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Abstract

In this study, we develop a three-period overlapping generations model with *inter vivos* gifts and human capital accumulation. We examine the effect of *inter vivos* gift taxation on wealth inequality and economic growth. The analysis shows that an increase in the tax rate reduces inequality, and a positive tax rate maximizes the growth rate.

Keywords: economic growth, human capital accumulation, intergenerational transfer, wealth inequality, gift taxation

JEL Classification Numbers: O11, O40, I24

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1 Introduction

Taxation of gifts is introduced in many countries. However, in some countries, this does not apply to gifts that are for educational purposes. In Japan, a tax exemption system for lump-sum gifts of educational funds was introduced in 2013. The purpose of the system is to encourage the transfer of assets held by elder generations to young generations and to promote economic growth.

Some empirical research shows that in addition to income inequality, intergenerational transfer including gifts are an important factor that affects wealth inequality.[1] The above system may be harmful for wealth inequality and economic growth. In addition to the fact that gift-giving itself can create disparities in assets, when gifts are used to fund education there may also be differences in educational opportunities. Differences in educational opportunities may result in greater income inequality. Thus, gift-giving can be a source of wealth inequality in the two ways mentioned above.

In this paper, we examine how gift tax rate affects economy. The above system mainly focus on *inter vivos* gifts from grandparents to grandchildren, so that this study develops a three-period overlapping generations model with *inter vivos* gifts and human capital accumulation to explicitly model the gifts. The analysis shows that an increase in the tax rate reduces inequality, and a positive tax rate maximizes the growth rate. The results suggests that rather than exempting gift tax, raising gift tax rate to some extent reduces inequality and moreover, promote human capital accumulation and economic growth.

Many studies on human capital accumulation and inequality employing the overlapping generations model do not consider the effect of intergenerational transfers on inequality.[2] Bossmann et al. (2007) analyzed the role of bequests with the overlapping generations model as in this study to tax bequests. They showed that using the coefficient of variation as a measure of inequality, bequests diminished the inequality of wealth. Michel and Pestieau (2004) introduced inheritance into an overlapping generations model and compared the social optimal solution with the market equilibrium solution by taxation. In most of the literature on intergenerational transfers, the use of intergenerational transfer is determined by the recipient. However, in this paper, we focus only on the use of *inter vivos* gifts for funding education, since the above tax system we are analyzing is for gifts of education funds. Thus, in addition to the inequality caused by the gift itself, we can analyze the inequality thorough education.

[1] See Davies and Shorrocks (2000) and Horioka (1993).

[2] Galor and Moav (2004), Glomm and Kaganovich (2008), De la Croix and Doepke (2003), De la Croix and Doepke (2004), and Grossmann and Mazumder (2008) are closely related to this paper in terms of analyzing the relationship between economic growth and inequality with overlapping generations framework.

2 The Model

Consider a three-period overlapping generations model. Time is discrete. The economy consists of households, the government, and firms under perfect competition. We assume a small open economy, which means that the interest rate is equal to the world interest rate $\bar{r}$. An individual lives for three periods. There are two types of individuals: L and H. The difference between these two types is initial human capital. Population of each type is one. There is no population growth. There are two families or dynasties consisting of one grandparent, one parent, and one child. In childhood, individuals born in period $t-1$ receive both public and private education and make no decisions. In adulthood, they supply human capital h_t to the labor market and allocate their income to consumption c_t and saving s_t. In old age, they retire and allocate their savings to consumptions d_{t+1} and gifts b_{t+1} for their grandchild. The budget constraint for individuals born in period $t-1$ is given by

$$w_t^i h_t^i = c_t^i + s_t^i, \tag{1}$$

$$(1+\bar{r})s_t^i = d_{t+1}^i + (1+\tau)b_{t+1}^i, \tag{2}$$

where w^i denotes wage rate of type i and τ denotes the gift tax rate. Each individual takes into account the effect of taxation when making decisions about giving education gifts. Tax reduces the amount of gifts they can give. Therefore, when they allocate b as gifts to their grandchild, the gross gift becomes $(1+\tau)b$. Individuals draw utility from consumption and the amount of donations.[3] The utility function of individuals born in period $t-1$ is given by

$$U_{t-1} = \ln c_t^i + \beta \ln d_{t+1}^i + \gamma \ln b_{t+1}^i. \tag{3}$$

The utilities from future consumption and donation are discounted by β and γ respectively. From (1), (2), and (3), solving the maximization problem of households, we derive

$$c_t^i = \frac{1}{1+\beta+\gamma} w_t^i h_t^i, \tag{4}$$

$$d_{t+1}^i = \frac{\beta(1+\bar{r})}{1+\beta+\gamma} w_t^i h_t^i, \tag{5}$$

$$b_{t+1}^i = \frac{\gamma(1+\bar{r})}{(1+\tau)(1+\beta+\gamma)} w_t^i h_t^i. \tag{6}$$

Firms produce goods by employing the efficiency unit of labor h_t and physical capital K_t from households. The capital depreciates fully. The production function is given by

$$y_t = K_t^\alpha \left(a_1 h_t^H + a_2 h_t^L\right)^{1-\alpha}. \tag{7}$$

[3] We assume that the motive for giving is the joy of giving, as in Glomm and Ravikumar (1992) and Galor and Zeira (1993).

where y_t denotes output at time t. We assume $a_1 \geq a_2$.[4] Under perfect competition, wages and interest rates are equal to the marginal products of each input in equilibrium. According to the assumption of a small open economy, $r_t = r_{t+1} = \bar{r}$ is satisfied. Thus, the wage rates are

$$w_t^H = \frac{\partial y_t}{\partial h_t^H} = (1-\alpha)\left(\frac{\bar{r}}{\alpha}\right)^{\frac{\alpha}{\alpha-1}} a_1 \equiv a_H, \tag{8}$$

$$w_t^L = \frac{\partial y_t}{\partial h_t^L} = (1-\alpha)\left(\frac{\bar{r}}{\alpha}\right)^{\frac{\alpha}{\alpha-1}} a_2 \equiv a_L. \tag{9}$$

The government taxes gifts at the tax rate $\tau \in (0, \infty)$. All revenue are used for public education. In each period, the government's budget constraint is balanced as follows:

$$e_{t+1} = \tau b_{t+1}^H + \tau b_{t+1}^L. \tag{10}$$

Human capital accumulation depends on private education b and public education e. The cost of private education is financed by after-tax gifts. Public education is provided by the government. When individuals make decisions, they do not consider that part of the gift that is financed by public education. Human capital production function is given by

$$h_{t+2}^i = [\epsilon(b_{t+1})^q + (1-\epsilon)(e_{t+1})^q]^{\frac{1}{q}}. \tag{11}$$

Here, ϵ represents the weight of each type of education. The larger the value of ϵ is, the greater the impact of private education on human capital accumulation is. Generally, private education and public education are substitutable; hereafter, we focus on the case where $q > 0$.

3 Dynamics and steady state

In this economy, we define the steady state as a situation in which both types of human capital grow at the same rate. By substituting (10) and (6) into (11), each type of human capital for $i, j \in \{H, L\}, i \neq j$ is

$$h_{t+1}^i = \frac{\Theta}{1+\tau}\left[\epsilon\left(a_i h_{t-1}^i\right)^q + (1-\epsilon)\tau^q\left(a_i h_{t-1}^i + a_j h_{t-1}^j\right)^q\right]^{\frac{1}{q}}. \tag{12}$$

We define the inequality as $\phi_t \equiv \frac{h_t^L}{h_t^H}$ in this model. From (12), we derive

$$\phi_{t+1} = \phi_{t-1}\left[\frac{\epsilon a_L^q + (1-\epsilon)\tau^q(a_L + \frac{a_H}{\phi_{t-1}})^q}{\epsilon a_H^q + (1-\epsilon)\tau^q(a_H + \phi_{t-1} a_L)^q}\right]^{\frac{1}{q}}. \tag{13}$$

[4] When h is sufficiently accumulated, the differences between each type of human capital is small, and it may be unnatural that there exists wage difference. However, if we consider two types of non-mobile regions, we can simulate a situation where there is a difference in wages even if the difference in the amount of human capital is small, such as between urban and rural areas.

In steady state, since ϕ is constant over time, we obtain

$$1 = \left[\frac{\epsilon a_L^q + (1-\epsilon)\tau^q (a_L + \frac{a_H}{\phi})^q}{\epsilon a_H^q + (1-\epsilon)\tau^q (a_H + \phi a_L)^q} \right] \equiv F(\phi). \tag{14}$$

Lemma 1. *There exists a unique steady state which satisfies $F(\phi) = 1$*

Proof. See appendix. □

Lemma 2. *The steady state is stable.*

Proof. See appendix. □

Therefore, we find that a unique stable steady state exists in this economy. Next, we analyze the effect of tax on inequality in the steady state.

Proposition 1. *An increase in the gift tax rate reduces inequality.*

Proof. See appendix. □

The intuition is as follows. An increase in the gift tax rate reduces the amount of private education but increases the amount of public education. When private and public education are substitutable, a larger total amount implies greater accumulation. Thus, type L with less private education will accumulate more human capital than type H when public education increases due to higher taxes. As a result, inequality will reduce. In other words, since the amount of giving is proportional to the income, the burden on wealthy individuals increases when taxes are raised. Meanwhile, an increase in tax revenue is directly reflected in an increase in public education, so the benefits they receive are equal regardless of their type. Therefore, the relatively poor type L is more likely to promote the accumulation of human capital, which reduces inequality.

Next, we analyze the effect on the growth rate. We define the growth rate as $g \equiv \frac{h_{t+1}}{h_t}$. In the steady state, since both types of human capital grow at the same rate, we omit the subscript i. From (12), we derive the growth rate where

$$g = \left\{ \left(\frac{\Theta}{1+\tau} \right) \left[\epsilon a_H^q + (1-\epsilon)\tau^q \left(a_H + \phi a_L \right)^q \right]^{\frac{1}{q}} \right\}^{\frac{1}{2}}. \tag{15}$$

Proposition 2. *The relationship between the growth rate and the gift tax rate is non-monotonic, and a positive gift tax rate maximizes the growth rate.*

Proof. See appendix. □

The intuition is as follows. An increase in the gift tax rate reduces private education and increases public education in the same way as the effect on inequality. Since the increase in both types of education has a positive effect on human capital accumulation, it has positive and negative effects on the growth rate. In addition, there exists an effect through the ratio of

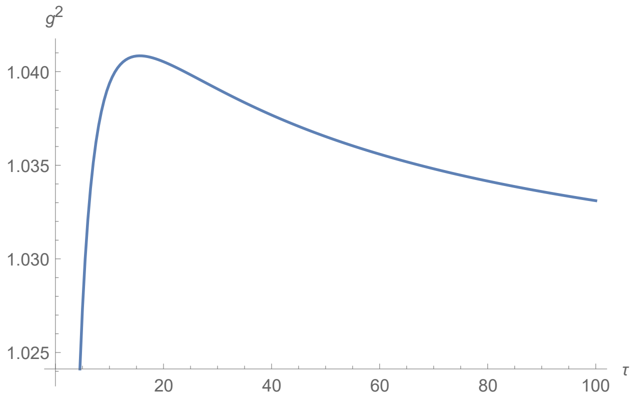

Figure 1: A numerical example:($\epsilon = 0.5$,$q = 0.8$)

human capital ϕ. From Proposition 1, inequality diminishes due to the increase in the tax rate. Declining inequality positively affects the growth rate. Thus, an increase in the tax rate has both positive and negative effects on the growth rate. When the tax rate is sufficiently small, the positive effects dominate. When it is sufficiently large, a negative effect dominates. Therefore, there exists a tax rate between 0 and ∞, which maximizes the economic growth rate. Figure 1 is a numerical example. We also find that to operate the gift tax rate, we cannot simultaneously minimize inequality and maximize the growth rate.

4 Appendix

Proof of lemma 1

The derivative of (14) is

$$F'(\phi) = \frac{-q(1-\epsilon)\tau^q(a_H + \phi a_L)^{q-1}\left(\epsilon(a_H^q/\phi^{q+1} + a_L^q) + (1-\epsilon)\tau^q(a_L + a_H/\phi)^{q+1}\right)}{[\epsilon a_H^q + (1-\epsilon)\tau^q(a_H + \phi a_L)^q]^2} < 0. \tag{16}$$

Calculating the limits, we find that $\lim_{\phi \to 0} F(\phi) = \infty$ and $F(1) < 1$.

Proof of lemma 2

The dynamics of ϕ is

$$\phi_{t+1} = \phi_{t-1}\left[\frac{\epsilon a_L^q + (1-\epsilon)\tau^q(a_L + \frac{a_H}{\phi_{t-1}})^q}{\epsilon a_H^q + (1-\epsilon)\tau^q(a_H + \phi_{t-1}a_L)^q}\right]^{\frac{1}{q}}. \tag{17}$$

Here, ϕ_{t+1} does not depends on ϕ_t and only on ϕ_{t-1}. Namely, we can treat this equation as first-order-difference equation. Differentiating (17) with respect to ϕ_{t-1}, we obtain

$$\frac{\partial \phi_{t+1}}{\partial \phi_{t-1}} = \frac{\epsilon^2 a_H^q a_L^q + (1-\epsilon)\tau^q (a_H + \phi a_L)^{q-1} \left(\frac{\epsilon a_H^q a_L}{\phi^{q-1}} + \epsilon a_H a_L^q \right)}{\left[\epsilon a_H^q + (1-\epsilon)\tau^q (a_H + \phi a_L)^q\right] \left[\epsilon a_L^q + (1-\epsilon)\tau^q \left(a_L + \frac{a_H}{\phi}\right)^q\right]}.$$

Comparing denominator with numerator, we obtain

$$\begin{aligned} &\epsilon^2 a_H^q a_L^q + (1-\epsilon)\tau^q (a_H + \phi a_L)^{q-1} \left(\frac{\epsilon a_H^q a_L}{\phi^{q-1}} + \epsilon a_H a_L^q \right) \\ &- \left[\epsilon a_H^q + (1-\epsilon)\tau^q (a_H + \phi a_L)^q\right] \left[\epsilon a_L^q + (1-\epsilon)\tau^q \left(a_L + \frac{a_H}{\phi}\right)^q\right] < 0. \end{aligned}$$

Clearly, both of them are positive, then we find $0 < \frac{\partial \phi_{t+1}}{\partial \phi_{t-1}} < 1$. Note that since, in this model, the decisions of an individual do not affect their child but their grandchild, it can be divided into two periods: odd and even. However, because the above proof doesn't depend on time t, both periods stable and converge same steady state.

Proof of proposition 1

From (14), ϕ in the steady state satisfies

$$(a_H + \phi a_L)^q - \left(a_L + \frac{a_H}{\phi}\right)^q = \frac{\epsilon(a_L^q - a_H^q)}{(1-\epsilon)\tau^q} \tag{18}$$

Define $M(\tau, \phi)$ as $M(\phi, \tau) \equiv (a_H + \phi a_L)^q - \left(a_L + \frac{a_H}{\phi}\right)^q - \frac{\epsilon(a_L^q - a_H^q)}{(1-\epsilon)\tau^q}$. Applying implicit function theorem,

$$\begin{aligned} \frac{\partial \phi}{\partial \tau} &= -\frac{M_\tau(\phi, \tau)}{M_\phi(\phi, \tau)} \\ &= \frac{\epsilon \phi^2 (a_H^q - a_L^q)}{(1-\epsilon)\tau^{q+1} \left[a_L \phi^2 (a_H + \phi a_L)^{q-1} + a_H \left(a_L + \frac{a_H}{\phi}\right)^{q-1}\right]}. \end{aligned} \tag{19}$$

Because of $q > 0$, ϕ is an increase function of τ.

Proof of proposition 2

There is no difference in the proof between the growth rate for the one period and the growth rate for the two periods, because, in the steady state, the growth rate is constant. For simplicity, we use the growth rate for the two periods. First, we show $\lim_{\tau \to 0} \frac{\partial g^2}{\partial \tau} = \infty$. Differentiating

(15) with respect to τ and taking limit, we derive

$$\lim_{\phi \to 0} \frac{\partial g^2}{\partial \tau} = \Theta[\epsilon a_H^q]^{\frac{1-q}{q}} \left\{ -\epsilon a_H^q + \lim_{\tau \to 0} \frac{a_L(a_H + \phi a_L)^{q-1} \epsilon \phi^2 (a_H^q - a_L^q)}{\tau[a_L \phi^2 (a_H + \phi a_L)^{q-1} + a_H(a_L + a_H/\phi)^{q-1}]} \right\}$$
$$= \infty. \tag{20}$$

Next, when τ is large enough, we show that $\frac{\partial g^2}{\partial \tau}$ is negative. Differentiating (15) with respect to τ and substituting into (19), we obtain

$$\begin{aligned}\frac{\partial g^2}{\partial \tau} &= \frac{\Theta}{(1+\tau)^2} \left[\epsilon a_H^q + (1-\epsilon)\tau^q (a_H + \phi a_L)^q\right]^{\frac{1-q}{q}} \\ &\times \left\{ -\epsilon a_H^q + (1-\epsilon)\tau^{q-1}(a_H + \phi a_L)^q + (1-\epsilon)(1+\tau)\tau^q a_L (a_H + \phi a_L)^{q-1} \frac{\partial \phi}{\partial \tau} \right\} \\ &= \frac{\Theta}{(1+\tau)^2} \left[\epsilon a_H^q + (1-\epsilon)\tau^q (a_H + \phi a_L)^q\right]^{\frac{1-q}{q}} \\ &\times \left\{ -\epsilon a_H^q + (1-\epsilon)\tau^{q-1}(a_H + \phi a_L)^q + \frac{(1+\tau)\epsilon(a_h^q - a_L^q)}{\tau\left[1 + \frac{a_H}{a_L}\phi^{1-q}\right]} \right\}. \end{aligned} \tag{21}$$

From (18), the second term in curly brackets can be rewritten to

$$(1-\epsilon)\tau^{q-1}(a_H + \phi a_L)^q = \frac{(1-\epsilon)\epsilon(a_L^q - a_H^q)}{\tau(1-\epsilon)} + \frac{(a_L + a_H/\phi)^q}{\tau^{q-1}}.$$

Due to $\frac{\partial \phi}{\partial \tau} > 0$, this is a decrease function of τ. Therefore,

$$\lim_{\tau \to \infty} (1-\epsilon)\tau^{q-1}(a_H + \phi a_L)^q = 0. \tag{22}$$

We can rewrite the third term to

$$\frac{(1+\tau)\epsilon(a_h^q - a_L^q)}{\tau\left[1 + \frac{a_H}{a_L}\phi^{1-q}\right]} = \frac{\epsilon a_L(a_H^q - a_L^q)}{a_L + \phi^{1-q}a_H} + \frac{\epsilon a_L(a_H^q - a_L^q)}{\tau(a_L + \phi^{1-q}a_H)}. \tag{23}$$

Taking limit each term of (23), since the maximum of ϕ is 1, we obtain

$$\lim_{\tau \to \infty} \frac{\epsilon a_L(a_h^q - a_l^q)}{a_L + \phi^{1-q}a_H} = \frac{\epsilon a_L(a_h^q - a_l^q)}{a_L + a_H}, \tag{24}$$

$$\lim_{\tau \to \infty} \frac{\epsilon a_L(a_h^q - a_L^q)}{\tau(a_L + \phi^{1-q}a_H)} = 0. \tag{25}$$

From (22), (24) and (25),

$$\lim_{\tau\to\infty}\left\{-\epsilon a_H^q+(1-\epsilon)\tau^{q-1}(a_H+\phi a_L)^q+\frac{(1+\tau)\epsilon(a_h^q-a_L^q)}{\tau\left[1+\frac{a_H}{a_L}\phi^{1-q}\right]}\right\}$$
$$=\frac{-\epsilon(a_H^{q+1}+a_L^{q+1})}{a_L+a_H}. \tag{26}$$

From the above, all terms of (21) except the first term in curly brackets are negligibly small when τ is sufficiently large. Thus, when τ is large enough, $\frac{\partial g^2}{\partial\tau}$ is negative. Therefore, there exists τ between 0 and ∞ at least which maximize the growth rate.

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