth rate in the constrained equilibrium is too high. If the externality effect is absent (δ=0), $1+h>1+h^*$; the laissez-faire growth rate is always too high.

The laissez-faire economy may not attain the first best solution for two reasons. First, the externality effect in the accumulation of human capital is not considered by the parent. This means that the competitive growth rate becomes too low. Second, M_t cannot be negative because there is no institutional mechanism to enforce such a liability on future generations. Human capital is too little and the marginal return on human capital is too high, which means that the competitive growth rate becomes too high. Therefore, the lower δ is the likely that the second effect dominates and the laissez faire growth rate is too high.

3.4 The case where physical bequests are operative

When $M > 0$, we have both (15-2) and (15-3) with equality. Hence,

$$1-\delta+h = 1+r \quad (24)$$

k is given by $\tilde{k}$.

$$A\alpha k^{-\alpha}[k - \frac{1-\alpha}{\alpha}] = \quad \delta \tag{25}$$

The unconstrained growth rate is thus given by

$$\gamma_{M>0} = \rho(1 - \delta + A\alpha\tilde{k}^{1-\alpha}) = \rho[1 + A(1-\alpha)\tilde{k}^{-\alpha}] \tag{26}$$

From (25) $\tilde{k}$ is independent of ρ or ε. (26) shows that the life cycle saving motive ε will not affect the growth rate, while an increase in the transfer saving motive ρ will definitely raise the growth rate.

Since $h > h^*$ and $r < r^*$, we always have

$$\gamma_{M>0} < \gamma^*$$

When physical bequests are operative, the competitive economy could differ from the first best solution only due to the externality effect of human capital. Thus, the laissez-faire growth rate is always too low.

4. Taxes and Economic Growth

4.1 The constrained economy

Consider now the effect of taxes on capital accumulation in the bequest-constrained economy of $M = 0$. When taxes are incorporated, (19) may be rewritten as

$$1 + \{\frac{1+r}{\varepsilon[1+(1-\tau)r]} + 1\}k = \frac{1+h}{[1+(1-\theta_B)h - \delta]\rho} \tag{19'}$$

Given (8-1), it is easy to find that LHD of (19)' is increasing with k, while RHD of (19)' is decreasing of k. Hence, as in section 3.3, the steady-state physical capital human capital ratio $\hat{k}$ is uniquely determined.

In this case (22) may be rewritten as

$$\gamma_{M=0} = \rho[1-\delta+(1-\theta_B)A\alpha\hat{k}^{1-\alpha}] \tag{22)'$$

An increase in the tax on life-cycle capital income (an increase in the interest income tax), τ, will reduce $\hat{k}$ and hence will depress the growth rate.

However, the effect on the growth rate of a tax increase on income from human capital (an increase in the wage income tax), θ_B, is ambiguous. It will directly reduce the growth rate, while it will indirectly raise the growth rate by raising $\hat{k}$ and h. Namely, an increase in the wage income tax will raise the physical capital-human capital ratio, and hence will increase h. If this indirect effect is dominant, an increase in the wage income tax will raise the growth rate.

Finally, let us consider how to attain the first best solution by using capital taxes. The optimal levels of τ and θ_B are given by

$$\tau = 0 \tag{27}$$

$$1-\delta+(1-\theta_B)A\alpha(\frac{\alpha}{1-\alpha})^{1-\alpha} = 1+A\alpha(\frac{\alpha}{1-\alpha})^{1-\alpha} \tag{28}$$

From (28) the optimal level of θ_B is negative so long as > 0[9]. Furthermore, in order to attain $k^* = \hat{k}$, an additional lump-sum intergenerational transfer from the young to the old such as debt issuance or unfunded social security is also needed. Such a policy can substitute negative bequests.

4.2 The unconstrained case

When $M > 0$, we have both (15-2) and (15-3) with equality. Hence,

$$1-\delta+(1-\theta_B)h = (1-\theta_M)(1+r) \tag{29}$$

In this case $\hat{k}$ is given by (29) and the growth rate is given by

$$\gamma_{M>0} = \rho[1-\delta+(1-\theta_B)A\alpha\hat{k}^{1-\alpha}] = \rho(1-\theta_M)[1+A(1-\alpha)\hat{k}^{-\alpha}] \qquad (26)'$$

An increase in θ_B will raise $\hat{k}$ and reduce r. Hence from the second equality of (26)' it will reduce the growth rate. An increase in θ_M will reduce $\hat{k}$ and h. Hence from the first equality of (26)' it will also reduce the growth rate. In other words, an increase in any taxes on transfer capital will definitely reduce the growth rate when bequests are operative. (26)' is independent of τ; the tax rate on life cycle capital income will not affect the growth rate.

The optimal level of θ_B is given by (28), which is the same as in the constrained case. Note that $\theta_M = \tau = 0$ at the first best solution. In this case the market failure comes only from the externality effect of human capital. A subsidy to human capital accumulation will raise the growth rate and can attain the first best solution.

5. Conclusion

This paper has incorporated the altruistic bequest motive into an endogenous growth model of overlapping generations. We have shown that the impact of taxes on capital accumulation on the growth rate is different, depending on whether bequests are operative or not. When bequests are zero, an increase in a tax on human capital accumulation may not reduce the rate of economic growth, while an increase in a tax on life-cycle physical capital will reduce the growth rate. If bequests are operative, a tax on life cycle capital accumulation will not affect the growth rate, while an increase in any taxes on transfer capital (educational investment or bequests) will reduce the growth rate. Our analysis has explored the paradoxical possibility that taxes on capital accumulation may not reduce the rate of economic growth in several cases.

Finally, in the bequest-constrained economy, the laissez-faire growth rate may be too high if the externality effect is small. A subsidy to human capital accumulation and a lump-sum transfer from the young to the old can attain the first best solution. In the unconstrained economy, the market failure comes only from the externality effect of human capital. A subsidy to human capital accumulation will raise the growth rate and can attain the first best solution.

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The definitions of all the variables

Y = output
K = physical capital
H = human capital
A = productivity parameter
B = human capital investment
M = physical bequests
$\hat{H}$ = average level of human capital
$\overline{H}$ = ratio of the others' human capital to the total number of people
σ = degree of externality
c^1 = consumption during middle age
c^2 = consumption during old age
s = savings for old age
h = wage rate
r = interest rate
θ_B = tax on income from human capital
θ_M = tax on physical bequests
τ = tax on income from life-cycle physical capital
R^1 = lump sum transfer on the middle
R^2 = lump sum transfer on the old
k = physical capital-human capital ratio
u = utility from an individual's own consumption
ε = private preference of old-age consumption
U = parent's utility
ρ = parent's concern for the child's well-being
γ = growth rate
γ * = optimal growrh rate

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[1] . King and Rebelo (1990) and Caballe and Santos (1993) investigated the effect of fiscal policy on economic growth using an infinite horizon endogenous growth model with physical and human capital. In an infinitely lived individual setting Chamely (1981) showed that capital taxation has detrimental effects on capital formation. Lucas (1990) has shown that capital income taxes have adverse effects on long run growth rates. Recently, Razin and Yuen (1996) study the effects of capital income taxation on growth with endogenous population and international capital mobility.

[2] . The Cobb-Douglas function is assumed only for simplicity. The qualitative results will hold in a more general case of a constant-returns-to-scale technology. This paper does not include the external contribution of physical investment to aggregate productivity such as Arrow (1962) and Marchand, Michel and Pestieau (1992).

[3] . This does not necessarily mean n=1. All we assume here is that n is fixed.

[4] . $\hat{H}_t = \frac{1}{n}\sum H_t^i = \frac{1}{n}H_t^j + \frac{1}{n}\sum_{i \neq j} H_t^i$, where H_t^j is household j of generation t's human capital.

[5] . For simplicity we do not incorporate unskilled labor. Thus, the tax on human capital transfer amounts to a tax on wage. This is not always the case in the real economy. It would be useful to consider this point in the future study.

[6] . We could consider the case where taxes on human capital accumulation are represented by taxes on wage income plus human capital. The qualitative results would be the same.

[7]. Ihori (1994) investigated implications of other intentional bequest motives (the bequest-as-consumption model and the bequest-as-exchange model) using an overlapping generations endogenous growth model.

[8]. The transitional dynamics are complicated. To maintain the tractability of our analysis, we shall confine our analysis to steady-state equilibria.

[9]. The growth-maximizing tax rate is not necessarily optimal. When $\delta=0$, the welfare-maximizing tax rate should be zero.