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Wealth Taxation and Economic Growth

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Abstract

This paper investigates the effect of wealth taxation on economic growth using an endogenous growth model with the altruistic bequest motive. We introduce intragenerational productivity differentials of human capital formation, resulting in differences of growth rates among individuals. The economy is divided into two groups; those who leave bequests to physical capital investment and those who leave bequests to human capital investment. An increase in taxes on life cycle savings will reduce the intragenerational growth differences, while the effect of taxation on bequests, wage income, or consumption on intragenerational growth differences is ambiguous.

Key words: wealth taxation, economic growth, intergenerational transfer

JEL classification numbers: H2, H3

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1. Introduction

There are two types of wealth from the viewpoint of origin; life cycle wealth (wealth accumulated from life cycle behavior) and transfer wealth (wealth deriving from intergenerational transfers). We observe a large amount of intergenerational transfers (bequests to human and physical capital) as well as life cycle savings and heavy taxes on various types of wealth in the real economy. It is widely believed that heavy wealth taxation would induce low economic growth, although the analytical results are dependent on how wealth is accumulated[1]. It is hence important to analyze the long-run effect of taxation on economic growth by explicitly differentiating two types of wealth accumulation. It is also interesting to examine the effect of wealth taxation on intragenerational differentials of income growth since wealth taxation is often used for redistributive objectives.

Recent advances in endogenous growth theories have opened up the possibility of analyzing the growth effects of various fiscal policy changes by extending a framework of the standard overlapping generations model. Jones and Manuelli (1990) showed that an income tax-financed redistributive policy can be used to induce positive endogenous growth. Azariadis and Drazen (1990) presented a model of endogenous growth in which the accumulation of human capital is subject to externalities. Glomm and Ravikumar (1992) presented an overlapping generations model with heterogeneous agents in which human capital investment through formal schooling is the engine of growth. Buiter and Kletzer (1993) investigated international productivity growth differentials by incorporating human capital accumulation. Caballe (1995) investigated the effect of several fiscal policy experiments for both bequest constrained economies and unconstrained ones. Ihori (1997) investigated the long-run effect of three types of taxes on capital; a tax on interest income, a tax on wage income, and a tax on physical bequests. Bovenberg and van Ewijk (1997) explored the trade-off

[1]. See Lord (1989), Trostel (1993), Nerlove et. al. (1993) and Pecorino (1993) among others.

efficiency and intra- and intergenerational equity in an endogenous growth model of an open economy with human capital accumulation. Chiu (1998) showed that greater income equality implies higher human capital accumulation and economic performance in an overlapping generations model with heterogeneity in income and talent[2]. These papers have shown that it is important to distinguish human capital from physical capital to explore the role of intergenerational transfers during wealth accumulation. Human capital is the most important component of national wealth and human capital accumulation could be the crucial factor in economic growth.

Incorporating heterogeneous agents who determine optimally human capital investment into an endogenous growth model with the altruistic bequest motive, the present paper also allows for intragenerational productivity differentials of the human capital accumulation process. It is shown that the economy is divided into two groups; those who operate bequests as physical capital investment and those who operate bequests as human capital investment. It is also shown that some types of taxation on wealth accumulation (in particular taxes on interest income from life-cycle savings) may reduce intragenerational differentials of growth rates among individuals even if they are not progressive. We can investigate analytically the long-run effects of several tax reforms involving taxes on wage income, bequests, interest income, and consumption.

This paper is organized as follows. In section 2 we present an overlapping-generations model of endogenous growth in which agents are altruistic toward their descendants. In section 3 we examine how growth rates of various types of individuals are determined in the long run. In section 4, we investigate the long-run effect of taxation on transfer wealth and life-cycle wealth

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[2]. In an infinitely lived individual setting Chamley (1981) showed that capital taxation has detrimental effects on capital formation. 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.

on economic growth. In section 5 we provide some remarks. Finally, in section 6 we conclude the paper.

2. Endogenous Growth Model

2.1 Technology

A general feature of endogenous growth models is the presence of constant or increasing returns in the factors that can be accumulated. We incorporate two types of capital (physical capital and human capital) as well as two types of wealth (transfer wealth and life cycle wealth) into the simplest version of endogenous growth models.

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 aggregate output, K is aggregate physical capital, and H is aggregate human capital. A is a productivity parameter which is taken here to be multiplicative and to capture the idea of endogenous growth. α is the output share of human capital.[3]

2.2 Three-period overlapping generations model

To make the point clear consider an endogenous growth version of the three-period overlapping generations model similar to Batina (1987), Jones and Manuelli (1990), Glomm and Ravikumar (1992), Marchand, Michel and Pestieau (1992), Buiter and Kletzer (1993), Nerlove et. al. (1993), Caballe (1995), and Razin and Yuen (1996). The number of households of each generation, n, is fixed and there is no population growth. A type-i parent produces a type-i child, so that a type-i dynasty continues forever.

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[3] . 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 Marchand, Michel and Pestieau (1992).

In the first period of his life ("youth"), a consumer of type i born in period t-1 has an endowment of time, normalized to 1, which he can either choose to consume as leisure x_{it-1} or to allocate to an alternative use, education e_{it-1} in efficiency units.

$$1 = \frac{e_{it-1}}{m_i} + x_{it-1}$$

where e_i / m_i is time spent on education and m_i is the productivity of educational input. Subscript i means an individual of type i (i=1,...,n). We allow for intragenerational differences in the productivity of educational input m among individuals. It is assumed that $m_1 < m_2 < ... < m_n$. The above equation may be rewritten as

$$m_i = e_{it-1} + m_i x_{it-1} \qquad (2)$$

An individual of highly productive dynasty has a large amount of m, so that he can spend a lot of time on education in efficiency units.

In period t-1 when a type-i household of generation t is young the (same-type) parent of generation t-1 can choose to spend private resources other than time on human capital formation of his child (as bequests to human capital), g_{it-1}, and physical savings for his child (as bequests to physical capital), b_{it-1}. The educational process during the first period of the household's life adds to the endowment of labor time in efficiency units H_{it} (human capital) during the second period "middle age", i.e., during period t for a household born in period t-1. The stock of human capital used in employment by the type-i household of generation t during period t, H_{it}, is assumed to be a function of the two inputs; his own educational input, e_{it-1} and his parent's gift to education, g_{it-1}.

We have for simplicity the following functional form.

$$H_{it} = \eta g_{it-1} e_{it-1}, \ \eta > 0 \qquad (3)$$

Technological parameter η will be normalized to 1[4]. Human capital accumulation is a combination of life-cycle spending on educational time

[4]. We could incorporate differences in η instead of m. The analytical results will be the same.

(educational investment) and bequests to human capital (a gift from the parent). The marginal productivity of the parent's transfer gift is dependent on the level of the child's educational input, and vice versa. The higher e (g), the greater is the marginal product on g (e). A few restrictive features of this human capital formulation deserve mention. An important feature of this specification is that the human capital of the child depends crucially on the parent's gift rather than on the average level of existing human capital. A child who grows up in a richer family will have access to better training and education which enhance the development of his human capital. This may give rise to persistent inequalities. The present formulation does not allow for consumption benefits from human capital, spillover benefits from human capital, or decreasing returns to scale. To keep the model tractable, the family-specific human capital formation of increasing returns to scale in a dynastic framework is used. This does not seem inappropriate since the bulk of intergenerational transfers probably occur in the form of human capital in the real economy.

During middle age, the type-i household of generation t concerns how much to consume c_{it}^1, to save for the old age s_{it}, to spend on physical capital formation for his child, b_{it}, and to spend on human capital formation for his child, g_{it}. The entire endowment of labor time services in efficiency units H_{it} is supplied inelastically in the labor market and wage income $h_t H_{it}$ is obtained. h is the wage rate. In the last period of life ("old age" of "retirement") households do not work or educate themselves. The old of generation t just consumes c_{it+1}^2. Table 1 summarizes two types of wealth and two types of capital in this model.

The government imposes taxes on capital, consumption, and wealth accumulation when private intergenerational transfers and life cycle savings are present. To focus on the distortionary effects of taxation, we make the conventional assumption that tax revenues are returned as a lump sum transfer to the same individual. This is a standard assumption of the differential tax incidence. There is no intragenerational redistribution effect of the tax-transfer policy; taxes are not progressive. Furthermore, the tax policy would not include the intergenerational redistribution effect such as debt issuance or unfunded social security.

Thus, the middle-age budget constraint is given by

$$\begin{aligned} c_{it}^1 + s_{it} + b_{it} + g_{it} + \theta_H h_t H_{it} + \theta_B(b_{it} + g_{it}) + \theta_C c_{it}^1 = \\ h_t H_{it} + (1 + r_t)b_{it-1} + R_{it}^1 \end{aligned} \quad (4\text{-}1)$$

where r is the rate of return on physical capital, θ_H is a tax on income from human capital (a wage income tax), θ_B is a tax on bequests (or gifts), θ_C is a tax on consumption, and R_t^1 is a lump sum transfer on the young in period t. Substituting (3) into (4-1), we have

$$\begin{aligned} c_{it}^1 + s_{it} + b_{it} + g_{it} + \theta_H h_t e_{it-1} g_{it-1} + \theta_B(b_{it} + g_{it}) + \theta_C c_{it}^1 = \\ h_t e_{it-1} g_{it-1} + (1 + r_t)b_{it-1} + R_{it}^1 \end{aligned} \quad (4\text{-}1)'$$

The old-age budget constraint is given by

$$c_{it+1}^2 + \tau r_{t+1} s_{it} + \theta_C c_{it+1}^2 = (1 + r_{t+1})s_{it} + R_{it+1}^2 \quad (4\text{-}2)$$

where τ is a tax on income from life-cycle physical capital and R_{t+1}^2 is a lump sum transfer on the old in period t+1.

The government budget constraint is given by

$$\sum_{i=1}^n R_{it}^1 = \sum_{i=1}^n [\theta_H h_t H_{it} + \theta_B(b_{it} + g_{it}) + \theta_C c_{it}^1] \quad (5\text{-}1)$$

$$\sum_{i=1}^n R_{it+1}^2 = \sum_{i=1}^n [\tau r_{t+1} s_{it} + \theta_C c_{it+1}^2] \quad (5\text{-}2)$$

Taxes on human capital is formulated as taxes on wage income, $\theta_H h_t H_t$, as in the conventional formulation. See, for example, Pecorino (1993).

The feasibility condition in the aggregate economy is given by

$$c_t^1 + c_t^2 + K_{t+1} + g_t = Y_t + K_t \quad (6)$$

where a variable without subscript i means an aggregate variable. Physical capital accumulation is given by

$$s_t + b_t = K_{t+1} \quad (7)$$

The rates of return on two types of capital are respectively given by

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

$$h = (Y - rK) / H = \partial Y / \partial H = A\alpha k^{1-\alpha} \quad (9)$$

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

2.3 Altruistic bequest motive

An individual of type i born at time t-1 consumes c^1_{it} in period t and c^2_{it+1} in period t+1 and derives his own utility (u_{it}) from leisure when young and his own consumption when middle and old.

$$u_{it} = \delta \log x_{it-1} + \log c^1_{it} + \varepsilon \log c^2_{it+1}, \qquad 0 < \delta,\ 0 < \varepsilon < 1 \tag{10}$$

δ means the private preference for leisure when young and ε reflects the private preference for 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[5]. The type-i parent's utility function is given by

$$U_{it} = u_{it} + \rho U_{it+1} = \delta \log x_{it-1} + \log c^1_{it} + \varepsilon \log c^2_{it+1} + \rho U_{it+1} \tag{11}$$

$0 < \rho < 1$. ρ reflects the parent's concern for the child's well-being. Namely, ρ is the parent's marginal benefit of his offspring's utility (U_{it+1}) and may be regarded as the private rate of generation preference or the private discount factor of the future generation. The higher ρ, the greater the parent cares about his offspring.

3. Economic Growth

3.1 Optimizing behavior

Substituting (2)(4-1)' and (4-2) into (11), we have

[5] . 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.

$$U_{it} = \delta \log\{(m_i - e_{it-1})/m_i\} +$$
$$\log\{[(1-\theta_H)h_t e_{it-1}g_{it-1} + (1+r_t)b_{it-1} - s_{it} - (1+\theta_B)(g_{it}+b_{it}) + R^1_{it}]/(1+\theta_C)\} +$$
$$\varepsilon \log\{[(1+(1-\tau)r_{t+1})s_{it} + R^2_{it+1}]/(1+\theta_C)\} + \rho\{\delta \log[(m_i - e_{it})/m_i]$$
$$+\log\{[(1-\theta_H)h_{t+1}e_{it}g_{it} + (1+r_{t+1})b_{it} - s_{it+1} - (1+\theta_B)(g_{it+1}+b_{it+1}) + R^1_{it+1}]/(1+\theta_C)\}$$
$$+\varepsilon \log\{[(1+(1-\tau)r_{t+2})s_{it+1} + R^2_{t+2}]/(1+\theta_C)\} + \rho U_{it+2}\} \tag{12}$$

An individual of type i born at time t-1 will solve the following problem of maximizing. He will choose e_{it-1}, s_{it}, g_{it}, and b_{it} to maximize (12). The optimality conditions with respect to e_{it-1}, s_{it}, g_{it}, and b_{it} are respectively

$$\frac{\delta m_i}{m_i - e_{it-1}} = \frac{(1-\theta_H)h_t g_{it-1}}{(1+\theta_C)c^1_{it}} \quad \text{if} \quad e_{it-1} > 0 \tag{13-1}$$

$$1/c^1_{it} = [1+(1-\tau)r_{t+1}]\varepsilon / c^2_{it+1} \tag{13-2}$$

$$1/c^1_{it} = \rho(1-\theta_H)h_{t+1}e_{it}/(1+\theta_B)c^1_{it+1} \quad \text{if} \quad g_{it} > 0 \tag{13-3}$$

$$1/c^1_{it} = \rho(1+r_{t+1})/(1+\theta_B)c^1_{it+1} \quad \text{if} \quad b_{it} > 0 \tag{13-4}$$

We call the individual who has both conditions (13-3) and (13-4) with equality the type-M individual. Namely, from (13-3) and (13-4), we have

$$1 + r_{t+1} = (1-\theta_H)h_{t+1}e_{Mt} \tag{14}$$

If $e_{it} < e_{Mt}$, then $1 + r_{t+1} > (1-\theta_H)h_{t+1}e_{it}$ and hence $g_{it} = H_{it+1} = 0$. Considering (13-1), we also know that $e_{it-1} = 0$. On the other hand, if $e_{it} \geq e_{Mt}$, then $1 + r_{t+1} \leq (1-\theta_H)h_{t+1}e_{it}$ and hence $b_{it} = 0$[6]. If the (after-tax) marginal return on human capital is higher (lower) than the marginal return on physical capital at *b=0 (g=0)*, the intergenerational transfer is operated only in the form of human capital investment (physical capital investment). It follows that the economy is divided into two groups; those who leave bequests only to human capital (i≥M) and those who leave bequests only to physical capital (i<M). It is assumed that the type-M individual is between 1 and n (1<M<n). Note that individuals i≥M accumulate also physical capital for old-age consumption.

3.2 Growth rates among individuals

[6]. For the type M individual g and b are indifferent. For simplicity, we assume that $b_M = 0$.

Suppose for a while the government does not levy any taxes; $\theta_H = \tau = \theta_B = \theta_C = 0$. Let us investigate how e_i and other economic variables are determined in the long run. We have from (4-2) and (13-2)

$$s_i = c_i^1 \varepsilon \qquad (15)$$

Substituting (15) into (4-1), we have for $i \geq M$

$$\frac{H_{it+1}}{e_{it}} + [\frac{1}{\varepsilon} + 1]s_{it} = h_t H_{it} \qquad (16)$$

On the other hand, from (13-3) in the steady state we have[7]

$$H_{it+1} = \rho e_i h H_{it} \qquad (17)$$

Their growth rates are given by

$$\gamma_{i>M} = \rho e_i h \qquad (18)$$

The larger e_i, ρ, or h, the greater is the growth rate.

From (7)(16) and (17) the steady-state physical capital-human capital ratio of type-i individual (for $i \geq M$), $k_i \equiv K_i / H_i$, is given by

$$k_i = \frac{(1-\rho)\varepsilon}{e_i \rho (1+\varepsilon)} \qquad (19)$$

As H_n / H approaches 1 in the long run, the aggregate physical capital-human capital ratio k will be approximately given by k_n in the steady state.

$$k = \frac{(1-\rho)\varepsilon}{e_n \rho (1+\varepsilon)} \qquad (20)$$

From (3) (13-1) (15) and (17) we also have

$$\frac{\delta m_i}{m_i - e_i} = \frac{\varepsilon}{\rho e_i^2 k_i} \qquad (21)$$

Therefore from (19) and (21), e_i is given by

$$e_i = m_i / [1 + \frac{\delta m_i (1-\rho)}{1+\varepsilon}] \qquad (22)$$

(22) means that e_i is decreasing with δ and increasing with m_i, ε and ρ. When the preference for leisure is high or when the productivity of educational input, the preference for old-age consumption, and the preference for the child are low,

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[7]. The transitional dynamics are complicated. To maintain the tractability of our analysis, we shall confine our analysis to steady-state equilibria, where H_i and K_i grow at the same rate and e_i, r, k and h remain constant.

time spent on human capital investment (educational input in efficiency units) becomes small. These results are intuitively plausible.

Considering (2) and (22) we have

$$x_i = \frac{\delta(1-\rho)e_i}{1+\varepsilon}$$

An individual with higher educational input also enjoys a larger amount of leisure when young since he has higher productivity of educational input.

From (17) the growth rate of individual M is also given by

$$\gamma_M = \rho e_M h \qquad (23)$$

where M is determined by (8) (9) (14) (20) and (22). Namely, considering (20) and (22), the following equation determines m_M.

$$1 + A(1-\alpha)k^{-\alpha} = A\alpha k^{1-\alpha} m_M / [1 + \frac{\delta m_M (1-\rho)}{1+\varepsilon}] \qquad (24)$$

On the other hand, (13-4) applies to those who have smaller values of m_i than the individual of type-M ($m_i < m_M$). Since they do not spend on any human capital accumulation, their e_i reduces to zero. They do not earn income from human capital and their common growth rate is given by

$$\gamma_{i<M} = \rho(1+r) = \gamma_M \qquad (25)$$

Their growth rates are the same and equal to γ_M because they face the same rate of return on physical capital accumulation.

3.3 Remark

We have shown that from (22) an increase in ρ raises e_i of highly productive individuals ($e_i \geq e_M$). This is because it will raise the marginal benefit of intergenerational transfer. Since higher ρ increases the marginal benefit of human capital investment, g_i is stimulated, which then raises the marginal return of e_i. Hence from (20) k and h decrease, while r increases.

An increase in the intergenerational preference ρ has three impacts on the growth rates for individuals with human capital accumulation. First of all, it will directly stimulate the intergenerational transfer from the old to the young, which induces higher growth. Second, it will stimulate his own human capital investment, which also induces higher growth. Finally, it will reduce k and hence the rate of return on human capital, h, which depresses economic growth. It follows from (18) that the overall impact on the type-specific growth rates for highly productive individuals is ambiguous.

On the contrary, we know from (25) that the effect on the growth rate for less productive individuals with physical capital bequests is positive. Namely, an increase in the intergenerational preference ρ will raise the rate of return on physical capital investment r, which enhances economic growth for individuals with bequests to physical capital.

As shown in (22), an increase in the private preference for old-age consumption ε or a decrease in the preference for leisure when young δ will have a similar effect on e_i as an increase in ρ. Namely, as shown in (13-1), an increase in δ will reduce e_i since it will raise the marginal cost of reduction in leisure. Hence from (20) k and h increase, while r decreases. It could raise the intragenerational differences of growth rates among individuals since it always reduces the lowest growth rate of the economy ($\gamma_{i \le M}$) and may raise the highest growth rate (γ_n).

An increase in ε will raise e_i since it will raise the marginal benefit of human capital accumulation. However, it will also stimulate physical capital accumulation. Since the direct effect of an increase in ε on k is large, considering (20) and (22), the overall effect of an increase in ε on k is also positive, which is opposite to the result in the case of an increase in ρ. Hence, an increase in ε will raise e_i, k and h, and reduce r. It follows that an increase in ε will raise $\gamma_{i>M}$ but reduce $\gamma_{i \le M}$. It will enlarge the intragenerational differences of growth rates among individuals. See Table 2.

4. Taxes and Economic Growth

4.1 Long-Run Effect of Taxation

We now consider the long-run effect of taxes on capital income and wealth accumulation. When taxes are incorporated, (20) may be rewritten as

$$k = \frac{(1-\rho^*)\varepsilon^*}{e_n \rho^*(1+\varepsilon^*)} \qquad (20)'$$

We also have in place of (22)

$$e_i = m_i / [1 + \frac{\delta^* m_i (1-\rho^*)}{1+\varepsilon^*}] \qquad (22)'$$

where

$$\delta^* = \frac{\delta(1+\theta_C)}{1-\theta_H} \qquad (26\text{-}1)$$

$$\varepsilon^* = \frac{\varepsilon[1+(1-\tau)r]}{1+r} \qquad (26\text{-}2)$$

$$\rho^* = \frac{\rho(1-\theta_H)}{1+\theta_B} \qquad (26\text{-}3)$$

δ^* is the effective preference for leisure when young, ε^* is the effective preference for old-age consumption, and ρ^* is the effective rate of generation preference. And (14) (18) and (25) may be rewritten as respectively

$$1 + r = (1-\theta_H) h e_M \qquad (14)'$$

$$\gamma_{i>M} = \rho^* e_i h \qquad (18)'$$

$$\gamma_{i<M} = \gamma_M = \frac{\rho(1+r)}{1+\theta_B} \qquad (25)'$$

4.2 Tax on wage income

First of all, let us consider the impact of a tax on income from human capital accumulation (or a tax on labor income) θ_H. As shown in (26-1) and (26-3), an increase in θ_H has the same effect as a combination of a decrease in ρ and an increase in δ. In other words, it will reduce the marginal benefit of intergeneration transfer and raise the marginal cost of reducing leisure. From (22)' an increase in θ_H will reduce e_i. Considering (20)', it will raise *k, h* and reduce *r*. This result is consistent with the earlier literature. The wage tax discourages investment in human capital relative to physical capital since e_i is not tax deductible and the marginal benefit of g_i is lowered.

Hence, from (25)' an increase in θ_H will reduce the growth rate for less productive individuals with physical bequests ($e_i = 0 < e_M$). Since

$$\gamma_{i<M} = \gamma_M = \rho(1+r)/(1+\theta_B),$$

the growth rate for the type-M individual reduces as well. Considering (14)', the effect on e_M is ambiguous. Hence, the effect on M is also ambiguous. It should be stressed that although an increase in the wage tax reduces time spent on human capital accumulation, it could raise the portion of people with human capital accumulation.

We have from (14)' (18)' (22)' and (25)'

$$\gamma_n / \gamma_1 = (m_n / m_M)([1+\varepsilon^* + \delta^* m_M(1-\rho^*)] / [1+\varepsilon^* + \delta^* m_n(1-\rho^*)]) \tag{27}$$

which may be regarded as a measure of intragenerational differentials of growth rates. From (27) we know that γ_n / γ_1 decreases in M. Thus, if an increase in a tax on wage income lowers M, it will enlarge intragenerational differences of growth rates, and vice versa. If the after-tax return on human capital, $(1-\theta_H)h$, declines enough to raise e_M, then M increases and an increase in θ_H will reduce intragenerational differences of growth rates.

In Figure 1 curve MA represents growth rates for individuals with human capital accumulation and line BM represents growth rates for individuals with physical bequests. An increase in θ_H shifts line BM downwards to B'M'. If it shifts curve MA upwards to M'A', M declines as in Figure 1-A. On the other hand, if it shifts curve MA downwards, M could rise as in Figure 1-B. Even if it reduces the growth rates for all, it could also enlarge intragenerational growth differences.

The effect on the growth rates for highly productive individuals with human capital accumulation (i>M) is ambiguous. An increase in θ_H directly depresses the growth rate by reducing ρ^*, the effective rate of generation preference. This is a direct negative effect of taxation. Furthermore, a decrease in e_i also depresses economic growth, while an increase in the rate of return on human capital accumulation stimulates economic growth.

We have

$$\frac{d\gamma_{i>M}}{d\theta_H} = \frac{\rho}{1+\theta_B}[-e_i h + (1-\theta_H)(\frac{\partial e_i}{\partial \theta_H}h + \frac{\partial h}{\partial \theta_H}e_i)]$$

$$= \frac{\rho}{1+\theta_B}[e_i((1-\theta_H)\frac{\partial h}{\partial \theta_H} - h) + (1-\theta_H)h\frac{\partial e_i}{\partial \theta_H}] \quad (28)$$

Since $\frac{\partial e_i}{\partial \theta_H} < 0$ for $i > M$, the second term on the right hand side of (28) is negative. The sign of the first term is ambiguous. If $\frac{\partial h}{\partial \theta_H}$ (>0) is very large, we could have $\frac{d\gamma_{i>M}}{d\theta_H} > 0$.

4.3 Tax on bequests

When a tax on bequests θ_B is raised, it will reduce ρ^*, the effective rate of generation preference, as shown in (26-3). Although the bequest tax does not discriminate between bequests to human capital and bequests to physical capital, it affects the relative price of intergenerational transfers. Thus, it has a similar effect as an increase in θ_H in the sense that it reduces the marginal benefit of intergeneration transfer. It follows that an increase in θ_B will raise *k* and *h*, while reducing e_i and *r*.

As in section 4.2, its effect on the growth rates for individuals with human capital accumulation is ambiguous. Since an increase in θ_B reduces the growth rate for individuals with physical capital accumulation, it will also reduce the growth rate for individual M (γ_M). Considering (14)', an increase in the bequest tax will reduce e_M. Its effect on M is ambiguous. Even if it reduces growth rates for productive individuals, it could enlarge intragenerational growth differences. An increase in θ_B will not necessarily reduce intragenerational differences of growth rates. We cannot necessarily say that the bequest tax is desirable in terms of equity.

We could consider a tax on bequests to human capital only. Since individuals with human capital accumulation do not leave bequests to physical capital, (26-3)' still holds. Thus, the analytical result would be essentially the same as in this section. We could also consider a tax on bequests to physical capital only. Such a tax would not affect (20)' or (22)'. Hence, the physical bequest tax would not have any impacts on human capital accumulation or physical capital accumulation. From (25)' it would only reduce the growth rate for less productive individuals, resulting in a decrease in M. Thus, it enlarges the intragenerational differences of growth rates.

We could investigate the effect of tax reforms involving an increase in θ_B with a decrease in θ_H. Two cases are interesting. First, suppose a tax reform which keeps ρ^* constant. Then, the real impact of the tax reform is the effect of a decrease in δ^*, which is analyzed in section 3.3. Second, suppose a tax reform which keeps e_i constant. Then, the impact of an increase in θ_B dominates that of a decrease in θ_H, and hence ***k*** and ***h*** will rise and ***r*** will decrease. From (14)', M will decrease. Hence this tax reform will enlarge the intragenerational differences of growth rates.

4.4 Tax on life cycle savings

When a tax on life cycle savings τ is raised, it will directly reduce ε^*, the effective preference for old-age consumption, as shown in (26-2). It has the same effect as a reduction in ε in the sense that it reduces the marginal benefit of capital accumulation for old age. Hence, it will reduce ***k***, ***h*** and raise ***r***. It will also reduce e_i for $i > M$. Considering (14)', it will raise e_M. Thus, M will increase.

An increase in τ will raise the growth rate for individuals with bequests to physical capital ($e_i = 0 < e_M$), while the effect on the growth rates for individuals with bequests to human capital is negative. An increase in τ will hence reduce the intragenerational differences of growth rates among individuals, which is a new result in this paper. As shown in Figure 2, it shifts line BM upwards and curve MA downwards, resulting in an increase in M. This is because a tax on life cycle saving does not directly affect the rates of return on intergenerational transfers, which are associated with growth rates among individuals. It would affect economic growth only through changes in the physical capital-human capital ratio.

We could investigate the effect of comprehensive income tax; $\theta_H = \tau$. Suppose $\theta_H = \tau$ is raised. Then, e_i decreases. But the effects on **k**, **h** and **r** are ambiguous. This is because the negative effect of an increase in τ on physical capital accumulation offsets that of an increase in θ_H.

4.5 Tax on consumption

Finally, let us consider the effect of a consumption tax, θ_C, on economic growth. As shown in (26-1), an increase in θ_C will raise δ^*, the effective preference for leisure when young. An increase in θ_C is qualitatively the same as an increase in δ in the sense that it raises the marginal cost of reducing leisure. From (22)' it will reduce e_i. It will raise **k** and **h** but reduce **r**. Considering (14)', it will also reduce e_M. Thus, from (22)' its effect on M is ambiguous.

An increase in θ_C might raise the growth rates for sufficiently productive individuals, although it will reduce the growth rate for individuals with physical bequests. An increase in θ_C will not necessarily reduce intragenerational differences of growth rates among individuals. In this sense, an increase in θ_C has qualitatively the same effect as an increase in θ_B or θ_H[8].

A tax reform of an increase in θ_B with a decrease in θ_H which keeps ρ^* constant will have the same effect as a decrease in θ_C. Both tax changes decrease δ^* by raising the marginal cost of reducing leisure. We could also consider a tax reform of an increase in θ_C with a decrease in θ_H which keeps e_i

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[8]. If educational input is exogenously given ($e_i = \bar{e}_i$), then the consumption tax has no real effects. The consumption tax becomes neutral, which is the standard result in the conventional literature.

constant. Such a tax reform has the same effect as a decrease in θ_B since both tax changes result in an increase in $\rho*$.

5. Remarks

Our main results are summarized by Table 3. In the real economy we would not expect the perfect dichotomization of the population where the poor save physical capital and the rich invest in human capital. There are several remarks to be made. First, the human capital accumulation equation (3) may be generally formulated as

$$H_{it} = H(g_{it-1}, e_{it-1}) \tag{29}$$

Equation (3) has assumed the increasing returns to scale technology; $\partial^2 H / \partial g \partial e > 0$. If we assume $\partial^2 H / \partial g \partial e = 0$, then (14) is rewritten as

$$1 + r_{t+1} = (1 - \theta_H) h_{t+1} \tag{30}$$

which is independent of e_M. In such a case, all individuals will have the same pattern of wealth accumulation. They accumulate both human capital and physical capital at the same time. Namely, if (30) holds, they leave bequests both to human capital and physical capital investment. If $1 + r < (1 - \theta_H) h$, they only leave bequests to human capital and accumulate physical capital for old-age consumption. The growth rate is the same for all individuals, although more productive individuals enjoy higher consumption and welfare. It seems that the increasing returns to scale technology could capture some aspects of human capital accumulation.

Second, we could interpret two types of capital K and H as (common) unskilled and (family-specific) skilled capital rather than physical and human capital, respectively. When an individual invests in K, everyone can obtain the same return. On the other hand, when he invests in H, the marginal return depends on his ability as well as his parent's ability. Thus, a more able family will leave bequests as investment in skilled capital, while a less able family will leave bequests as investment in unskilled capital. This does not seem inappropriate in the real economy.

Third, we could incorporate differences in abilities of investing in physical capital instead of investing in human capital. In this case K may be regarded as skilled capital and H may be regarded as unskilled capital. Then, highly productive individuals leave bequests only to physical capital without accumulating human capital. The less productive individuals operate only as human capital investment. It seems that differences in ability of investing in human capital are larger than those in physical capital.

Finally, it is well recognized that there may be a variety of motives for bequeathing in the real economy. We briefly focus our attention on the consumption-as-bequest model where the parent cares about the size of bequest as well as the size of spending on human capital formation of his child.

$$u_{it} = \delta \log x_{it-1} + \log c_{it}^1 + \varepsilon \log c_{it+1}^2 + \lambda \log b_{it} + \omega \log g_{it} \tag{31}$$

Then, the optimality conditions with respect to e_{it-1}, s_{it}, g_{it} and b_{it} are respectively given as (13-1), (13-2) and

$$\frac{1+\theta_B}{c_{it}^1} = \frac{\omega}{g_{it}} \tag{32-1}$$

$$\frac{1+\theta_B}{c_{it}^1} = \frac{\lambda}{b_{it}} \tag{32-2}$$

Hence, when taxes are zero, the long-run growth rate for individual i is given as

$$\gamma_i = \frac{1}{1+\varepsilon+\lambda+\omega+\delta}[m_i h\omega + \lambda(1+r)] \tag{33}$$

Note that in this case all individuals have both positive physical bequests and human capital transfers; *b, g* >0 for all individuals. The higher m_i, the larger is the growth rate. Since the altruistic motive is not the only motive for bequeathing in the real economy, we would not expect the perfect dichotomization of the population. Our analysis has clarified the potential mechanism of dichotomization in the economy where a child who grows up in a richer family will have access to better training and education which enhance the development of his human capital.

We have excluded any intragenerational redistribution effect of the tax-transfer policies. This has provided us with a pure experiment allowing us to study the substitution effects created by the tax policy. We could investigate the effect of progressive taxation on wealth as in Bovenberg and van Ewijk (1997). Progressive taxes would imply that tax payments are larger than transfers for highly productive individuals. With progressive taxes the steady-state physical capital-human capital ratio of a highly productive individual becomes higher than in section 4, resulting in less time for human capital investment. Therefore, it would reduce the growth rates for highly productive individuals, compared with the proportional tax rate.

6. Conclusion

It has been recognized that in modern economies most private wealth takes the form of human capital and hence disparities in income originate mainly in interpersonal differences in learning capabilities. Human capital accumulation is also dependent on intergenerational transfers. This paper has incorporated two types of wealth, life-cycle wealth and transfer wealth as well as two types of capital, physical capital and human capital, into an endogenous growth model of overlapping generations. We have also introduced intragenerational productivity differentials of human capital formation, which would result in intragenerational differences of growth rates among individuals. We have shown that human capital investment when young has a crucial role to investigate the long-run effect of wealth taxes on economic growth. It has also been shown that the economy is divided into two groups; those who operate bequests only to physical capital (or unskilled capital) and those who operate bequests only to human capital (or skilled capital).

We have investigated the distortionary effects of wealth taxation on economic growth. Although taxes on wage income, interest income, bequests, and consumption reduce educational input when young, the effects on economic growth are not always the same. An increase in the tax on bequests has the same effect as a decrease in the intergenerational preference since it reduces the marginal benefit of intergenerational transfers. It will reduce human capital investment and could enlarge intragenerational differentials of growth rates. An increase in the wage tax may be regarded as a combination of a decrease in the intergenerational preference and an increase in the preference for leisure since it also raises the marginal cost of reducing leisure. When taxes on wage income raise the after-tax rate of return on human capital investment, growth rates for sufficiently productive individuals may rise. An increase in the consumption tax has qualitatively the same effect as an increase in the preference for leisure when young. It raises the marginal cost of reducing leisure. Hence, it will depress human capital accumulation and may reduce intragenerational differentials of growth rates. On the contrary, an increase in the tax on life cycle savings has the same effect as a decrease in the own preference for life cycle savings. It raises the return on physical capital and reduces the return on human capital, reducing the intragenerational differences.

We have also considered the impact of several tax reforms. A tax reform of an increase in the bequest tax with a decrease in the wage tax can keep the effective rate of generation preference constant. This tax reform has the same effect as a decrease in the effective preference for leisure and is equivalent to a decrease in the consumption tax. Both tax changes raise the marginal cost of reducing leisure. A tax reform of an increase in the bequest tax with a decrease in the wage tax can keep educational input constant. This tax reform will enlarge the intragenerational differences of growth rates. We have also considered a tax reform of an increase in the consumption tax with a decrease in the wage income tax which keeps educational input constant. Such a tax reform has the same effect as a decrease in the bequest tax since both tax changes result in an increase in the effective rate of generation preference.

We have assumed for simplicity that intelligence is 100 percent hereditary.

A useful extension would be to allow for more realistic changes in abilities among generations.

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Table 1: Wealth and Capital

	life cycle wealth	transfer wealth	total
human capital	e	g	H
physical capital	s	b	K

Table 2: Changes in Parameters

	$e_{i>M}$	$\gamma_{i>M}$	$\gamma_{i\leq M}$
ρ	+	?	+
ε	+	+	-
δ	-	?	-

Table 3: Effects of Wealth Taxation

	$e_{i>M}$	**M**	**r**	**h**	$\gamma_{i>M}$	$\gamma_{i\leq M}$	γ_n/γ_1
θ_H	-	?	-	+	?	-	?
θ_B	-	?	-	+	?	-	?
τ	-	+	+	-	-	+	-
θ_C	-	?	-	+	?	-	?

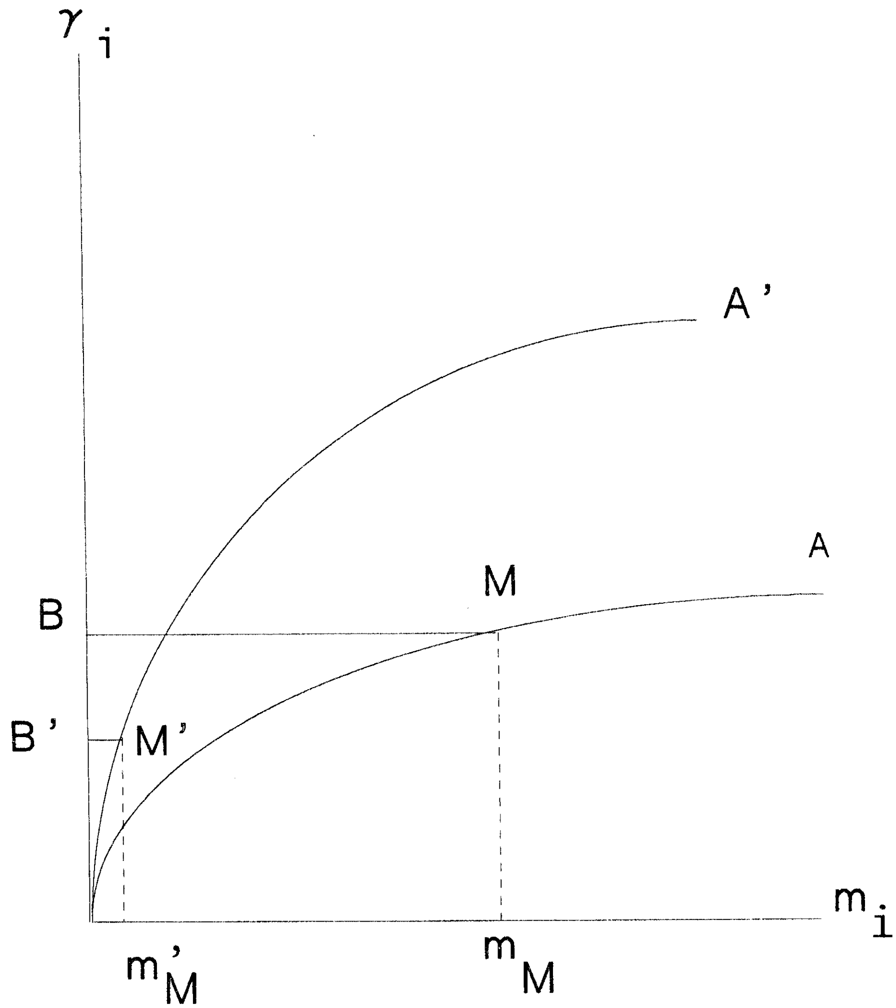

Figure 1-A

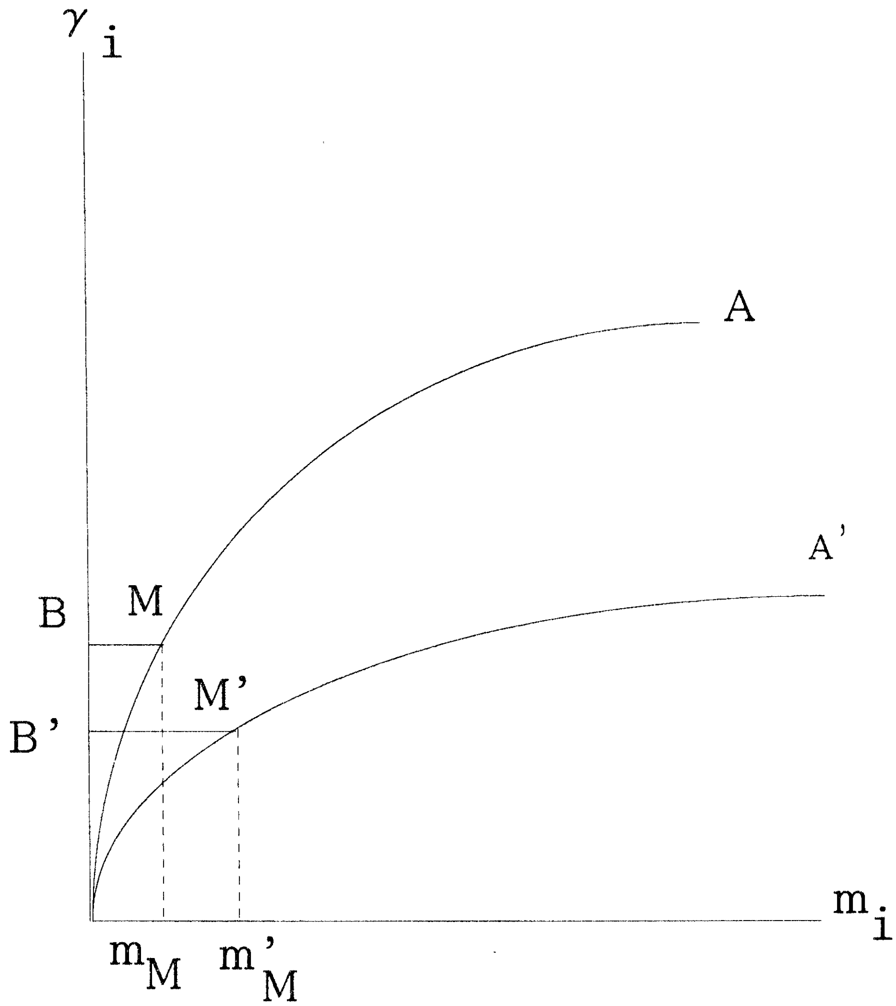

Figure 1-B

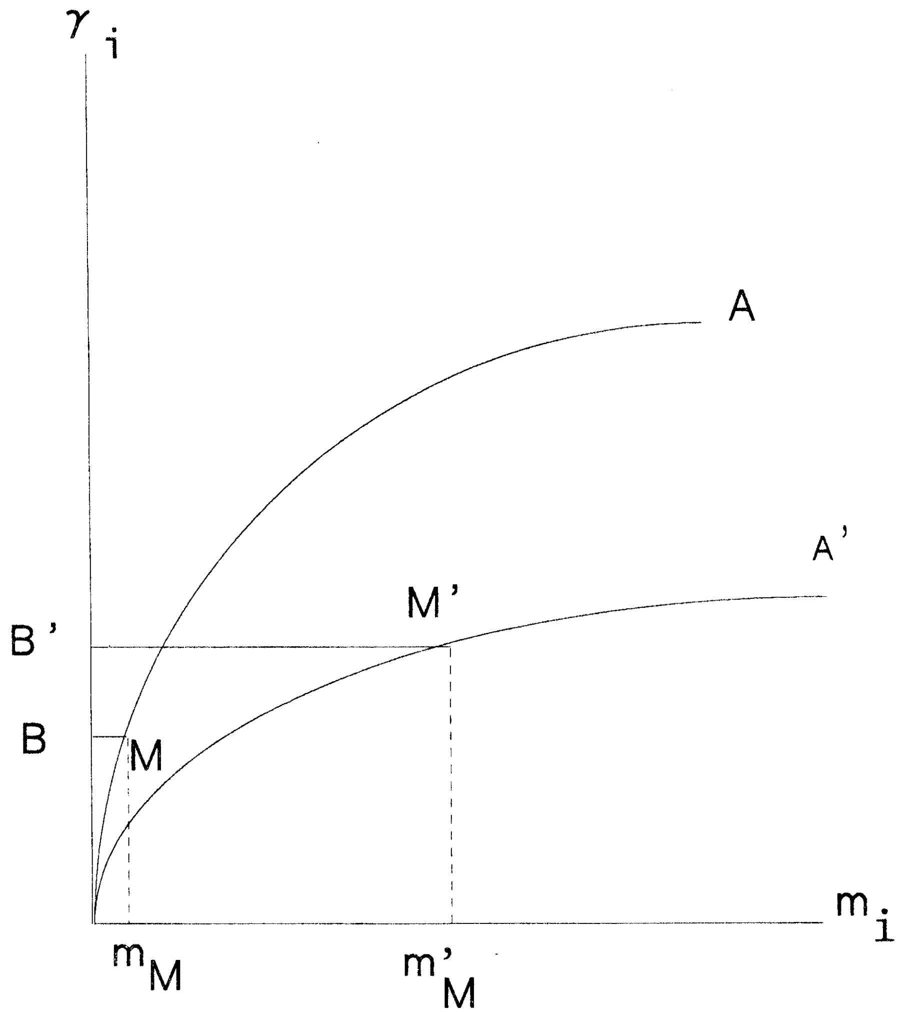

Figure 2