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Public Education Investment, Economic Growth and Welfare: A Political Economy Analysis with Preference Heterogeneity

Kamu Eğitim Yatırımı, Ekonomik Büyüme ve Refah: Tercih Heterojenliği Altında Ekonomi-Politik Bir Analiz

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Abstract

This study examines the politics of public education policy and its impact on economic growth and welfare under intergenerational altruism. The study considers an endogenous growth model with altruistic overlapping generations. Due to its significant role in promoting long-term economic expansion, we consider investment in public education to be an effective tool of productive government intervention. Nonetheless, public educational investment has been the subject of political disputes owing to its inherent intergenerational redistributive implications. Backed by the tendency of democratically elected governments to maintain their political power, the preferences of some particular individuals or group of individuals become more dominant in the political process of determining the level of public investment in education. In particular, governments are more concerned with the preferences of the median voter, or the current generation at large, because they, as electors, have the ability to determine the next government. This reality leads governments to exhibit a bias toward the desires of these people. As a result, such political considerations divert the economy from its optimal path of economic growth and reduce the welfare of future generations. This effect becomes more pronounced when individuals with lower levels of altruism toward their offspring assume a more influential position in the political decision-making process over the allocation of public funds for education. Our theoretical analyses demonstrate the implications for economic growth and welfare resulting from policy decisions made by democratically elected governments with inherent biases, as opposed to decisions made by an unbiased social planner.

Jel Codes: *D64, E24, H23, H52, H53, I25, I28*
Keywords: *Endogenous Growth, Welfare, Redistribution, Public Policy, Education, Human Capital, Median Voter*

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Öz

Bu çalışma, kamu eğitim politikasının siyasi yönünü ve bunun ekonomik büyüme ve refah üzerindeki etkisini nesiller arası fedakarlık çerçevesinde incelemektedir. Çalışma, altruistik örtüşen nesillere sahip içsel bir büyüme modelini göz önünde bulunduruyor. Uzun vadeli ekonomik genişlemeyi teşvik etmedeki önemli rolü nedeniyle, kamu eğitimine yapılan yatırımları verimli hükümet müdahalesinin etkili bir aracı olarak değerlendiriyoruz. Bununla birlikte, kamu eğitim yatırımları, nesiller arası yeniden dağıtımına ilişkin etkilerinden dolayı siyasi tartışmaların konusu olmuştur. Demokratik olarak seçilmiş hükümetlerin siyasi güçlerini koruma eğilimlerinin de desteğiyle, belirli bireylerin veya birey gruplarının tercihleri, eğitime yapılan kamu yatırımı düzeyinin belirlenmesine ilişkin siyasi süreçte daha baskın hale gelmektedir. Özellikle hükümetler ortalama seçmenin veya genel olarak mevcut neslin tercihleriyle daha fazla ilgilenirler, çünkü bu bireyler seçmen olarak bir sonraki hükümeti belirleme yeteneğine sahipler. Bu gerçek, hükümetlerin bu insanların arzuları karşısında taraflı davranmalarına yol açmaktadır. Sonuç olarak, bu tür politik düşünceler ekonomiyi optimal ekonomik büyüme yolundan saptırmakta ve gelecek nesillerin refahını azaltmaktadır. Bu etki, çocuklarına karşı daha düşük seviyede özgecilik sergileyen bireylerin, eğitim için kamu fonlarının tahsisi konusunda siyasi karar alma sürecinde daha etkili bir pozisyona sahip olmaları durumunda daha da belirgin hale gelmektedir. Teorik analizlerimiz, tarafsız bir sosyal planlamacı tarafından alınan kararlara kıyasla, doğası gereği taraflı olan ve demokratik olarak seçilmiş hükümetler tarafından alınan politika kararlarının ekonomik büyüme ve refah üzerindeki etkilerini göstermektedir.

Jel Kodları: *D64, E24, H23, H52, H53, I25, I28*
Anahtar Kelimeler: *İçsel Büyüme, Refah, Yeniden Dağıtma, Kamu Politikası, Eğitim, Beşeri Sermaye, Ortalama Seçmen*

1. Introduction

Education, as a key input of human capital accumulation, has been viewed as a substantial driver of sustained economic growth (see Lucas, 1988; Krueger & Lindahl, 2001). Accordingly, governments have played a prominent role in the financing and provision of educational services. The average proportion of total expenditure on primary to tertiary education that came from public resources in OECD countries in 2020 was 84%, while the share of private resources was 15%. Public expenditure on education also has a substantial share in total expenditures across economies. In the same year, it averaged 5.1% as the share of gross domestic product and 10% as the share of total government expenditure across the OECD countries (Indicators, O. E. C. D., 2023).

The composition of public expenditures in education has important consequences regarding their contribution to economic growth and welfare. The proportion of current expenditures in OECD countries' total expenditures on primary to tertiary educational institutions accounted for 91% in 2019, while capital expenditures accounted for a mere 9%. In Australia, Estonia, Greece, Japan, Korea, Latvia, and Norway, the share of capital expenditures reached 12% or more at the high end. Greece implemented large infrastructure investments at the tertiary level. Its capital expenditure reached 48% of the overall expenditure on tertiary education. Similarly, Latvia allocated the highest capital expenditure of 18% at the primary and secondary levels of education. In 2019, the investment in long-term capital assets was slightly over USD 1000 per student in OECD countries. This amount varied, with Australia, Japan, Korea, Luxembourg, Norway, and the United States spending approximately USD 1500 per student, while Chile, Colombia, Italy, and Lithuania spent around USD 500 per student. With the growing impact of political and economic pressures on the education budget, investment expenditures in public education exhibit large fluctuations throughout time in comparison to current expenditures. Political initiatives to develop and execute innovative investment strategies in education result in public investment in education reaching peak levels. In most of the years, nonetheless, it remains comparatively low (Indicators, O. E. C. D., 2022).

Government interventions in education have generally been justified by externalities or other market failures (Azariadis & Drazen, 1990; Galor & Zeira, 1993; Zhang, 1996). It can also be justified based on the interaction of market forces and political decision-makers (Corcoran & Evans, 2010; Glomm et al., 2011). From an economic perspective, there is almost no controversy on that market competition is an essential step toward economic prosperity. The role of governments should primarily focus on mitigating the adverse effects of market failures. However, good economic policies are not always in the best interest of governments, despite their potential benefits. Indeed, the elected political leaders might be more concerned with securing their office at the expense of economic prosperity and growth (Bueno de Mesquita et al., 2001). Therefore, when it comes to implementing redistributive public policies, it has been central for governments to solve the problems concerned by vested interests.

A good economic policy is typically regarded as one that aims to optimize the overall welfare of society, encompassing both the present and future generations. In democratic societies,

economic objectives are not always at the heart of public policies. Politicians, driven by their desire to secure their office, may opt for setting public economic policies in a politically biased way, given the redistributive effect of such policies. We assign different political and economic objectives to the government, particularly motivated by political or economic considerations. First, taking into account the widespread nature of majoritarian democracies across the globe, we establish the government's goal as the maximization of the welfare of the median voter. We apply Black's median voter theorem, which posits that political decisions are made through majority rule (Black, 1948). As shown by Roberts (1977), the decisive voter under majority rule is the median voter. Second, considering that governments are not as farsighted as social planners and are mostly concerned with the welfare of current generations as their electors, we set the maximization of the total welfare of the current generation as an alternative policy objective for the government. Lastly, we set the maximization of economic growth as the government's policy objective, which is equivalent, in our modeling framework, to solving the social planner's problem.

This article aims to analyze and contrast the impact of the government's policy objectives on the economy in terms of welfare and growth. Considering its unanimous role in promoting long-run economic growth and intergenerational redistribution, we particularly focus on public investment in education in a theoretical environment. The role of government as to determine the size of public investment in education and the income tax rate to finance it is examined in isolation. We ask how the economy diverges from its equilibrium growth path if the government sets its policy by targeting the median voter's welfare, the current generation's welfare, or economic growth. Subsequently, we assess and contrast the consequences of the policy choices of the government in terms of long-run economic growth and welfare.

The definition of the median voter in the literature of public education and its impact on macroeconomic factors is very controversial. The empirical literature that follows Meltzer & Richard (1981) characterizes the median voter as the median-income household. The relationship between the political decision of public investment in education and household income is a subject of inquiry in the literature. Busemeyer (2012) empirically shows that the relationship between individual-level preferences for public education expenditure and household income is indeed nil. As an alternative, Gradstein & Kaganovich (2004) and Levy (2005) argue the role of differences in preferences of overlapping generations in support of public education. They note that the generations that are more concerned with education will vote for public education expenditures. In a pay-as-you-go social security system, expecting a higher income, old people will also support public investment in child education. Another strand of the literature on preferences for allocation of public funds to education emphasizes the role of child ability and parental skill (Epple & Romano, 2008; Blankenau et al., 2007; Viaene & Zilcha, 2013). There are other studies in the literature in which the support for public education depends on individual preferential differences for types of education, such as bilingual versus monolingual education, inclusion of religious education, and academic versus vocational education (Alesina et al., 1999). Di Gioacchino et al. (2019) empirically show that individual preferences for basic public education expenditure are significantly affected by

individual characteristics, measured by parents' educational attainment, political orientation and involvement, age, parent status, gender, and being in the education sector. As a result, personal attributes toward and expectations from child education appear to be the main determinants in the political process of deciding on the level of public investment in education. In order to take these considerations into account when deciding on the level of public investment in education, we add heterogeneity to the preferences of parents for child education. The heterogeneity in altruism, as an individual characteristic related to education, is the source of the political decision.

In the endogenous growth literature, the educational investment decision is highly interrelated with the fertility decision. Most economic models of fertility choice are built on the notion of a quality-quantity trade-off between the number of children and education per child (Becker & Lewis, 1973; Becker et al., 1990; De la Croix & Doepke, 2004). Given this interdependence between education investment and fertility decisions, any model of public education investment overlooking the fertility decision will also overlook the effect of fertility on the economy. Our modeling framework associates the child quantity-quality trade-offs as it depends on the heterogeneity in altruism for the human capital of children.

We develop an analytically tractable endogenous growth model of overlapping generations that integrates the political determination of public education investment with fertility and the educational spending decisions of households. In the model, parents are altruistic towards their children and care about the quantity and quality of their children. A key feature of the model is how public education investment policies that are motivated by different political objectives affect the growth and welfare aspects of the economy through changes in the consumption, fertility, and human capital accumulation decisions of altruistic parents.

The model incorporates a distinct source of heterogeneity that adults differ in their preferences for the level of their children's human capital. Parental benevolence towards their children's human capital has a direct impact on the political decision-making over investment in public education. Understanding the impact of political restraints on education is vital, given the substantial involvement of governments in the education sector and the relevance of education for human capital accumulation, economic growth, and welfare. To account for varying individual characteristics in public education investment preferences, we incorporate heterogeneity in parental altruism based on the aforementioned factors.

Our contribution to the literature is as follows: (i) In contrast to the previous studies in the endogenous growth literature, our model incorporates political decision-making that is based on personal preferences directly related to the policy being considered, reflecting real-world dynamics. (ii) Additionally, our paper considers the trade-off between child quantity and quality by endogenizing the fertility decisions of altruistic parents. Although the fertility decisions of parents are time-invariant due to the logarithmic form of the utility function, they are affected by the personal preferences of parents for child quality. (iii) By taking into account policy-relevant preferences, we analyze and contrast the impact of different political and economic objectives of the government on determining the level of public education investment and how this affects the growth path of the economy and welfare. We

demonstrate that when governments prioritize political considerations, the growth of the economy diverges from its frontier, which is determined by the social planner.

The rest of this paper is organized as follows: In section 2, we introduce a literature survey of related papers. Thereafter, in section 3, we present the general equilibrium model and define the competitive equilibrium of the economy as a function of political equilibrium. Section 4 defines the political equilibrium. Section 5 solves the government's problem under different policy objectives. Section 6 compares the effects of such policies on the welfare and growth of the economy. Section 7 provides a general discussion and concluding remarks.

2. Related Literature

Perceived as an instrument of redistribution and reduction of income inequality, public education expenditure has been at the center of many theoretical and empirical studies (Glomm & Ravikumar, 1996, 1998, 2003; Eckstein & Zilcha, 1994; Benabou, 2000; Corcoran & Evans, 2010; Glomm et al., 2011; Cardak et al., 2020; Artige & Cavenaile, 2023). The focus of our study is the theoretical investigation of the relationship between public education and economic growth, taking into account the influence of parental altruism towards children. Glomm & Ravikumar (1996, 1998, 2003) investigate the impact of alterations in educational policy on economic growth and welfare across generations by employing endogenous growth models. In their models, the political process of deciding on the optimal level of public education investment is based on preferential differences of overlapping generations.

There are many studies integrating the democratic process of voting with dynamic growth models to determine public policy. These studies primarily focus on the factors that influence public policy. For example, Zhang (2003) and Gradstein & Kaganovich (2004) focus on the impact of aging. Saint-Paul & Verdier (1993) study the influence of income inequality. Glomm & Ravikumar (1996) investigate the effect of future policy expectations. Ono and Uchida (2016) analyze the effects of social security. Ono & Uchida (2018) explores the implications of debt financing as an alternative to income tax in public policy. These studies examine how political decisions are made by considering their impact on household income. However, the impact of household income on preferences for public education is rather ambiguous. For instance, households located at the tails of the income distribution might prefer lower public investment in education. Low-income households have a preference for retaining their income rather than using it to pay taxes. Likewise, high-income households would resist the redistributive impact of public policy (Levy, 2005). In contrast, we incorporate a distinctive preference attribute particular to each household into the model, which directly pertains to the public policy decision-making process within the voting system.

While the theoretical research on the relationship between public educational investment and economic growth is very limited, the empirical literature on this subject reports conflicting findings. Some empirical studies report that government spending on education has a positive effect on economic growth (Evans & Karras, 1994; Blankenau et al., 2007). However, some other studies indicate a negative correlation between government education expenditures and growth (Vedder, 2004; Mo, 2007). Mo (2007) argues that public investment in education

creates positive externalities, and its impact on growth must be evaluated in the long run. Providing evidence on the temporariness of such negative impacts, he warns that such instantaneous negative impacts must be viewed with caution. Vedder (2004), on the other hand, argues that the negative effect could be the result of inefficient allocation of public funds. The results of our model are in line with the empirical findings. Our model indicates a positive relationship between public education investment and economic growth by setting public investment in education as a productive instrument of public policy. Additionally, we demonstrate that the productive effect of public education investment is reduced by the inefficiencies of the political process, causing the economy to deviate from its optimal growth path.

The theoretical paper by Saint-Paul & Verdier (1993) is closely related to our study. The authors construct an endogenous growth model that includes altruistic households and incorporates public education expenditure, which is financed by proportional income tax. Their main finding is that the tax rate that optimizes the median voter's welfare reduces income inequality and generates higher growth compared to a zero-tax rate. In their study, the decisive agent is the median-income household. Our results are consistent with theirs. Furthermore, we introduce different policy objectives for the government. Although maximizing the median voter's welfare generates higher growth in comparison to the case of no government intervention, we show that economic growth and welfare can be further enhanced if the government acts with different policy objectives.

Another study that is closely related to ours is that of Ono & Uchida (2018). The paper examines the impacts of income-tax-financed and debt-financed public education expenditures within a framework of endogenous growth. The political equilibrium is established by taking into account the preferential differences of young, middle-aged, and old for public education. One of their primary findings is that financing public education with labor income tax yields better economic performance compared to public debt financing, even though the majority middle-aged people prefer debt financing for public education. Our study distinguishes itself from previous research by examining various political objectives pursued by the government and evaluating their impact on both economic growth and welfare. In addition, given that the subject of policy formation is public education, we consider heterogeneity in altruism for future generations as the basis of the political decision process, as it aligns more closely with the policy preferences of individuals.

Our general equilibrium model is a modified version of De la Croix & Doepke (2004). In their model, the fertility rate does not change across time since the utility function is in logarithmic form. Like theirs, we obtain time-invariant fertility decisions. Nonetheless, the child quantity-quality tradeoff is present in our model since fertility is determined by the heterogeneous altruism parameter for child quality. In addition, unlike their paper, the tax rate preferences of households are different, and households have conflicting interests in public policy due to the added heterogeneity.

Lastly, this paper is relevant to the research on time inconsistency. Barro (1974) showed that the well-known dynamic inefficiency built in the overlapping generations model of Diamond (1965) can be neutralized by intergenerational altruism. Nevertheless, the presence of public

goods in the overlapping generations model gives rise to a time inconsistency problem, regardless of the presence of intergenerational altruism in the model. This is attributed to a form of temporal preference bias. Krusell et al. (2002) argue that democratic governments elected by biased people also have the same bias and face self-control problems for fiscal policy. In reality, public policies are determined by governments that are elected by the current generation. Concerned with rightfully maintaining their political power, democratically elected governments are generally biased toward the preferences of the current generation (Gupta et al., 2016; Jacobs, 2016). Our model explains how this bias leads to a slowdown in economic growth and reduces the economic welfare of households.

3. Model Economy

The model economy is populated by overlapping generations of heterogeneous people who live for two periods: childhood and adulthood. The time is discrete and goes from zero to infinity. In each period, only adults make decisions. In each period t, there is a new adult generation of size N_t. Adults are heterogeneous in altruism and are indexed by i, where $i \in [0, N_t]$.

The law of motion for population growth is given by

$$N_{t+1} = \int_0^{N_t} n_{it} di = N_t \bar{n}_t \tag{1}$$

where $\bar{n}_t$ is the average number of children at time t.

3.1. Individuals

Adults obtain utility from their consumption, c_{it}, number of children, n_{it}, and human capital of children, h_{it+1}. We assume a logarithmic utility function:

$$u_{it} = \log c_{it} + \varphi \log n_{it} + \lambda_i \log h_{it+1} \tag{2}$$

with $\phi, \lambda_i \in \mathbb{R}_{++}$. Our formulation of utility is in line with, for example, De la Croix & Doepke (2004). Another frequently used utility formulation in the child quantity-quality trade-off literature follows from Barro & Becker (1988, 1989). In their formulation, parents directly care about the utility of their children, so each generation ends up caring about all the subsequent generations, causing the household's problem to become intractable.

In the utility function, the parameter ϕ is an altruism factor for child quantity and λ_i is an altruism factor for child quality. We introduce heterogeneity into the altruism factor for child quality because child quality, as measured by human capital formation, is directly related to education. Each family has a unique and time-invariant λ_i that is drawn from a continuous distribution with positive support. If the distribution of altruism is skewed to the right, the median voter is less altruistic than the mean voter. If it is skewed to the left, the median voter is more altruistic than the mean voter.

Future generations accumulate human capital through the investments of their parents and the government in education. The human capital accumulation function is

$$h_{it+1} = \mu \, x_t e_{it}^{\eta} h_{it}^{1-\eta} \tag{3}$$

with $\mu \in \mathbb{R}_{++}$ and $\eta \in (0,1)$. μ is a measure of productivity for education technology. η measures the share of households' spending on child education. It also gives a measure of the intergenerational transmission of human capital. x_t denotes public investment in education. Public investment is rather considered as an infrastructural or innovative investment in education as it augments the productivity of education technology.

Adult *i* faces the following budget constraint:

$$c_{it} + n_{it} e_{it} \leq w_t h_{it} l_{it} (1 - \tau_t) \tag{4}$$

where w_t is the wage per unit of human capital, τ_t the proportional income tax rate, h_{it} the human capital of adult *i*, and l_{it} the time allocated to work by adult *i*. The government finances public educational investment with a proportional income tax. Adults spend their after-tax income on consumption and education.

Adults are endowed with one unit of time, which they can allocate between working and childrearing. The time constraint for the adult *i* is

$$l_{it} + \kappa n_{it} \leq 1 \tag{5}$$

where κ is the unit cost of childrearing.

3.2. Firms

There is a single GDP-producing firm. We assume an aggregate production function of the following form:

$$Y_t = \omega L_t \tag{6}$$

where $\omega \in \mathbb{R}_{++}$. Y_t is the total output and L_t the effective labor demand used in the production.

3.3. Government

The government obtains $\tau_t \in [0,1]$ portion of wage incomes as tax revenue. To focus on its welfare and growth effect, we assume public investment in education is the only policy instrument of the government.

We assume there are $R_t > 0$ school districts in the country at time *t*. Each school district is populated with a constant, ρ, number of adults, hence $R_t \rho = N_t$. The government's educational policy is to improve schooling infrastructure in each school district. In order to do this, it makes infrastructural/innovative educational investment, x_t, in each school district. The regional level of public educational expenditure is assumed to be set in such a way that the average human capital level must be sustained in each school district. The government's total spending on education is X_t, where $X_t = x_t R_t \bar{h}_t$. In this equation, $\bar{h}_t$ denotes the average human capital. We can rewrite the government's total educational investment at time *t* as $x_t (N_t / \rho) \bar{h}_t$. We also assume the government maintains a balanced budged each period. Therefore, the government's budget constraint is of the following form:

$$\int_0^{N_t} \tau_t l_{it} h_{it} di = x_t (N_t/\rho)\bar{h}_t \tag{7}$$

The government's objectives are shaped by its priorities. We examine the impact of government decisions on educational investment, focusing on welfare and growth outcomes. We investigate how different political or economic priorities influence these decisions, particularly when the government prioritizes the welfare of the median voter, the welfare of the current generation, or economic growth. The welfare of the median voter is measured by her indirect utility. The welfare of the current generation is measured as the sum of their indirect utility functions. Lastly, in our model, targeting maximum economic growth is equivalent to targeting maximum welfare for the whole society, encompassing both current and future generations. Thus, the government that aims to maximize growth assumes the role of a social planner. In this scenario, the government's objective is to maximize economic growth, as described by $g = \bar{h}_{t+1}/\bar{h}_t$.

3.4. General Equilibrium

The following defines the general equilibrium of the model:

Definition 1 Given a sequence of policies, $\{\tau_t, x_t\}_0^\infty$, and the distribution of altruism levels of households, λ_i, *general equilibrium* is a sequence of allocations $\{c_{it}, n_{it}, e_{it}, l_{it}, h_{it+1}, N_{t+1}, L_t, Y_t\}_{t=0}^\infty$ and wages $\{w_t\}_{t=0}^\infty$ with the initial conditions $h_{i0} > 0$ and $N_0 > 0$ such that (i) given $\{\tau_t, x_t\}_0^\infty$ and $\{w_t\}_0^\infty$, $\{c_{it}, n_{it}, e_{it}, l_{it}, h_{it+1}\}_0^\infty$ solve the utility maximization problem of the household *i*; (ii) given $\{w_t\}_0^\infty$, $\{L_t\}_0^\infty$ solve the profit maximization problem of the firm; (iii) the labor market clears at $L_t = \int_0^{N_t} l_{it} h_{it} di$, which yields $w_t = \omega \; \forall t$; (iv) given the price of the final good is normalized to 1, the final good market clears at $Y_t = \int_0^{N_t} c_{it} di$ by the Walras' Law; and (v) the sequence $\{N_{t+1}\}_0^\infty$ is determined endogenously by the law of motion for population growth, i.e. $N_{t+1} = \int_0^{N_t} n_{it} di$.

Since the final good production function is linear, the firm's problem yields an infinitely elastic, horizontal demand curve at the wage level $w_t = \omega \; \forall t$. Hence, we normalize the wage to 1.

Given the budget constraint, time constraint, and human capital accumulation functions, adult *i*'s utility is maximized by the following decisions:

$$e_{it} = \frac{\lambda_i \eta h_{it}(1-\tau_t)\kappa}{\phi - \lambda_i \eta} \tag{8}$$

$$n_{it} = \frac{\phi - \lambda_i \eta}{(1+\phi)\kappa} \tag{9}$$

$$c_{it} = \frac{h_{it}(1-\tau_t)}{1+\phi} \tag{10}$$

$$l_{it} = \frac{1+\lambda_i \eta}{1+\phi} \tag{11}$$

Given the adult i 's decisions, the human capital accumulation function of her children becomes

$$h_{it+1} = \mu\, x_t \left(\frac{\lambda_i \eta (1 - \tau_t) \kappa}{\phi - \lambda_i \eta}\right)^{\eta} h_{it} \qquad (12)$$

In this model, for adults with relatively higher levels of human capital, child-rearing becomes costlier because of the time tradeoff between working and child-rearing. Having a higher income will drive adults to have fewer children with a better education. Additionally, adults with more altruism for their children's welfare will favor child quality over child quantity. Lastly, the return of education and child quantity preference parameters have opposite effects on the optimal levels of child quantity and education.

4. Equilibrium for Exogenously-Given Policy Variables

Policy variables, τ_t, x_t maximize the policymaker's objective function, defined by its political and economic priorities.

Definition 2 A *political equilibrium* is a sequence of policies $\{\tau_t, x_t\}_{t=1}^{\infty}$, allocations $\{c_{it}, n_{it}, e_{it}, l_{it}, h_{it+1}, N_{t+1}, L_t, Y_t\}_0^{\infty}$, and wages $\{w_t\}_0^{\infty}$ with the initial conditions $h_{i0} > 0$ and $N_0 > 0$ such that (i) the conditions in Definition 1 (General Equilibrium) are satisfied and (ii) the government's objective function is maximized given its budget constraint.

From the government's budget constraint,

$$x(\tau_t, \xi_t) = \frac{(1 + \eta \xi_t)\, \tau_t}{\rho(1 + \phi)} \qquad (13)$$

for the optimal level of l_{it}, obtained from the adult i's problem, where $\xi_t = E_i[\lambda_i h_{it}]/\bar{h}_t$. By definition, $\{\xi_t\}_{t=1}^{\infty}$ is a stationary sequence that converges to some constant ζ as t goes to infinity. Therefore, the regional public education investment over time is also a stationary sequence. For the rest of this paper, we will take $x_t = x(\tau_t)$ because ξ_t is not of any concern.

Regardless of its policy motivation, the government's economic objective is shaped by the welfare of households, which is measured by households' indirect utility functions. Assuming τ_t^* is the optimal tax rate, the indirect utility of adult i of the generation t can be re-written as

$$v_{it} = (1 + \lambda_i \eta)\log(1 - \tau_t^*) + \lambda_i \log(\tau_t^*) + (1 + \lambda_i)\log(h_{it}) + \lambda_i A + B \qquad (14)$$

where $A = \log\frac{\mu(1 + \eta\xi)}{\rho(1 + \phi)}\left(\frac{\lambda_i \eta \kappa}{\phi - \lambda_i \eta}\right)^{\eta}$ and $B = -\log(1 + \phi) + \phi\log\frac{\phi - \lambda_i \eta}{(1 + \phi)\kappa}$ include time-invariant and policy-irrelevant parameters.

The utility difference between the successive generations is

$$v_{it+1} - v_{it} = \eta(1 + \lambda_i)\log(1 - \tau_{t+1}^*) + (1 + \lambda_i)\log(\tau_{t+1}^*) + (1 + \lambda_i)A \qquad (15)$$

The government's objective might be to maximize the welfare of particular individuals or society at large, encompassing all generations. Given the widespread prevalence of majoritarian democracies worldwide, we set the government's objective as to maximize the

welfare of the median voter. In addition, governments are not as farsighted as the social planner and they are mostly concerned with the welfare of the present generation because of their political role as voters. Thus, we propose the maximization of the total welfare of the current generation as an alternative policy target for the government. Finally, we establish the pursuit of economic growth as the government's policy objective. This objective is equivalent to maximizing the overall welfare of all generations, which is the primary objective of the social planner.

The government's objective function, as defined by these alternatives, is strictly concave in tax rate because the indirect utility functions of individuals are also strictly concave in tax rate. Furthermore, the degrees of altruism within families are time-invariant; that is, the mean and median of altruism distribution are preserved over time. These facts together lead to single-peaked public policy preferences. In other words, there is no incentive for the individuals who are at the tails of the distribution to form a coalition to set a different tax rate in order to be better off (Benhabib & Przeworski, 2006). As a result, the government's problem with the above-mentioned alternative policy objectives will yield non-trivial and unique values for the policy variables.

5. Political Decision-Making

In this section, we establish the alternative policy objectives of the government and determine the optimal values of policy variables for each respective objective.

5.1. Median-Voter Equilibrium

In majoritarian democracies, the objective of the government is to maximize the welfare of the median voter. Defining the median voter as $i = MV$, her preferred tax rate will be determined by the maximization of her indirect utility with respect to τ_t, that is to say

$$\tau^*_{MVt} = \arg\max v_{MVt}$$

$$s.t. \quad x(\tau_t) = \frac{(1 + \eta\xi)\tau_t}{\rho(1 + \phi)}$$

where v_{MVt} denotes the indirect utility of the median voter of the generation t and is defined by the equation (14). The government's problem yields

$$\tau^*_{MV} = \frac{\lambda_{MV}}{1 + \lambda_{MV} + \lambda_{MV}\eta} \in (0,1) \tag{16}$$

We drop the time subscript since the tax rate is time-invariant.

Given $Y_t = \omega N_t \bar{q}_t$, where $\bar{q}_t = \frac{1}{N_t}\int_0^{N_t} q_{it}\,di$ and $q_{it} = l_{it}h_{it}$, the economic growth measured by $(Y_t/N_t)/(Y_{t+1}/N_{t+1})$ can be written as $\bar{h}_{t+1}/\bar{h}_t$ because the labor supply is time-invariant. Hence, the political equilibrium defined by optimizing the median voter's welfare yields the following growth rate:

$$g_{MV} = \frac{\bar{h}_{t+1}}{\bar{h}_t} = \frac{\mu(1+\eta\xi)}{\rho(1+\phi)}\tau_{MV}^*(1-\tau_{MV}^*)^\eta \left(\frac{\bar{\lambda}\eta\kappa}{\phi - \bar{\lambda}\eta}\right)^\eta \tag{17}$$

where $\bar{\lambda}$ is the mean altruism level for children's human capital. As mentioned earlier, the mean and median of the altruism distribution do not change over time; that is to say, the mean and median voters are the descendants of the same respective families.

The indirect utility of adult i becomes

$$v_{it}^{MV} = (1 + \lambda_i\eta)\log(1 - \tau_{MV}^*) + \lambda_i\log(\tau_{MV}^*) + (1 + \lambda_i)\log(h_{it}) + \lambda_i A + B \tag{18}$$

Given the adult i's indirect utility function, the effect of a change in tax rate on her welfare is

$$\frac{dv_{it}}{d\tau^*} = \frac{\lambda_i}{\tau^*} - \frac{1 + \lambda_i\eta}{1 - \tau^*} \tag{19}$$

where τ^* denotes the optimal tax rate. Evaluating the welfare change at the tax rate that maximizes the welfare of the median voter, we have

$$\frac{dv_{it}}{d\tau_{MV}^*} = \frac{1 + \lambda_{MV} + \lambda_{MV}\eta}{\lambda_{MV}(1 + \lambda_{MV}\eta)}(\lambda_i - \lambda_{MV}) \tag{20}$$

In this case, with an increase in the tax rate and public investment in education, the households with the altruism levels below that of the median voter will be worse off, and the households with altruism levels above that of the median voter will be better off.

By integrating the above equation over i, we obtain

$$\int_0^{N_t} \frac{dv_{it}}{d\tau_{MV}^*}\, di = \frac{1 + \lambda_{MV} + \lambda_{MV}\eta}{\lambda_{MV}(1 + \lambda_{MV}\eta)}(\bar{\lambda} - \lambda_{MV}) \tag{21}$$

The effect of public policy on the total welfare of the current generation depends on the skewness of the altruism distribution. If the distribution is right-skewed, then the mean altruism is greater than the median altruism. Therefore, the total welfare of the current generation increases as the tax rate further increases.

5.2. Welfare Maximizing Equilibrium

Democratic governments, represented by the politicians of the current generation who are interested in protecting their office in the near future, are commonly biased toward the current generation. This situation causes public policies to be inherently myopic in democratic societies (Gupta et al., 2016; Jacobs, 2016). Considering that public policies commonly prioritize the improvement of the social welfare of the present generation, we set the government's objective accordingly. The total welfare of the generation t can be defined as $TW = \int_0^{N_t} v_{it}\, di$, where v_{it} is as defined by the equation (14).

In this case, the government's preferred tax rate is

$$\tau_{TW}^* = \frac{\bar{\lambda}}{1 + \bar{\lambda} + \bar{\lambda}\eta} \tag{22}$$

This tax rate indicates that maximizing the welfare of the current generation is equivalent to maximizing the welfare of the mean voter. Under this scenario, the economy will grow at the following rate:

$$g_{TW} = \frac{\mu(1+\eta\xi)}{\rho(1+\phi)}\tau_{TW}^*(1-\tau_{TW}^*)^\eta\left(\frac{\bar{\lambda}\eta\kappa}{\phi-\bar{\lambda}\eta}\right)^\eta \tag{23}$$

The indirect utility of the adult *i* becomes

$$v_{it}^{TW} = (1+\lambda_i\eta)\log(1-\tau_{TW}^*) + \lambda_i\log(\tau_{TW}^*) + (1+\lambda_i)\log(h_{it}) + \lambda_i A + B \tag{24}$$

Evaluating $dv_{it}/d\tau^*$ at τ_{TW}^*, we have

$$\frac{dv_{it}}{d\tau_{TW}^*} = \frac{1+\bar{\lambda}+\bar{\lambda}\eta}{\bar{\lambda}(1+\bar{\lambda}\eta)}(\lambda_i-\bar{\lambda}) \tag{25}$$

In this case, as the tax rate and public investment in education increase further, the households with altruism levels below the mean altruism level will be worse off, and the households with altruism levels above the mean altruism level will be better off.

By integrating the above equation over *i*, we obtain

$$\int_0^{N_t}\frac{dv_{it}}{d\tau_{TW}^*}di = \frac{1+\bar{\lambda}+\bar{\lambda}\eta}{\bar{\lambda}(1+\bar{\lambda}\eta)}(\bar{\lambda}-\bar{\lambda}) = 0 \tag{26}$$

which indicating that the total welfare of the current generation is at its optimum when the tax rate is τ_{TW}^*.

5.3. Growth Maximizing Equilibrium

In this last scenario, acting as a social planner, the government's primary objective is to maximize economic growth; equivalently, to maximize the total welfare of all generations. In this case, the government's preferred tax rate can be written as

$$\tau_G^* = \arg\max \bar{h}_{t+1}/\bar{h}_t$$

where $\bar{h}_{t+1}/\bar{h}_t = \frac{\mu(1+\eta\xi)\tau_t}{\rho(1+\phi)}\left(\frac{\bar{\lambda}\eta(1-\tau_t)\kappa}{\phi-\bar{\lambda}\eta}\right)^\eta$

This optimization problem yields the tax rate

$$\tau_G^* = \frac{1}{1+\eta} \tag{27}$$

In this case, the economy will grow at the rate

$$g_G = \frac{\mu(1+\eta\xi)}{\rho(1+\phi)}\tau_G^*(1-\tau_G^*)^\eta\left(\frac{\bar{\lambda}\eta\kappa}{\phi-\bar{\lambda}\eta}\right)^\eta \tag{28}$$

The indirect utility of the adult *i* becomes

$$v_{it} = (1+\lambda_i\eta)\log(\tau_G^*) + \lambda_i\log(\tau_G^*) + (1+\lambda_i)\log(h_{it}) + \lambda_i A + B \tag{29}$$

Evaluating $dv_{it}/d\tau^*$ at τ_G^*, we have

$$\frac{dv_{it}}{d\tau_G^*} = -\frac{1+\eta}{\eta} < 0 \qquad (30)$$

In this case, the welfare of every household of the current generation gets worse as the size of the government further increases. The welfare effect of a tax rate change around τ_G^* is independent of altruism parameters.

6. Main Results

This section contrasts the consequences of public policy implemented by governments with different priorities. The model is designed to ensure that the relative position of each household in the welfare distribution remains unchanged throughout time. Therefore, the welfare disparity across generations of any specific family will be representative of the whole society in terms of the economy-wide interpretation of intergenerational welfare differences.

The welfare of the household i of the current generation attains its maximum when $\tau = \lambda_i/(1 + \lambda_i + \lambda_i\eta)$. Any departure from the government size represented by this tax rate will reduce the welfare of the household i. As is obvious, the tax rate τ is increasing in the altruism parameter λ and decreasing in the return to education parameter η. Put simply, when there is an increase in the return to private education spending, households tend to favor a reduction in tax rates. However, households with higher degrees of altruism tend to favor higher tax rates due to the redistributive nature of the public education policy that is integrated into the model.

The impact of altruism heterogeneity on household decisions is only intragenerational, whereas the public policy financed by taxes has intergenerational impacts. Households caring more for child quality tend to have less children. Given the time cost of childrearing, the households with higher levels of altruism towards child quality typically work more hours than those with lower levels of altruism. By dedicating more time to work instead of childrearing, they are able to allocate more resources to privately support their children's education.

The impact of policy shifts on households is manifested through changes in the tax rate, as it influences their consumption and educational spending decisions. Due to the logarithmic nature of household preferences, their labor supply and fertility decisions are not affected by policy shifts. On the other hand, as the tax rate rises, households can allocate less resources to both consumption and education. Public investment in education funded by tax revenue has a productivity impact on the human capital accumulation of future generations. However, the complementarity between public education investment and private education spending in the human capital accumulation process suggests that increasing the tax rates, which effectively increases public investment in education, also has a negative impact on the accumulation of human capital due to the crowding-out effect of the government action on household spending. In other words, when the tax rate is raised to support more public investment in education, households can allocate less resources for consumption and private education. This is due to the fact that they dedicate a greater portion of their income to tax payments.

Which policy implementation leads to a higher growth rate is a matter of the government size. In cases where the government prioritizes political considerations, that is, if the government cares about the welfare of the median voter or the current generation as a whole, the optimal tax rate will align with the preferred tax rates of the median voter and mean voter, respectively. The tax rate preferred by any household i, $\lambda_i/(1 + \lambda_i + \lambda_i\eta)$, is less than the tax rate, $1/(1 + \eta)$, that maximizes economic growth. Considering that the median voter and the mean voter are specific households, the tax rates that optimize their individual welfare are less than the tax rate that maximizes economic growth. Among the two cases, where political considerations are predominant, which one yields a higher tax rate depends on the skewness of the altruism distribution. If the distribution is skewed to the right, then $\bar{\lambda} > \lambda_{MV}$. In this case, the tax rate that maximizes the overall welfare of the current generation is higher than the tax rate that maximizes the welfare of the median voter. If the altruism distribution is skewed to the left, then $\lambda_{MV} > \bar{\lambda}$. In this case, the total welfare-maximizing tax rate is lower than the tax rate preferred by the median voter.

Economic growth attains its maximum when the government assumes the role of a social planner. Because government action is regarded as productive, it generates economic growth at any level of tax rate $\tau \in (0,1)$. The growth rate reaches its peak when the tax rate is τ_G^*. When the government size is below τ_G^*, the growth rate grows as the government size increases. However, when the government size is above τ_G^*, the growth rate declines as the government size further increases. The model posits that economic growth is driven by human capital accumulation, which is defined as an increasing function of public educational investment and private educational spending. As the tax rate surpasses the level that maximizes economic growth, the crowding-out effect of public education investment on private education spending outweighs the productivity impact of public education investment on human capital accumulation. This causes the growth rate to decline. As the tax rate reaches its maximum level, consumption and private educational spending will be completely crowded out, which is undesirable for both society and the government.

Comparing the growth rates in the equilibriums associated with maximizing the welfare of the median voter and the current generation as a whole, we have the following ratio:

$$\frac{g_{MV}}{g_{TW}} = \frac{\tau_{MV}^*(1 - \tau_{MV}^*)^\eta}{\tau_{TW}^*(1 - \tau_{TW}^*)^\eta} \tag{31}$$

In both of these cases, the optimal tax rates are less than the growth-maximizing level of the tax rate, and economic growth is an increasing function of the tax rate; that is, $\frac{dg}{d\tau^*} > 0$, if $\tau^* < \frac{1}{1+\eta}$. Which case yields a higher growth rate depends on the skewness of the altruism distribution. When the altruism distribution is right-skewed, the total welfare-maximizing tax rate is higher, leading the ratio of growth rates to be less than 1. If the altruism distribution is left-skewed, then the tax rate maximizing the welfare of the median voter is higher, leading the ratio of the growth rates to be greater than 1.

Regarding the welfare effect of the policy, any degree of public investment in education, backed by any tax rate $\tau \in (0,1)$, will enhance the overall welfare of the whole society. The equation (20) states that adults with altruism levels above that of the median voter will be better off as the tax rate increases further above the level associated with the median voter equilibrium. The equation (21) demonstrates the effect of a tax rate change around τ_{MV}^* on the total welfare of the current generation. The impact of public policy on the overall well-being of the present generation is contingent upon the asymmetry of the altruism distribution. In the case of a right-skewed distribution, the mean level of altruism is greater than the median altruism. Therefore, increasing the tax rate above τ_{MV}^* will increase the total welfare of the current generation. As the tax rate implemented by the government further increases and approaches the tax rate that maximizes the overall welfare of the current generation, the total welfare of the current generation increases and approaches its maximum. If the altruism distribution is left-skewed, then any such increase in tax rate makes the total welfare of the current generation worse. In this case, decreasing the tax rate to the level τ_{TW}^* will increase the welfare of the current generation to its maximum.

When we look at the equation (30), it is obvious that the welfare of each current-generation adult becomes worse as the tax rate increases above the growth-maximizing level. Similarly, decreasing the tax rate below this level increases the welfare of current-generation adults. This implies that no individual of the current generation prefers the policy associated with the social planner. Thus, governments with political concerns are likely not to implement such policies since the people of the current generation are their electors.

Finally, the equation (15) indicates that the welfare difference between successive generations increases as the tax rate increases. The welfare difference attains its maximum when the rate reaches to τ_G^*. This equation indicates that the positive effect of a tax rate increase on the welfare of future generations is greater compared to its adverse effect on the welfare of the current generation. Assuming the altruism distribution is right-skewed, it is also obvious from this equation that increasing the tax rate further above the level associated with the maximization of the total welfare of the current generation will make future generations better off. Similarly, if the altruism distribution is left-skewed, increasing the tax rate further above the level associated with the maximization of the welfare of the median voter will make future generations better off. It is evident from this equation that the favorable impact of the public policy progressively outweighs the adverse effect of the tax burden.

7. Discussion and Conclusion

This paper presents an endogenous growth model of overlapping generations, incorporating public education investment into the process of human capital accumulation. Public investment in education, financed by proportional income taxes, features intergenerational redistribution and affects economic growth through human capital accumulation. The allocation of funds for public education is a topic of political contention due to its inherent redistributive nature. To enhance our understanding of the process of political decision-making, we introduce heterogeneous altruism for descendants' human capital into the model.

This is particularly important as it is directly related to the public policy preferences of households. Differential altruism has a direct effect on the economy by influencing households' fertility decisions and forming the basis for political decisions on public investment in education. As the main determinant of education technology and financed by a proportional tax on household income, public education investment affects consumption and education expenditure decisions of households. Under the assumption of a balanced government budget at each period, investing in public education has a negative effect on economic growth through taxes and a positive impact by augmenting education technology. While the level of public education investment may be decided with political concerns, its positive effect on economic growth and welfare remains significant. Nevertheless, the determination of its level with political concerns reduces its contribution to the economy.

Our model aligns with the widely accepted perspective in the literature that investing in public education has a beneficial impact on the process of economic growth. We take public investment in education technology as a productive instrument of government intervention. Public investment in education, financed by a proportional income tax, enhances the accumulation of human capital. Nonetheless, governments with electoral worries may exhibit a political bias that hampers economic progress resulting from public policies. In our theoretical framework, even if the government targets maximizing the welfare of the most selfless household (the household with the highest level of altruism), the slowdown in economic progress is still evident. At the other end, when the government prioritizes improving the well-being of less altruistic households, the productive effect of public education investment on the economic progress becomes further diminished. If the government prioritizes the welfare of the median voter and degree of right-skewedness in the altruism distribution is very pronounced, the slowing effect of the government action will become more significant.

The model argues that the political concerns of governments lead to underinvestment in education, hence the underaccumulation of human capital, relative to the policy choice of the social planner. The difference between the policy choice of a social planner and politician arises from the fact that the politician cares only for the current generation to maintain its political power, whereas the social planner, unburdened by such political considerations, values the welfare of all generations. The shortsightedness of democratic governments results in underinvestment in education and the underaccumulation of human capital. Effective economic policies require foresight, which may not align with the interests of democratic governments that are more interested in securing political power through the support of the current generation. The time inconsistency problem inherent in democracies incentivizes governments to prioritize the preservation of their positions, even if it hampers economic growth and diminishes societal well-being.

In conclusion, as a source of sustained growth and intergenerational redistribution, public investment in education moves the frontier of the economy upward. However, the political considerations of democratic governments divert the economy from its frontier. The foundation of our theoretical study lies in the heterogeneity in altruism levels of households

regarding the human capital of their children. This heterogeneity is particularly pertinent to the policy variable of public investment in education.

Our study can be extended in several ways. Defining the heterogeneous altruism parameter for child quality through educational inclusion of families, we can calibrate the model with data. Measures such as the skill levels and educational attainments of parents and the size of the household budget allocated to educational expenditure by parents can be taken as possible indicators for the educational inclusion of households. Additionally, we can introduce heterogeneity into school districts by differentiating education technologies locally. This will incentivize families with more educational inclusion to relocate to school districts that offer superior education technologies. We leave these tasks for future research.

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