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Size and Composition of Public Education Expenditure in a Model of Human Capital Accumulation

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Abstract

This paper proposes a theory to study the formulation of education policies and human capital accumulation. The government collects income taxes and allocates tax revenue to primary and higher education. The tax rate and allocation rule are both endogenously determined through majority voting. The tax rate is kept at a low level and public funding for higher education is not supported unless majority of individuals have human capital above some threshold. Although public support for higher education promotes aggregate human capital accumulation, it may create long-run income inequality because the poor are excluded from higher education.

Keywords: Majority voting; Public education; Multistage education; Human capital; Income distribution

JEL classification: D72; H52; I24; I25; O43

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1 Introduction

Human capital accumulation can be an engine of economic growth, and the government has significant roles in providing formal education. In many existing studies, human capital is produced in a single education sector, where an amount of government expenditure is a direct input. In reality, however, an education system is divided into multiple stages, such as primary, secondary, and tertiary education, and the government supports each of them. Primary and secondary (K-12) education has a particularly big difference from tertiary education in the sense that it is mandatory but serves everyone for free although college education is optional and requires private spending.

It is relatively recently, however, that a number of studies have begun to analyze how policy changes for different education sectors affect economic growth and income distribution (Abington and Blankenau, 2013; Arcalean and Schiopu, 2010; Blankenau, 2005; Blankenau et al., 2007a; Restuccia and Urrutia, 2004; Su, 2004). In particular, with heterogeneity in income or innate ability, changes in the size of public education funds or budget allocations across different education sectors may increase the welfare of some individuals at the expense of others as shown by Su (2004), Blankenau et al. (2007a), and Abington and Blankenau (2013), which provides fertile ground for politico-economic analysis. For example, enhancing college education may most benefit the rich but may not benefit the poor who do not attend there.

This paper proposes an overlapping generations model in which both a tax rate to finance overall government education expenditures and a budget allocation for multiple education sectors are determined via majority voting, and analyzes the effects on human capital dynamics. Since individuals vote for both a tax rate and an allocation rule, the policy is multidimensional. In general, it is extremely, and often impossibly, difficult to find political equilibrium when a policy is multidimensional (Persson and Tabellini,

2000). In this paper, we provide a model of a special case to avoid such difficulty and prove that the individual with median income (median human capital) is the decisive voter. Although our model is simple, it enables us to analyze the interaction between the political determination of education policies and the dymanics of human capital. The outline of the model is in the following.

Individuals live for two periods, childhood and adulthood, and they have children when they are adult. Individuals in adulthood make all the economic and political decisions but they care about human capital of their children. The government operates two education sectors, which we call primary and higher education sectors. Primary education is compulsory but serves all childhood individuals free of charge. On the other hand, higher education is optional and requires private expenditures. In each education sector, private return on education depends on resource allocations from the government and parental human capital. Parents with low human capital are unwilling to have their children receive higher education because its private return is low. They prefer a low income tax rate and to allocate all the public funds to primary education. Parents whose human capital is above some threshold are willing to have their children obtain higher education. They prefer a higher tax rate and to allocate some resources to higher education. The policy implemented in political equilibrium depends on the level of median human capital.

Our model generates various dynamics of human capital accumulation and steady state income inequalities. As long as human capital of the median voter is below some threshold, an income tax rate, which determines budget size of education, is low and all the resources are provided for primary education. In some cases, the median voter accumulates sufficient human capital through primary education, and, as an economy develops, a higher tax rate (i.e., larger budget for education) and a positive alloca-

tion for higher education are realized. In other cases, however, only the initial income distribution matters for policy implementation. Although the emergence of higher education unambiguously promotes human capital accumulation and increases aggregate income level, it may lead to income inequality because the poor are excluded from higher education.

This paper is related to the literature that studies the political economy of education and its macroeconomic implications.[1] In our model, the tax rate is low and higher education is not realized if median human capital (income) is below some threshold. There are several reasons for which median income is low, but one of the main possible reasons is large income inequality. If this is the case, our paper is also related to studies on income inequality and growth. Saint-Paul and Verdier (1993) develop a model in which income redistribution is in the form of public education. It is well known that, in majority voting models, large income inequality causes large income redistribution. Based on the redistributive character of public education, Saint-Paul and Verdier (1993) show that in majority voting, large income inequality creates strong support for public education, thereby promoting human capital accumulation and economic growth. The model prediction is, however, not supported by empirical studies (e.g., Easterly, 2001, 2007). We regard public education differently from Saint-Paul and Verdier (1993). Private return from public education is not equal among individuals but dependent on their inherited human capital. Moreover, higher education requires private spending. Thus public education does not necessarily have a redistribution effect. In our model, if large income inequality makes the majority of individuals poor, it may have adverse effects on growth.

Other studies use political mechanisms other than majority voting. Galor et al.

[1] Notable examples include Glomm and Ravikumar (1992), Saint-Paul and Verdier (1993), Su (2006), and Galor et al. (2009).

(2009) and Su (2006) consider environments in which rich individuals have strong political power. Galor et al. (2009) construct a model in which landowners, who are better endowed with a production factor, prevent public education that promotes human capital formation and growth. The most related to our paper is Su (2006). She studies how public budget allocation between primary and higher education is determined when the top class has dominant political power as in many less-developed countries. In economies where the middle class is poor, the top class implements a policy that allocates more resources to higher education at the expense of primary education. The results in Su (2006) accord with observed cross-country differences of education policies.

Because the purpose of this paper is to provide a theory, we follow most of the literature and use majority voting as the political mechanism. However, our model can be immediately extended to study an environment in which only the rich have political power. In a typical case of less-developed economies, where a vast majority of the population is very poor and only a small portion at the top has high human capital, our model predicts that public funds are allocated to higher education despite the fact that most individuals are excluded from higher education. This result matches the characteristics of less-developed economies documented by Su (2004, 2006). Thus, our paper is not without empirical value. Nonetheless, our main interest and the goal of this paper is theoretical. It aims to provide one step to analyze how politically determined public budget size and its allocation rule interact with the dynamic behavior of human capital accumulation.

The rest of this paper is organized as follows. Section 2 describes the basic environments of the model. Section 3 characterizes the static equilibrium and Section 4 analyzes the dynamics. Section 5 concludes.

2 Basic Environment

We consider an overlapping generations economy in which individuals live for two periods, childhood and adulthood. The size of each generation is normalized to one. Every individual belongs to a lineage and has one child in her adulthood. An individual who belongs to a lineage indexed by i is simply called individual i hereafter unless it causes confusion. Individual i born in period t derives utility from consumption in her adulthood, c_{it+1}, and human capital of her child, h_{it+1}:

$$U(c_{it+1}, h_{it+1}) = c_{it+1} + h_{it+1}. \tag{1}$$

The economy is small open. Individuals can freely lend and borrow at the gross interest rate determined at international financial markets. The gross interest rate is normalized to one.

In childhood, individuals make no decisions but must receive compulsory primary education supplied by the government. After the completion of primary education, parents decide whether their children should receive higher education. Higher education is also supplied by the government, but in contrast to primary education, requires a private cost. For example, the cost includes the expense of migration to attend college as well as tuition fees. We assume that the size of the cost is fixed and normalized to one.[2]

In adulthood, individuals make all the economic and political decisions. They either become workers at a firm or school teachers. The firm transforms one unit of human capital into one unit of a final good. The final good market is perfectly competitive and therefore the wage per unit of human capital is one. Labor mobility across sectors is

[2]Such a fixed cost is a tradition of growth and development literature at least since Galor and Zeira (1993).

perfect. Income from becoming workers and teachers is identical, and thus individuals are indifferent about their occupation. They choose it randomly, which makes the average quantity of human capital equal in each sector. In addition to supplying labor, individuals simultaneously vote for (i) an income tax rate, which determines the overall size of government expenditure, and (ii) an allocation of tax revenue between primary and higher education, which determines the quality of each. After observing the realized tax rate and allocation rule, they decide whether their children should receive higher education, and then consume all their remaining wealth.

Individuals accumulate human capital solely through public education funded by government tax revenue, as in Su (2004, 2006) and others.[3] As for higher education, considering not only government expenditure to enhance the quality but also subsidies to cover its private costs captures an important aspect of education policies. Nonetheless, according to OECD (2013), the majority of public education expenditure is used to directly improve the quality of higher education. In 2010, direct public expenditure for institutions accounts for 78.3 percent of total public education expenditure for tertiary education, in the overall average of OECD countries.[4] Thus, subsidies to higher education are not so much as direct expenditures on institutions. We consider an environment in which government expenditure influences the quality of higher education rather than the private costs of higher education.

Income earned at period $t+1$ is taxed at the rate of τ_{t+1}, and the tax revenue is $\tau_{t+1}\bar{h}_t$, where $\bar{h}_t$ is the average (and aggregate) human capital supplied at period $t+1$. Keeping a balanced budget, the government allocates the tax revenue to primary and higher education. Denoting the share of government expenditure on primary education

[3]For example, see Blankenau et al. (2007b), Galor et al. (2009), and Naito (2012).
[4]Scholarships and other grants to households are 11.4 percent.

by x_{t+1}, the government budget constraints are given by

$$G^P_{t+1} = x_{t+1}\tau_{t+1}\bar{h}_t, \tag{2}$$

$$G^A_{t+1} = (1 - x_{t+1})\tau_{t+1}\bar{h}_t, \tag{3}$$

where G^P_{t+1} and G^A_{t+1} are the government expenditures on primary and higher education, respectively.

A child's human capital depends on the quality of education and the level of parental human capital. Specifically, if individual i born in period $t+1$ receives only primary education, she accumulates human capital according to

$$h_{it+1} = (n^P_{t+1})^\beta h_{it} + \hat{h}, \quad \beta \in (0,1), \quad \hat{h} \geq 0, \tag{4}$$

where h_{it+1} is the human capital output, n^P_{t+1} is the number of teachers in primary education, and $\hat{h}$ is the equally endowed innate human capital with which each individual is born. The return from education is increasing in her parental human capital and the number of teachers. If individual i receives higher education, she accumulates her human capital according to

$$h_{it+1} = (n^P_{t+1})^\beta h_{it} + (n^A_{t+1})^\beta h_{it} + \hat{h}, \tag{5}$$

where n^A_{t+1} is the number of teachers in higher education.

Since average quantity of human capital supplied at period $t+1$ is $\bar{h}_t$ in every sector, the average wage payments to teachers are also $\bar{h}_t$. This leads to $n^P_{t+1} = G^P_{t+1}/\bar{h}_t$ and $n^A_{t+1} = G^A_{t+1}/\bar{h}_t$, the same result as in Naito (2012). From (2), (3), (4), and (5), the

human capital of individual i is given by

$$h_{it+1} = x_{t+1}^{\beta}\tau_{t+1}^{\beta}h_{it} + \hat{h} \equiv F^{P}(x_{t+1}, \tau_{t+1}, h_{it}) \tag{6}$$

if she receives only primary education, and it is given by

$$h_{it+1} = [x_{t+1}^{\beta} + (1 - x_{t+1})^{\beta}]\tau_{t+1}^{\beta}h_{it} + \hat{h} \equiv F^{A}(x_{t+1}, \tau_{t+1}, h_{it}) \tag{7}$$

if she receives higher education.

3 Static Equilibrium Analysis

Before finding the combination of an income tax rate and an allocation rule that each individual votes for, let us discuss how an individual decides whether to invest in higher education under a given tax rate and an allocation rule. If individual i has her child obtain higher education, (1) and (7) give her utility, $V^{A}(x_{t+1}, \tau_{t+1}, h_{it})$, as

$$V^{A}(x_{t+1}, \tau_{t+1}, h_{it}) = [(1 - \tau_{t+1})h_{it} - 1] + F^{A}(x_{t+1}, \tau_{t+1}, h_{it}). \tag{8}$$

The first term is the consumption in her adulthood and the second term is the human capital of her child. If individual i decides not to have her child receive higher education, (1) and (6) give her utility, $V^{P}(x_{t+1}, \tau_{t+1}, h_{it})$, as

$$V^{P}(x_{t+1}, \tau_{t+1}, h_{it}) = (1 - \tau_{t+1})h_{it} + F^{P}(x_{t+1}, \tau_{t+1}, h_{it}). \tag{9}$$

Individual i is willing to have her child receive higher education if and only if

$V^A(x_{t+1}, \tau_{t+1}, h_{it}) \geq V^P(x_{t+1}, \tau_{t+1}, h_{it})$, which is equivalent to

$$h_{it} \geq \frac{1}{(1 - x_{t+1})^{\beta} \tau_{t+1}^{\beta}} \equiv H(x_{t+1}, \tau_{t+1}). \tag{10}$$

$H(x_{t+1}, \tau_{t+1})$ is increasing in x_{t+1} and decreasing in τ_{t+1} since a larger share of government expenditure on higher education (i.e., a lower value of x_{t+1}) and a higher income tax rate raise the productivity of higher education and make more individuals willing to invest in higher education for their children. To understand (10) in terms of x_{t+1}, it is useful to define $x(\tau_{t+1}, h_{it})$ by $H(x(\tau_{t+1}, h_{it}), \tau_{t+1}) = h_{it}$. Individual i is willing to have her child receive higher education if and only if $0 \leq x_{t+1} \leq x(\tau_{t+1}, h_{it})$.

The level of income tax rate, τ_{t+1}, and the share of government expenditure on primary education, x_{t+1}, are both determined under majority voting. We begin by identifying the welfare-maximizing share of each individual for a given income tax rate. The value of $V^P(x_{t+1}, \tau_{t+1}, h_{it})$ is maximized at $x_{t+1} = 1$ since it is monotonically increasing in x_{t+1}. To describe the maximum of $V^A(x_{t+1}, \tau_{t+1}, h_{it})$, let us define x^* by

$$x^* \equiv \arg\max_{x_{t+1} \in [0,1]} V^A(x_{t+1}, \tau_{t+1}, h_{it}) = 1/2. \tag{11}$$

The maximizers of $V^P(x_{t+1}, \tau_{t+1}, h_{it})$ and $V^A(x_{t+1}, \tau_{t+1}, h_{it})$ are both independent of τ_{t+1}. Individual i prefers $x_{t+1} = x^*$ to $x_{t+1} = 1$ if $V^A(x^*, \tau_{t+1}, h_{it}) \geq V^P(1, \tau_{t+1}, h_{it})$. Simple calculations show that it is equivalent to

$$h_{it} \geq \tilde{H}(\tau_{t+1}) \equiv \frac{1}{(2^{1-\beta} - 1)\tau_{t+1}^{\beta}}. \tag{12}$$

This equivalence relation means that the welfare of individual i is maximized at $x_{t+1} = x^*$ if $h_{it} \geq \tilde{H}(\tau_{t+1})$, while it is maximized at $x_{t+1} = 1$ if $h_{it} < \tilde{H}(\tau_{t+1})$. This result

itself has a similarity with the result in Su (2006): individuals with low human capital prefer to allocate all the tax revenue to primary education, while individuals with high human capital prefer a balanced budget allocation.

There are two types of individuals who prefer $x_{t+1} = 1$ to $x_{t+1} = x^*$. If $x^* > x(\tau_{t+1}, h_{it})$, or equivalently $h_{it} < H(x^*, \tau_{t+1})$, individual i obviously prefers $x_{t+1} = 1$ since she decides not to have her child obtain higher education. Even if $x^* \leq x(\tau_{t+1}, h_{it})$, however, $V^A(x^*, \tau_{t+1}, h_{it}) < V^P(1, \tau_{t+1}, h_{it})$ may still hold. In this case, although individual i is willing to have her child receive higher education if $x_{t+1} = x^*$ is realized, she prefers to make $x_{t+1} = 1$ rather than make $x_{t+1} = x^*$ and invest in higher education for her child. The following lemma summarizes the obtained results.

Lemma 1. *For a given income tax rate $\tau_{t+1} \in [0, 1]$, the welfare of individual i is maximized at $x_{t+1} = x^*$ if $h_{it} \geq \tilde{H}(\tau_{t+1})$, while it is maximized at $x_{t+1} = 1$ if $h_{it} < \tilde{H}(\tau_{t+1})$.*

Lemma 1 states that the budget share, x_{t+1}, preferred by individual i is either 1 or x^*, and there are no other possibilities. For any τ_{t+1}, since $V^P(x_{t+1}, \tau_{t+1}, h_{it})$ is maximized at $x_{t+1} = 1$ and $V^A(x_{t+1}, \tau_{t+1}, h_{it})$ is maximized at $x_{t+1} = x^*$, all we need to do is to compare the maxima of $V^P(1, \tau_{t+1}, h_{it})$ and $V^A(x^*, \tau_{t+1}, h_{it})$ with respect to τ_{t+1} in order to identify the most preferred set of x_{t+1} and τ_{t+1}. Let us define τ^P and τ^A by

$$\tau^P \equiv \underset{0 \leq \tau_{t+1} \leq 1}{\arg\max}\, V^P(1, \tau_{t+1}, h_{it}) = \beta^{\frac{1}{1-\beta}}, \tag{13}$$

$$\tau^A \equiv \underset{0 \leq \tau_{t+1} \leq 1}{\arg\max}\, V^A(x^*, \tau_{t+1}, h_{it}) = 2\beta^{\frac{1}{1-\beta}} < 1. \tag{14}$$

Comparing $V^A(x^*, \tau^A, h_{it})$ with $V^P(1, \tau^P, h_{it})$ gives the following equivalence relation:

$$V^A(x^*, \tau^A, h_{it}) \geq V^P(1, \tau^P, h_{it}) \quad \Leftrightarrow \quad h_{it} \geq \frac{1}{\beta^{\frac{\beta}{1-\beta}}(1-\beta)} \equiv \hat{H}. \tag{15}$$

Furthermore, simple calculations yields that $\tilde{H}(\tau^A) < \hat{H} < \tilde{H}(\tau^P)$. If $h_{it} < \hat{H}$, individual i prefers $(x_{t+1}, \tau_{t+1}) = (1, \tau^P)$. If $h_{it} \geq \hat{H}$, individual i prefers $(x_{t+1}, \tau_{t+1}) = (x^*, \tau^A)$. The following lemma sammarizes the obtained results.

Lemma 2. *Individual i prefers $(x_{t+1}, \tau_{t+1}) = (1, \tau^P)$ if $h_{it} < \hat{H}$, while she prefers $(x_{t+1}, \tau_{t+1}) = (x^*, \tau^A)$ if $h_{it} \geq \hat{H}$.*

It is easy to show that the individual with median income is the decisive voter. This result immediately follows from lemma 2. Let h_{mt} denote the human capital of the individual with median income. If $h_{mt} < \hat{H}$, then the individual with h_{mt} prefers $(x_{t+1}, \tau_{t+1}) = (1, \tau^P)$ the most. Since individuals whose human capital is less than h_{mt} comprise 50 percent of the total population and they all prefer $(x_{t+1}, \tau_{t+1}) = (1, \tau^P)$ the most, it is chosen under majority voting. Similarly, if $h_{mt} \geq \hat{H}$, then the individual with h_{mt} prefers $(x_{t+1}, \tau_{t+1}) = (x^*, \tau^A)$ the most. Since individuals whose human capital is greater than h_{mt} have the same preference and constitute 50 percent of the total population, $(x_{t+1}, \tau_{t+1}) = (x^*, \tau^A)$ is chosen under majority voting.

Proposition 1. *Under majority voting, $(x_{t+1}, \tau_{t+1}) = (1, \tau^P)$ is implemented if $h_{mt} < \hat{H}$, while $(x_{t+1}, \tau_{t+1}) = (x^*, \tau^A)$ is implemented if $h_{mt} \geq \hat{H}$.*

4 Dynamic Analysis

This section analyzes the dynamics of human capital in the political equilibrium described in Proposition 1. It should be remembered that the realization of higher education relies only on whether or not h_{mt} exceeds $\hat{H}$. In the case where $(x_{t+1}, \tau_{t+1}) = (1, \tau^P)$ is realized, human capital of all lineages is accumulated according to

$$h_{it+1} = F^P(1, \tau^P, h_{it}) = \beta^{\frac{\beta}{1-\beta}} h_{it} + \hat{h}. \tag{16}$$

In the case where $(x_{t+1}, \tau_{t+1}) = (x^*, \tau^A)$ is realized, human capital of lineage i with $h_{it} < H(x^*, \tau^A)$ is augmented only through primary education. It is accumulated according to

$$h_{it+1} = F^P(x^*, \tau^A, h_{it}) = \beta^{\frac{\beta}{1-\beta}} h_{it} + \hat{h}. \tag{17}$$

Human capital of lineage i with $h_{it} \geq H(x^*, \tau^A)$ is augmented by both primary and higher education:

$$h_{it+1} = F^A(x^*, \tau^A, h_{it}) = 2\beta^{\frac{\beta}{1-\beta}} h_{it} + \hat{h}. \tag{18}$$

Note that regardless of whether $(x_{t+1}, \tau_{t+1}) = (1, \tau^P)$ or $(x_{t+1}, \tau_{t+1}) = (x^*, \tau^A)$, human capital of lineage i with $h_{it} < H(x^*, \tau^A)$ is accumulated in the same fashion since $F^P(1, \tau^P, h_{it}) = F^P(x^*, \tau^A, h_{it})$. Taking the level of the income tax rate as given, a decrease in x_{t+1} lowers the quality of primary education. In the political equilibrium, however, the level of the income tax rate rises from τ^P to τ^A in parallel with the emergence of higher education, and consequently the quality of primary education is maintained constant. Simple calculations show that the slope of $F^A(x^*, \tau^A, h_{it})$ is less than one if and only if $\beta > 1/2$, and we focus on the analysis of human capital dynamics in the case where $\beta > 1/2$. Let h^P and h^A denote the intersection of $F^P(1, \tau^P, h_{it})$ and the 45-degree line and that of $F^A(x^*, \tau^A, h_{it})$ and the 45-degree line, respectively:

$$h^P \equiv \frac{\hat{h}}{1 - \beta^{\frac{\beta}{1-\beta}}}, \quad h^A \equiv \frac{\hat{h}}{1 - 2\beta^{\frac{\beta}{1-\beta}}}.$$

There are two cases that need to be considered: (i) $\hat{H} \leq h^P$ and (ii) $\hat{H} > h^P$.

[Figure 1 around here]

First, we consider the case where $\hat{H} \leq h^P$. Figure 1 (a) sketches the dynamics of h_{mt}. If $h_{m0} < \hat{H}$, higher education is not realized at the first place and all individuals

consequently accumulate their human capital according to $F^P(1, \tau^P, h_{it})$. However, human capital of lineage m eventually exceeds $\hat{H}$ at some time period, say $\hat{t}$, following which higher education is always realized and h_{mt} converges to h^A. Human capital dynamics of the other lineages can also be easily analyzed. As shown in Figure 1 (b), after $\hat{t}$, human capital of lineage i with $h_{i\hat{t}} < H(x^*, \tau^A)$ is accumulated only through primary education for some periods of time. However, because $\hat{H} < h^P$, the human capital certainly exceeds $H(x^*, \tau^A)$ at some period, and thereafter, it is augmented by both primary and higher education.[5] Human capital of the lineage thus converges to h^A. Individuals in lineage i with $h_{i\hat{t}} \geq H(x^*, \tau^A)$ always have their children receive higher education since period $\hat{t}$, and human capital in the lineage also converges to h^A. In this case, human capital in all lineages converges to h^A. Note that if $h_{m0} \geq \hat{H}$, then $\hat{t} = 0$, and the above analysis remains intact.

Second, we consider the case where $\hat{H} > h^P$. In this case, the realization of higher education depends on the value of h_{m0}. Figure 1 (c) depicts the dynamics of h_{mt}. If $h_{m0} < \hat{H}$, human capital of lineage m converges to h^P. Higher education is never realized, and human capital of all lineages converges to h^P. If, on the other hand, $h_{m0} \geq \hat{H}$, higher education is realized at the begining, and h_{mt} converges to h^A. Individuals in lineage i with $h_{i0} \geq H(x^*, \tau^A)$ always receive higher education, and human capital of the lineage converges to h^A. For individuals in lineage i with $h_{i0} < H(x^*, \tau^A)$, the dynamics of human capital depends on the values of $H(x^*, \tau^A)$ and h^P. If $H(x^*, \tau^A) \leq h^P$, all individuals in the lineage eventually receive higher education, and human capital of the lineage converges to h^A. In this case, there is no income inequality in the long-run. If $h^P < H(x^*, \tau^A)$, in contrast, individuals in lineage i with $h_{i0} < H(x^*, \tau^A)$ never receive higher education, and human capital of the lineage converges to h^P as shown in Figure 1 (d). Income inequality expands in the process of economic growth and there is

[5] Since $H(x^*, \tau^A) < \hat{H}$, $\hat{H} < h^P$ implies $H(x^*, \tau^A) < h^P$.

substantial inequality in the long-run. In the case where $\hat{H} > h^P$, the value of h_{m0} determines whether the tax raise and budget allocation to higher education are politically implemented. If a low value of h_{m0} is due to large initial inequality, an implication of the result is that large inequality prevents implementation of institutions promoting human capital and harms growth. If low h_{m0} is due to economy-wide underdevelopment, then underdevelopment reproduces itself.

Although we have used majority voting as the political mechanism, the analysis can be immediately extend to the case where only the rich have political power, as in Su (2006). In the case where $\hat{H} > h^P$ and $h^P < H(x^*, \tau^A)$, let us consider a characteristic of less-developed economies: most individuals are very poor but only a small portion of individuals are so rich that their human capital exceeds $\hat{H}$. Then, $(x_{t+1}, \tau_{t+1}) = (x^*, \tau^A)$ is politically implemented. Public resources are allocated to finance higher education although most individuals are poor and never obtain higher education. This result is, to some extent, consistent with characteristics of public education policies in less-development economies provided by Su (2004, 2006).

5 Conclusion

The government plays an important role of funding both primary and higher education. This paper proposes a model in which both the size of public education budget and its allocation across the two education sectors are determined through majority voting, and analyzes the interaction between politically implemented education policies and human capital accumulation. In our model, the return from each education sector is positively correlated with the human capital level inherited from parents. A tax raise to finance higher education is not politically supported until majority of individuals accumulate sufficient human capital. In some cases, higher education starts to be realized

as majority of individuals accumulate sufficient human capital through primary education. In other cases, however, only the initial distribution of human capital matters. Although the implementation of higher education accelerates aggregate human capital accumulation, it may generate large and persistent income inequality in the long-run because the poor do not receive higher education.

We have assumed that individuals must cover private costs to obtain higher education supplied by the government. The logic of our model would be applied to other public policies by considering a situation in which access to publicly provided services requires private spending. For example, the government may consider two policies: (i) public support to enhance productivity in high-tech industries that employ skilled workers, and (ii) lump-sum transfer of tax revenue to all individuals. Rich individuals who can cover education costs to become skilled workers would prefer public support for high-tech industries, while poor individuals would prefer lump-sum transfer. The implication of such a situation for economic growth would be a topic for future research.

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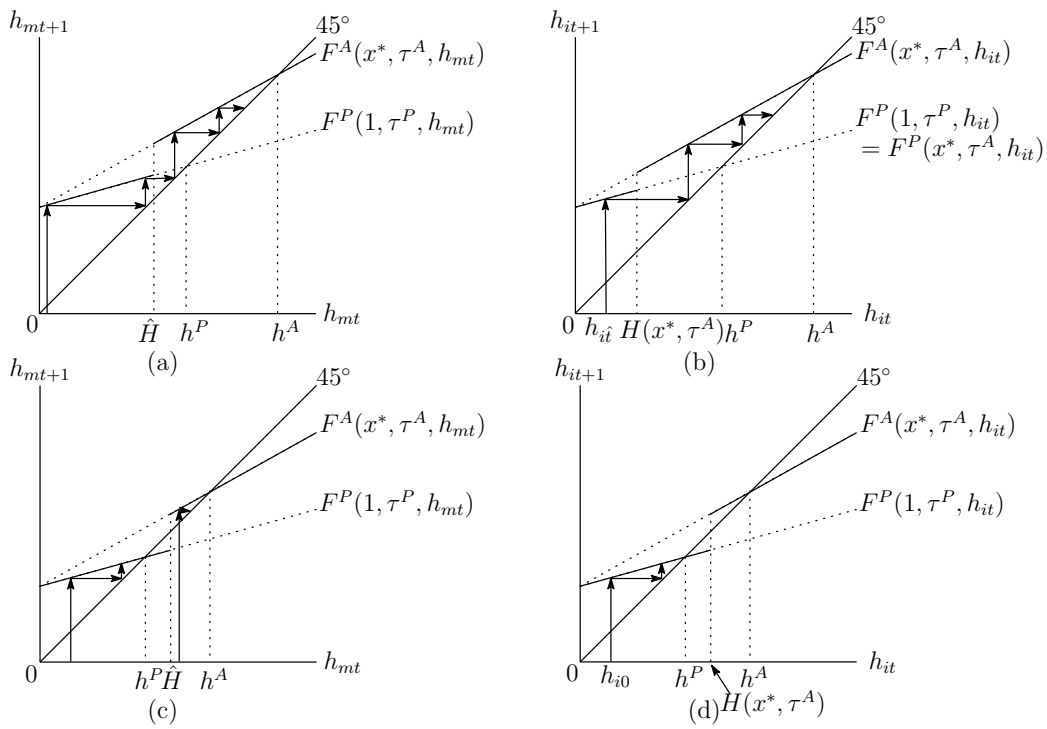

Figure 1: Dynamics of human capital