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The Effect of Public Museums on the Economic Growth*

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Abstract

This paper presents a model in which human capital of individuals is accumulated through visiting public museums with their parents in a childhood as well as receiving educational input provided by the government. With the model, we demonstrate that how a change of the education budget affects the economic growth rates. We show that (1) when the tax revenue for education is large enough, there is the budget allocation between the public museums and the public schools which maximizes the growth rate. (2) When the tax revenue for education is not large, the growth effect of allocation depends on the required time that parents have to spend to take their children to museums. If it takes long time for parents to take their children to museums, there is also the budget allocation which maximizes the growth rate. If it takes short time for them to bring their children to museums, the growth rate decreases along with that the government increases the budget for museums.

Keywords: Human capital, Education, Economic growth.
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1 Introduction

There are many museums all over the world. Both people who have the aim to know and/or look at something specific and who do not have the clear aim, we can learn something from the collections by visiting museums. Visiting museums itself may afford us pleasure. It is popular for European people to visit museums during their vacations. The information of the latest exhibitions around the area appears in the newspapers and magazines. In many countries, children might have a chance to visit museums as a method of school program. Therefore, museums are very familiar facilities.

Public museums are supplied by the government with a considerable national budget. Households can visit them with paying not so expensive entrance fees to get new knowledge and experiences from their collections and museum lectures. Our paper focus on the educational effects of public museums which contribute to accumulate human capital of children.

Many researchers, such as Azariadis and Drazen (1990), Stokey (1991), Glomm and Ravikumar (1992), Zhang and Casagrande (1998), Kaganovich and Zilcha (1999), Wigger (2004), Rojas (2004), Dissou et al. (2016), and Jacobs and Yang (2016) among others, examine the human capital accumulation and growth.Different from their papers, our model adds a new route to human capital accumulation by considering the possibility that children can improve their human capital level by visiting public museums with their parents. In contrast to Mochida (2019) which also considers the educational aspect of museums, this paper assumes that parents need to spend time, otherwise they can work to receive labor income, to bring their children to museums as well as the family's admission fees. They determine how many times they bring their kids to museums, maximizing their utility.

With such settings, this paper examines how a change of the educational budget affects the economic growth rates. We show that (1) when the tax revenue for education is large enough, there is the budget allocation between the public museums and the public schools which maximizes the growth rate. (2) When the tax revenue for education is not large, the growth effect of allocation depends on the required time that parents have to spend to take their children to museums. If it takes long time for parents to take their children to museums, there is the threshold allocation level between the public museums and schools which maximizes the growth rate. If it takes short time for them to bring their children to museums, the growth rate decreases along with that the government increases the budget for public museums.

The remainder of this paper is organized as follows. Section 2 describes the model. Section 3 examines the effects of the educational budget for public museums on the growth rates in the economy. Concluding remarks are presented in Section 4.

2 The economy

We consider an overlapping-generations model of endogenous growth. The life of a representative individual is divided into three periods: a childhood, a young-working, and a retirement period.

The government levies a tax $\epsilon \in [0, 1)$ on labor wage and redistributes η part of the revenue to operate public museums, and $(1 - \eta)$ part of it to supply public schools. The values of the museum budget per visitor and the public school investment per child at time t are described, respectively, as M_t and e_t^g.

2.1 Households

In childhood, individuals only accumulate human capital through visiting museums as well as receiving education in the public schools. Individuals are endowed with one divisible unit of time in their young periods, reproduce asexually, and allocate their time toward labor and taking their children to museums. When we visit museums, we may be able to learn something from the collections in the real world. Thus, in our model, we assume that children can increase their human capital by visiting public museums. The more times children visit museums, the higher the human capital level is. As individuals are set to do not make any economic decisions in childhood, the number of visits to museums is determined by their parents those who receive their utility from their children's human capital level. In the end of their young periods, individuals receive labor income, which is taxed away. They consume part of their income, pay entrance fees per visit of parents and their children, and save the rest of it for their retirement period. Subsequently, individuals obtain the principal and interest from their saving and consume them after retirement.

Each individual who is born at time t, and called generation $t+1$, accumulates human capital h_{t+1} according to

$$h_{t+1} = (\mu_t \phi M_t)^{\gamma} (e_t^g)^{1-\gamma}, \tag{1}$$

where μ_t is the number of visits to museums per child, and $\phi \in (0,1]$ is assumed to be the proportion of that children can learn and improve their human capital from the museum budget per capita. In that equation, $\gamma \in (0,1)$ denotes the efficiency of education input through visiting museums. Individuals determine their number of visits to museums, taking the value of ϕM_t and e_t^g as given, respectively.

The time constraint of generation t at time t is

$$1 = l_t + q\mu_t,$$

where l_t and q denote the labor time and the required time for visiting museums per visit. In this model, the amount of q has no relations with human capital accumulation. We can regard time cost, q, as the distance to museums. If q is larger, the museum exists far away. In such a case, parents may rarely bring them to the museums. The second term of the equation is the total required time of visiting museums.

The budget constraints of a member of generation t when young and retired are given, respectively, by

$$(1-\epsilon)w_t h_t l_t = c_t^y + m_t(1+n)\mu_t + s_t,$$

and

$$(1+r_{t+1})s_t = c_{t+1}^o,$$

where c_t^y, m_t, n, s_t, and c_{t+1}^o is the consumption when young, the admission fee per person, the number of children, the amount of savings, and the consumption when retirement.[1] w_t is the wage rate at time t, and r_{t+1} is the interest rate at time $t+1$. Both factor prices are given for households.

The utility function of generation $t(\geq 0)$ is

$$u_t = \ln c_t^y + p\ln c_{t+1}^o + \sigma n \ln h_{t+1}. \quad (2)$$

The parameter $p(>0)$ is subjective discount rate and $\sigma \in (0,1)$ measures the taste for children's human capital. By solving individuals' optimization

[1] In this model, we assume that the admission fee for adults and children is the same amount. Under the assumption that the admission fee is different between adults and children, the results of this paper will not be changed, drastically.

problems, the optimal values are given by:

$$c_t^y = \frac{1}{(1+p+n\sigma\gamma)}(1-\epsilon)w_t h_t,$$

$$c_{t+1}^o = \frac{p}{(1+p+n\sigma\gamma)}(1+r_{t+1})(1-\epsilon)w_t h_t,$$

$$s_t = \frac{p}{(1+p+n\sigma\gamma)}(1-\epsilon)w_t h_t, \tag{3}$$

and

$$\mu_t = \frac{n\sigma\gamma}{[q(1-\epsilon)w_t h_t + (1+n)m_t]}\frac{1}{(1+p+n\sigma\gamma)}(1-\epsilon)w_t h_t. \tag{4}$$

2.2 Production

Competitive firms produce a single final good by employing both physical capital and effective labor input. The aggregate production function at time t is given by

$$Y_t = F(K_t, h_t l_t N_t) = AK_t^{\alpha}(h_t l_t N_t)^{1-\alpha},$$

where Y_t, A, K_t, N_t and $\alpha \in (0,1)$ respectively denote the aggregate output, the productivity parameter, the physical capital that fully depreciates in the production process, the working-age population, and the share of physical capital. Firms hire physical capital and effective labor inputs up to the point at which the marginal product equals the factor price:

$$(1+r_t) = \frac{\partial Y_t}{\partial K_t} = A\alpha(\frac{K_t}{h_t l_t N_t})^{\alpha-1},$$

and

$$w_t = \frac{\partial Y_t}{\partial(h_t l_t N_t)} = A(1-\alpha)(\frac{K_t}{h_t l_t N_t})^{\alpha}.$$

2.3 The Government

The government supplies public museums as an educational opportunity for children, using both a share η of the education-tax revenue and the total admission fees, including of parents and children, paid by visitors. Here, η is treated as a predetermined parameter and is constant over time. At time t, the total amount of museum budget per visit, M_t, and the value of public school investment per child e_t^g, are adjusted to balance the governmental budget constraints. The budget constraints governing the education policy at time t are given by

$$\text{Public Museums;} \qquad \eta\epsilon w_t h_t l_t N_t + m_t(1+n)\mu_t N_t = M_t(1+n)\mu_t N_t,$$

$$\text{Public Schools;} \qquad (1-\eta)\epsilon w_t h_t l_t N_t = e_t^g n N_t.$$

Thus, the value of education investment per child at time t are determined, respectively, as

$$\text{Public Museums;} \qquad M_t = \frac{\eta\epsilon w_t h_t l_t + m_t(1+n)\mu_t}{(1+n)\mu_t}, \tag{5}$$

$$\text{Public Schools;} \qquad e_t^g = \frac{(1-\eta)\epsilon}{n} w_t h_t l_t. \tag{6}$$

2.4 Equilibrium

In here, we shall assume that the museum entrance fee per visitor is χ proportion of parents' wage income per labor time as:

$$m_t = \chi w_t h_t, \qquad \chi \in (0,1). \tag{7}$$

From (4) and (7), we have the number of visits which maximizes the parents' utility which is constant over time:

$$\mu_t = \frac{n\sigma\gamma\kappa(1-\epsilon)}{q(1-\epsilon)+(1+n)\chi} \equiv \bar{\mu}, \tag{8}$$

where $\kappa \equiv \frac{1}{(1+p+n\sigma\gamma)}$.

Thus, labor time is also constant over time, as:

$$l_t = (1-q\bar{\mu}) = \frac{q\kappa(1-\epsilon)(1+p)+(1+n)\chi}{q(1-\epsilon)+(1+n)\chi} \equiv \bar{l} \tag{9}$$

Using (1), (5), (6), (8), and (9), the human capital level of generation $t+1$ is represented as

$$h_{t+1} = (\frac{\phi[\eta\epsilon(1-q\bar{\mu})+(1+n)\chi\bar{\mu}]}{(1+n)})^{\gamma}(\frac{(1-\eta)\epsilon(1-q\bar{\mu})}{n})^{1-\gamma} w_t h_t \equiv h^* w_t h_t, \tag{10}$$

where $h^* \equiv (\frac{\phi[\eta\epsilon(1-q\bar{\mu})+(1+n)\chi\bar{\mu}]}{(1+n)})^{\gamma}(\frac{(1-\eta)\epsilon(1-q\bar{\mu})}{n})^{1-\gamma}$.

By employing the capital market-clearing condition, $K_{t+1} = s_t N_t$, (3), (9) and (10), the per-effective labor growth rate at time t is constant over time:

$$(1+g_t) = \frac{\frac{Y_{t+1}}{h_{t+1}l_{t+1}N_{t+1}}}{\frac{Y_t}{h_t l_t N_t}}$$

$$= A(1-\alpha)(\frac{p\kappa(1-\epsilon)}{n(1-q\bar{\mu})})^{\alpha}(h^*)^{1-\alpha} \equiv (1+g^*). \tag{11}$$

3 Museum Education

Let's examine how the budget proportion for public museums affects the growth rate in the economy. The following proposition summarizes the effect of the change of budget proportion for public museums on the growth rate.

Proposition 1.

(1) If $\epsilon \geq \tilde{\epsilon}$, *then* $sign(\frac{\partial(1+g^*)}{\partial\eta}) \geq (<) 0$, *when* $\eta \leq (>) \hat{\eta}$,
(2-i) If $\epsilon < \tilde{\epsilon}$ *and* $q > \tilde{q}$, *then* $sign(\frac{\partial(1+g^*)}{\partial\eta}) \geq (<) 0$, *when* $\eta \leq (>) \hat{\eta}$,
(2-ii) If $\epsilon < \tilde{\epsilon}$ *and* $q \leq \tilde{q}$, *then* $sign(\frac{\partial(1+g^*)}{\partial\eta}) < 0$, *for all* η,

where $\tilde{\epsilon} \equiv \frac{(1-\gamma)n\sigma\kappa}{(1-\gamma)n\sigma\kappa+1}$, $\hat{\eta} \equiv \frac{\gamma\epsilon[q\kappa(1-\epsilon)(1+p)+(1+n)\chi]-(1-\gamma)(1+n)\chi n\sigma\gamma\kappa(1-\epsilon)}{\epsilon[q\kappa(1-\epsilon)(1+p)+(1+n)\chi]}$, *and* $\tilde{q} \equiv \frac{[(1-\gamma)n\sigma\kappa(1-\epsilon)-\epsilon](1+n)\chi}{\epsilon(1-\epsilon)\kappa(1+p)}$.

Proof. *See the Appendix.*

This proposition shows that the growth effect of the increase in public museum budget depends on the payroll education-tax rate, ϵ, and the time cost of taking children to museums, q. When both the tax rate and thereby the amount of education revenue is large enough ($\epsilon \geq \tilde{\epsilon}$), and when although the tax rate is not large ($\epsilon < \tilde{\epsilon}$), the time cost to museums is large enough ($q > \tilde{q}$), there is the threshold level of budget allocation between the public museums and the public schools which maximizes the growth rate. When both the tax rate and the time cost to museums are not large ($\epsilon < \tilde{\epsilon}$, $q \leq \tilde{q}$), the economic growth rate decreases along with that the government increases the national budget for museums.

We can interpret case (2-ii) as follows. In case of low visiting time cost, that is, there is a museum near home, the households often bring their children to accumulate human capital to maximize utility. Besides, when the education tax rate is lower, parents afford to take them to museums with the larger disposable income. Under such situation, the government allocate education revenue, which is not so large amount because of lower education tax rate, only to public schools to maximize the growth rate.

4 Concluding Remarks

This paper considers how a change of the education budget affects the economic growth rates, by using a model in which human capital of children is accumulated through visiting public museums as well as receiving educational input provided by the government.

Human capital accumulation through education is recognized as one of the most important engines of economic growth. It might be important for the government to supply public museums effectively, considering the educational aspects of public museums and the households' behavior. From our results, the management of public museums might be transfered to private sectors after the government constructs the public museums with national budget, in the economy where households can frequently visit museums to increase the human capital level of their children.

Appendix

Proof of Proposition 1.

By differentiating (11) with respect η, we obtain the following equation:

$$sign(\frac{\partial(1+g^*)}{\partial\eta})\geq 0$$

$$\Longleftrightarrow sign(\frac{\partial[\eta\epsilon(1-q\bar{\mu})+(1+n)\chi\bar{\mu}]^{\gamma(1-\alpha)}(1-\eta)^{(1-\gamma)(1-\alpha)}}{\partial\eta})\geq 0$$

$$\Longleftrightarrow sign(-\epsilon(1-q\bar{\mu})\eta+\gamma\epsilon(1-q\bar{\mu})-(1-\gamma)(1+n)\chi\bar{\mu})\geq 0$$

$$\Longleftrightarrow \eta \leq \frac{\gamma\epsilon(1-q\bar{\mu})-(1-\gamma)(1+n)\chi\bar{\mu}}{\epsilon(1-q\bar{\mu})}$$

$$\Longleftrightarrow \eta \leq \frac{\gamma\epsilon[q\kappa(1-\epsilon)(1+p)+(1+n)\chi]-(1-\gamma)(1+n)\chi n\sigma\gamma\kappa(1-\epsilon)}{\epsilon[q\kappa(1-\epsilon)(1+p)+(1+n)\chi]}$$

$$\equiv \hat{\eta}.$$

If the numerator of $\hat{\eta}$ is less than or equal to 0, then the value of $\hat{\eta}$ is also less than or equal to 0. At that time, $\eta\in(0,1)$ is always more than $\hat{\eta}(\leq 0)$. That is, $\eta > \hat{\eta}$. Thus, $sign(\frac{\partial(1+g^*)}{\partial\eta}) < 0$ for all η. This is the case (2-ii).

Using the numerator of $\hat{\eta}$, we have

$$\hat{\eta}\leq 0$$

$$\Longleftrightarrow q\leq\frac{[(1-\gamma)n\sigma\kappa(1-\epsilon)-\epsilon](1+n)\chi}{\epsilon(1-\epsilon)\kappa(1+p)}\equiv\tilde{q}.$$

By using the numerator of $\tilde{q}$, we confirm that $\tilde{q} > 0$ is bound only when

$$\tilde{q} > 0$$

$$\Longleftrightarrow \epsilon < \frac{(1-\gamma)n\sigma\kappa}{(1-\gamma)n\sigma\kappa+1}\equiv\tilde{\epsilon}\in(0,1).$$

If $\epsilon\geq\tilde{\epsilon}$, and then $\tilde{q}\leq 0$. With the assumption of time cost q is positive ($q > 0$), we have $q > \tilde{q}(\leq 0)$, thus $\hat{\eta}$ is always positive. Thus, there is the $\hat{\eta}$ which maximizes the growth rate.[2] This is the case (1). If $\epsilon < \tilde{\epsilon}$ and $q > \tilde{q}$, and then $\hat{\eta}$ is positive. Therefore, there exists the $\hat{\eta}$. This is the case (2-i). This is the proof of Proposition 1.

Q.E.D.

[2]When $\hat{\eta} > 0$, we can confirm $\hat{\eta}\in(0,1)$, easily.

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