Political rivalry effects on human capital accumulation and inequality: a New Political Economy approach

Elena Sochirca ¹,²
Oscar Afonso ¹,²
Sandra Silva ¹,²

¹ FEP-UP, School of Economics and Management, University of Porto
² CEF.UP, Research Center in Economics and Finance, University of Porto
Abstract

We propose an endogenous growth model with elements of new political economy in order to study the effects of political institutions and political rivalry on human capital accumulation and income inequality. Relating to the increasing literature on the relationship between income redistribution, inequality and growth, and on the political economy of growth, our model shows that (i) non-distortionary redistribution via public education equalizes income levels and increases human capital accumulation; (ii) political rivalry produces negative outcomes in all dimensions of the considered economic interactions. In particular, we find that occurring episodes of political rivalry reduce human capital accumulation through their negative impact on public investments in education, workers’ wages and individual learning choice, and increase income inequality. As regards the role of political institutions, our analysis suggests that the elasticities of human capital accumulation with respect to public and private investments have crucial implications for public policies and require particular attention to the political rivalry effects.

Keywords: political rivalry, institutions, human capital accumulation, public education, inequality, efficient redistribution, economic growth.

JEL classification: H21, H40, H52, E24, I24, O43

1 Introduction

Understanding how political institutions influence and determine economic outcomes has become one of the most challenging questions of modern economic theory. Related economic analysis of political institutions attributes considerable importance to their role in defining aggregate economic performance both from a theoretical and a practical, policy-making perspective. For example, studies of political incentives and political institutions argue that policy cannot be viewed as an exogenous process, playing a central role in explaining differences in growth rates across countries (e.g. Persson and Tabellini, 1992; Acemoglu and Robinson, 2000; Acemoglu, 2006). In many contexts of new political economy, the need to jointly model political and economic mechanisms and their interaction is emphasized (see, for example, Sayer, 2000). Existing empirical evidence also indicates that political processes have a crucial impact on resulting economic policies and outcomes (e.g. Alesina and Rodrik, 1992; Perotti, 1996).
We propose an overlapping generations model with elements of new political economy to study the effects of political rivalry on human capital accumulation and income inequality and examine how different political incentives and policies may affect the resulting economic allocations. With this objective, we combine elements of endogenous growth theory and new political economy by considering human capital accumulation as the engine of endogenous growth and accounting for the crucial role of institutions in securing undistorted economic outcomes. In analysing the impact of political institutions we focus on two important policies affecting economic performance: fiscal policy and provision of public goods in the form of investments in human capital accumulation via publicly provided education. This choice is motivated by the similarity in the targeted effects of both human capital accumulation and efficient redistribution, such as decreasing inequality, correcting possible institutional or economic failures, stimulating investments, improving economic performance and increasing growth. Our research framework relies on the idea that, being the basis for long-term economic development and one of the key factors influencing aggregate productivity and individual income, human capital accumulation is a fundamental macroeconomic policy, the significance of which cannot be neglected and for which political effects have a critical role. We also consider that understanding the determinants of income and income inequality is particularly important in what regards vertical and inter-generational social mobility.

The present work relates to the increasing literature on: (i) the relationship between income redistribution, inequality and growth; (ii) the political economy of growth. In particular, as regards the possible effects of redistribution on income inequality and growth, our model accommodates some of the important conclusions of existing theoretical and empirical research. Considering the negative effects, in consistency with the hypothesis advanced by the theories, early cross-country analyses has established a negative association between the level of inequality and economic growth through the distortionary nature of taxation, emphasizing that anticipated distortionary redistribution will lower the incentives to accumulate and thus may hamper growth (e.g. Alesina and Rodrik (1992), Persson and Tabellini (1992), Perotti (1996), Drazen (2000)). Our model's results verify these findings. As for the positive effects, Perotti (1992) shows how in economic structures with public investments in education the effect of taxes on growth is positive, a conclusion also supported in the research works by Alesina and Rodrik (1992) and Persson and Tabellini (1992). In a later study, Perotti (1996) also shows that higher inequality is indeed associated with a lower level of human capital accumulation, and lower human capital accumulation is associated with lower levels of economic growth. Recently, the cross-country analysis of Easterly (2007) reaffirmed that human capital accumulation and economic development are adversely affected by inequality, which is a barrier to schooling and economic growth. Finally, there are some studies that integrate both positive and negative effects, by considering that, at different levels of economic development, inequality may have a dual impact on growth (for example, Saint Paul and Verdier (1996), Perotti (1996), and Galor and Moav (2004),2), which is also accommodated by our model.

---

1They conclude that efficient redistribution policies limit the degree of distortions in investment decisions and promote economic growth.

2In the study performed by Saint Paul and Verdier (1996), the authors reconsider the conventional political economy view that more unequal societies tend to redistribute more, and more redistribution is harmful to growth. In particular, using a simple voting model, Saint Paul and Verdier (1996) show that: (i) higher inequality does not necessarily lead to more redistributive taxation (without detailing, they briefly enumerate some mechanisms that may generate a negative relation between inequality and taxation, such as progressive taxes and transfers, endogenous political participation, and particularities of the median/mean ratio); and (ii) more redistribution is not necessarily harmful for growth through the conventionally accepted mechanism, namely that more redistribution means higher tax rates on investment returns, which in turn reduces investment and growth. On the contrary, their analysis suggests that inequality does not have to be always positively correlated with redistribution, arguing that particular transfers may affect growth positively rather than negatively.

3Similarly, the study in Galor and Moav (2004) suggests that the replacement of physical capital accumulation by human capital accumulation as the prime engine of economic growth has changed the qualitative impact of inequality on the process
Regarding the political economy of growth, directed research that combines economic analysis with political economy elements refers to political rivalry as a key element affecting economic performance (see, for example, Dixit et al., 2000; Scruggs, 2001; Acemoglu, 2006). The effects of political rivalry are generally associated with breaking the balance between political power and economic opportunities, thus negatively affecting the relation between political institutions, redistribution and economic outcomes. For example, Rodrik (1999) suggests that disagreements between political groups may inflict the extra cost on the economy, as well as Acemoglu and Robinson (2001) and Dixit and Londregan (1995), who suggest that contesting political power (resulting in inefficient redistribution) may induce economic costs due to its growth retarding effects. Success or failure of implemented economic policies then depends on how prevailing institutions manage political rivalry. This is a crucial assumption in our model. As regards the specific concept of political rivalry adopted in this work, we follow Acemoglu (2006), who defines political rivalry as (negative) political competition arising when enrichment by other social groups poses a threat to the elite’s ability to benefit from their political power in the future. It also implies a strong negative impact when goals pursued by the political elite, instead of economic efficiency considerations, determine the policy choice. In this respect, it reflects how political constraints may explain the choice of policies, and thus economic outcomes. In particular, in our model political rivalry arises in the form of political competition against replacement and political incentives in public policy, and we consider that distortionary taxes are then beneficial for the elite as a way of impoverishing their political competitors. As such, political rivalry becomes a key distorting factor in the economy.

In line with our research objective, this framework is adopted to illustrate that (i) non-distortionary redistribution via public education equalizes income levels and increases the human capital accumulation in the economy, which has a growth promoting effect;\(^4\) (ii) the efficiency of such redistribution policy is distorted by political rivalry, with resulting negative effects on economic outcomes.

Our model combines elements from the study of Glomm and Ravikumar (2003), extended by the introduction of a final-goods production sector and endogenous new political economy elements as suggested by Acemoglu (2006). Introducing a production sector in the economy allows us to specifically derive the equilibrium income and its growth rate; considering endogenous fiscal and public investments policies allows for a richer analysis of economic results that accounts for the effects of the inherent political mechanisms and political rivalry, and the role of political institutions. As in Glomm and Ravikumar (2003), we examine the evolution of inequality in an overlapping generations model with human capital accumulation. However, our specific focus on endogenous fiscal policy and political rivalry enables us to show how political processes may distort the efficiency of economic interactions. Our analysis suggests distinct perspectives as regards public policies targeting investments in education and inequality. In particular, we find that increasing the tax rate will increase public investments in education only when taxes are non-distortionary. When taxes are excessively increased due to political rivalry, the result will be lower educational investments, reduced individual learning incentives and limited human capital accumulation.

\(^3\) \(\) This kind of redistribution facilitates investment by the poor without impeding investment by the rich, and therefore is again positively associated with growth.

\(^3\)
which will lower production, wages and consequently may deepen or prolong income inequality. This implies that only in the absence of political rivalry, can public investments in education be used as an efficient social mobility promoter, enabling income convergence and overcoming inequality. Thus, although being attenuated by public policy oriented towards education and human capital accumulation, we find that political rivalry produces negative outcomes in all dimensions. We also find that the elasticities of human capital accumulation with respect to public and private investments have crucial implications for the role of political institutions and require particular attention to the political rivalry effects.

The structure of this paper is the following. In Section 2 we outline our model’s specifications and derive equilibrium values for our main variables regarding productive activities, human capital accumulation, optimal policy choice, and income inequality. Section 3 includes the comparative statics analysis focusing on the effects of public investments policy and political rivalry. In Section 4 conclusions and references for possible future research are presented. Mathematical detail for the comparative statics analysis of Section 3 is provided in the Appendix.

2 Model specifications

We consider an overlapping generations economy with constant population where individuals live for two periods. The economy consists of a continuum of risk-neutral agents $1 + S^e + S^m$, each with a discount factor equal to $\beta \in (0, 1)$. We assume there is a total of $S^e$ elite agents, $S^m$ middle-class agents and a continuum of workers, with a measure normalized to 1, being that each agent's social group membership (i.e. elite, middle-class or worker) does not change over time. In this model, the elite, denoted by $e$, represents the social group of agents that hold the political power in the society, decide on policies and do not take part in productive activities. We make this assumption in order to emphasize the effects of political economy and show how a decoupling between political and economic power can lead to political rivalry, distortionary policy and poor economic outcomes. The middle class, denoted by $m$, are the entrepreneurs in the economy with access to the final good production technology. The workers, who supply their labour inelastically, are employed by the middle-class entrepreneurs for producing the final good. Finally, we also assume that in each period workers are differentiated by the amount of parental income invested in their education and by the human capital stock they accumulate depending (among other things) on their individual learning choice and on fiscal and public education policies adopted by

---

5 We divide our model’s agents into these three social groups following the terminology frequently used in the new political economy literature.

6 Although the mechanisms and processes of political power distribution in the society is an independent research question per se, here we take as given the assumed distribution and, instead, focus on how challenging it may lead to different policies and thus to different economic paths.

7 When political and economic powers are decoupled, the conflicts of interest in the society are more likely to result in political rivalry that will necessarily distort the outcomes of economic policies pursued by the institutions in power. Being impossible to isolate the resulting resources distribution from the aggregate economic performance, the resulting allocations will be inefficient and will often involve different types of distortions. For example, Alesina and Rodrik (1992) conclude that individuals who have access to productive assets of an economy are more likely to be restrained in their desire to tax them, suggesting that it is easier to avoid damaging conflict over redistribution policies when the economy’s assets are widely shared. Similarly, the discussion in Dixit and Londregan (1995) suggests that positive results can be achieved when redistribution is done according to economic criteria and not political characteristics.
2.1 Middle-class entrepreneurs and productive activities

For producing the final good, each middle-class entrepreneur has access to the following Cobb-Douglas Harrod-neutral production function:

\[ Y_{i,t} \equiv F(K_{i,t}, G_{i,t}) = (K_{i,t})^{\alpha} \left( A_t \cdot G_{i,t} \right)^{(1-\alpha)} \]  

where \( Y_{i,t} \) is the final-good output produced in \( t \) by entrepreneur \( i \), \( K_{i,t} \) is capital used, \( A_t \) is the aggregate labour-augmenting productivity term, and \( G_{i,t} \) is the total contribution of workers of different skill levels to final good production, such that \( G_{i,t} = L_{i,t} \cdot H_{i,t} \), with \( L_{i,t} \) being the total amount of labour used in \( t \) and \( H_{i,t} \) the total amount of human capital that each worker (of a specific skill level) is endowed with in period \( t \). The use of a Cobb-Douglas production technology allows us solving for the political equilibrium analytically and, as it will be seen further, also links equilibrium taxes and public education investments to the elasticity of output with respect to capital.

In order to derive the steady-state capital stock per unit of human capital and final output, we assume that, at each \( t \), the economy starts with two predetermined variables: the output tax rate, \( \tau_t \), and the capital stocks of the middle-class entrepreneurs, \( K_t \). We assume that the linear tax on output, \( \tau_t \), is applied by the elite to middle-class production for raising state revenues. As it will be shown in Section 2.3, \( \tau_t \) is endogenously determined in our model depending on political rivalry considerations of the politically powerful social group, i.e. the elite. As in Acemoglu (2006), we also assume that taxes are set before the entrepreneurs make their investment decisions, namely, that their capital and labour stocks for the next date are chosen after observing the tax rate previously announced by the elite. Then, final output is produced, and a fraction \( \tau_t \) of the output is collected as tax revenue.

Denoting by \( k \equiv \frac{K_{i,t}}{G_{i,t}} \) the capital stock per unit of human capital, we can rewrite equation (1) as \( f(k_i) = A^{(1-\alpha)} \cdot k_i^\alpha \). Then, assuming that a fraction \( \delta \) of capital depreciates, we can write the utility of an entrepreneur with a capital stock per unit of human capital \( k_i \) at time \( t \) as a function of the announced fiscal policy. In particular, given a predetermined tax rate on output, \( \tau_t \), the utility of a middle-class entrepreneur can be written as:

\[ U^m(k_t, \tau_t, \delta) = \sum_{s=t}^{\infty} \beta^{s-t} \left( (1-\tau_s)f(k_s) + (1-\delta)k_s - k_{s+1} \right) \]  

Maximizing (2) with respect to each entrepreneur’s choice of the next period capital stock per unit of human capital, \( k_{t+1} \), yields the steady-state capital stock per unit of human capital that must satisfy:

\[ \beta (1-\tau) f'(k_{t+1}) + 1 - \delta = 1 \]  

Because of linear preferences, expression (3) applies for all \( t \) and using the above defined production function, \( f(k_i) \), implies:

\[ \text{In defining the middle-class entrepreneurs' utility we assume that preferences are linear, and thus the value function can be written as a discounted sum of gross production levels (i.e. before subtracting labour costs).} \]

\[ \text{For the sake of simplicity, we suppress the index } i. \]
From expressions (4) and (5) we can see that, given the announced fiscal policy, output produced by the middle-class entrepreneurs will be reduced (in advance) by a fraction \( \tau \) and the steady-state output and capital stock per unit of human capital will be strictly lower than they would be in an economy without taxation. In fact, in a political economy context, anticipation of a redistributive policy motivated merely by political considerations can reduce economic incentives and prevent economically advantageous actions from being taken (e.g. Alesina and Perotti, 1994; Dixit and Londregan, 1995; Acemoglu and Robinson, 2001). This implies that, with a tax rate increased by political rivalry, economic incentives for production activities will be more reduced, as we will see further in this paper.

2.2 Human capital accumulation and wages

By our model’s assumptions, workers are the only economic agents who receive wages and accumulate human capital individually. Assuming that workers are paid their marginal product for the labour they supply to middle-class entrepreneurs, the wage at time \( t \), accounting for the above derived capital stock per unit of human capital (4), is given by:

\[
    w_t(K^*) = (1 - \alpha) \cdot A_t \cdot H_t \cdot \left( \frac{\beta^{-1} + \delta - 1}{\alpha(1 - \tau)} \right)^{\frac{1}{\alpha - 1}}
\]

Next, we assume that each worker’s human capital stock at time \( t + 1 \) results from a combination of factors devoted to its accumulation and, following Lucas (1988) and Glomm and Ravikumar (2003),

\[
    H_{t+1} = E^t \cdot w_t \gamma (1 - l_{j,t})
\]

where \( 1 - l_{j,t} \) denotes time devoted to learning; \( w_t \), weighed by \( \gamma \), denotes parental income (wages of individuals old enough to work in \( t \)) invested in children’s education; and \( E_t \), weighed by \( \zeta \), is a compound variable that denotes investments in public education designed to improve its quality, expand infrastructure, and provide equality of access and opportunity. Elements such as educational material provision, teaching quality improvement and individual support and incentives through merit scholarships and means-testing subsidies, are examples of various aspects of educational investments captured by \( E_t \).

To capture the effect of (initial) income distribution, we assume that individuals differ in parental income invested in their education, from which they benefit by a factor of \( \gamma \). They will also differ ex-post in the human capital they accumulate through the public education system, from which they benefit by a

---


11 As it will be shown in the next section, \( E_t \) is determined by a (weighed) proportion of tax revenues collected by the elite from the middle-class entrepreneurial activity.
factor of $\varsigma$. Although both parameters $\gamma$ and $\varsigma$ are assumed exogenous in our current study, their role in human capital accumulation should not be underestimated. For example, the closer the parameter $\varsigma$ is to 1, the more dominating is the weight of public education in human capital accumulation. Also, it is important to emphasize, that even when $\gamma = 0$ (i.e. when parents do not or can not invest in their childrens’ education), there is still human capital accumulation in the economy because of the publicly provided education. The economic and political implications of different magnitudes of $\gamma$ and $\varsigma$ will be discussed in more detail in the next sections.

Furthermore, given that young workers accumulate human capital and old workers are employed and remunerated for producing the final good, we assume that time devoted to learning, $1 - l_{j,t}$, is determined by each worker’s individual preferences over leisure when young and consumption when old given by the standard constant-relative-risk-aversion utility function:

$$\frac{l_{j,t}^{1-\sigma} + c_{j,t+1}^{1-\sigma}}{1 - \sigma}, \quad 0 < \sigma < 1 \tag{8}$$

where $l_{j,t}$ is leisure at time $t$, $c_{j,t+1}$ is consumption at time $t + 1$, which we assume to be given by $w_{j,t+1}$, and $\sigma$ is the usual coefficient of relative risk aversion, which we refer to throughout the model as the individual preferences parameter.\(^{13}\)

The young agent’s problem at time $t$ is to choose the optimal time allocation between leisure, $l_{j,t}$, and learning, $1 - l_{j,t}$. This choice (along with public investments in education and parental income) will determine the worker’s human capital accumulation and corresponding wage (and consumption) in $t + 1$. Formally, we maximize (8) subject to $c_{j,t+1} = w_{j,t+1}$, where $w_{j,t+1}$ is given by (6) in $t + 1$ together with (7). Then, for a standard constant-relative-risk-aversion utility function and assuming an interior solution to workers’ maximization problem, the optimal learning choice, $(1 - l_{j})^*$, is given by:

$$(1 - l_{j})^* = \frac{\left((1 - \alpha) \cdot A_{t+1} \cdot E_{t} w_{t}^{\gamma} \cdot \left(\frac{\delta^{-1+\delta-1}}{\alpha(1-\gamma)} \right)^{\frac{\alpha}{\alpha-1}} \right)^{1-\sigma}}{1 + \left((1 - \alpha) \cdot A_{t+1} \cdot E_{t} w_{t}^{\gamma} \cdot \left(\frac{\delta^{-1+\delta-1}}{\alpha(1-\gamma)} \right)^{\frac{\alpha}{\alpha-1}} \right)^{1-\sigma}} \tag{9}$$

Given $E_t$, the choice of $1 - l_{j,t}$ allows us to (recursively) fully derive $H_{t+1}$, $w_{t+1}$, and $c_{t+1}$.

Again, because our objective in this paper is to analyse the effects of political economy, we note that, depending on the specific value of $\tau$, a dual effect on the workers’ optimal learning choice (given the effects of an increase in the output tax on $w_t$ and $E_t$) is possible. Various implications of distinct fiscal policies will be discussed in more detail in the next sections.

### 2.3 Elite utility and optimal policy choice

In this section, we characterize the “policy” block of our model by looking at the fiscal and public investment policy choices of the elite. Recall that, in our paper, we have assumed that the elite does not take part in productive activities, its only role in the economy being purely political. This assumption is crucial for separating economic and political power, thus allowing for political rivalry effects. Considering

\(^{12}\)The use of this standard functional form ensures the existence of a balanced growth path.

\(^{13}\)We impose the restriction $0 < \sigma < 1$ to guarantee that a worker’s lifetime utility is increasing in $l_{j,t}^{1-\sigma}$ and $c_{j,t+1}^{1-\sigma}$ and is globally positive.
the specific fiscal and public policy and the incentives of the elite, we then derive the optimal tax rate for each \( t \) under different scenarios of future political power distribution.

**Fiscal and public policy and the incentives of the elite**

As regards fiscal policy, we consider available two instruments: a linear tax on output, \( \tau_t \in (0, 1) \), and lump-sum transfers to the elite, \( T^e_t \). As regards public investments policy, we assume that the elite devotes part of the collected tax revenues to investments in public education, through which human capital accumulation is done. We consider that the elite’s incentive for implementing this policy is supported (as for any type of public investments) by its expectations to reap the benefits of these investments in the future. Being closely related to economic development through its inherent features of increasing competencies, knowledge and other qualitative attributes, when incorporated in workers’ performance, human capital accumulation produces increased economic value and leads to both quantitative and qualitative progress, from which (in a political economy context) the elite benefits directly. In particular, we consider that the elite’s motivation for making public education investments is twofold. On the one hand, besides increasing wages paid to workers, accumulated human capital also makes them more productive and increases the final output produced by middle-class entrepreneurs, thus enabling the elite to collect higher tax revenues. This part refers to the revenue extraction motive (Acemoglu, 2006) and, as we will further show, does not entail distortionary economic outcomes. On the other hand, human capital accumulation also offers exclusively to the political group in power additional revenues, resulting from innovations, property rights, patents, etc. In our political economy context, this strengthens the elite’s intention to secure its politically dominating position in order to be able to access future (including elite exclusive) revenues from productive activities and human capital accumulation.

Thus, there are two opposing forces that determine the elite’s optimal policy choice. On the one hand, there is an elementary revenue extraction motive, so it is in the elite’s interest to have a highly productive middle-class and growing human capital accumulation, as this would enable higher output-tax and additional elite exclusive revenues. This determines the elite to choose non-distortionary fiscal policies that promote human capital accumulation and economic growth. On the other hand, because in the next period the elite do not want to lose power and all the benefits it entails, they will recur to political rivalry mechanisms. In particular, the elite will set an excessive tax rate that will lower production and reduce human capital accumulation, impeding the middle class from becoming richer and consequently more powerful. With these considerations and in what public goods provision is concerned, political rivalry may become particularly detrimental to economic performance. By generating distortions that negatively affect the resulting economic outcomes, political rivalry implies higher social costs, lower investments and reduced economic growth.

---

14 Because the elite initially holds the political power in our model, we can restrict our analysis to the sequence of policies that imply no direct redistribution either to the middle-class entrepreneurs or workers.

15 Throughout this paper, we use the terms “economic growth” and “final output growth” as synonymous, since both imply positive variations in \( F(K, G) \).

16 In our research context, the implicit economic costs of the failure to employ tax revenues for the originally intended purpose (instead using them for political rivalry related reasons) can be interpreted in terms of forgone investments in human capital accumulation and economic growth opportunities.
Maximization problem of the elite

Following Acemoglu (2006) and with the above considerations in mind, we can derive the utility of the elite (the net present discounted utility of a representative elite agent). We start by calculating the elite transfer $T^e_t \geq 0$ subject to the government budget constraint as:

$$T^e_t \leq \frac{\omega}{\xi} \tau_t \int F(K_{i,t}, G_{i,t})di$$

(10)

where the left-hand side denotes government expenditures in transfers per one elite agent and the right-hand side are the revenues raised through taxing the middle-class output. As in Acemoglu (2006), we also include the parameter $\omega \in [0, 1]$ as a measure of state capacity to raise and redistribute revenues, such that it captures how much of the tax revenue can be redistributed, with the remaining $1 - \omega$ being waisted.\(^\uparrow\)

Then, the elite choose the tax rate for the period $t$, $\tau_t$, so as to maximize their current value accounting for the transfer amount, investments in public education, exclusive elite revenues and the probability of loosing power in the next period.

We can write the maximization problem of an elite agent when choosing the tax rate $\tau_t$ at $t - 1$ recursively as:

$$V^\tau(E) = \max \left\{ T^e_t - E_t + \pi^e_t(H) + \beta (1 - \theta(\tau))V^\tau(E) + \theta(\tau)V^\tau(M) \right\}$$

(11)

where $T^e_t = \omega \tau_t \cdot A_i G_t \cdot \left( \frac{x^{-1+\delta+\gamma}}{\alpha(1-\gamma)} \right)^{\frac{\omega}{\xi}} S^m_{\xi}$ is the transfer to one elite agent given the output produced by $S^m$ middle-class entrepreneurs, $E_t = \left( \frac{1 - \alpha}{\alpha} \cdot \xi \right) \cdot T^e_t$ is the fraction of state tax revenues, weighed by the factor $\frac{1 - \alpha}{\alpha} \cdot \xi$, destined for financing public education and $\pi^e_t(H)$ denotes rents from human capital, available to the party in power exclusively. Note that, for a given level of tax-collected revenues, $T^e_t$, the elite’s choice of the investment amount in public education is further adjusted by the ratio between output elasticities with respect to human and physical capital, $\frac{1 - \alpha}{\alpha}$, on the one hand, and the relative importance of public education for human capital accumulation, $\frac{\xi}{\xi}$, on the other hand.\(^\uparrow\)

Finally, the component $\beta (1 - \theta(\tau))V^\tau(E) + \theta(\tau)V^\tau(M)$ relates to the likelihood of political replacement and generates the political rivalry effects in the model. In particular, $\theta(\tau)$ denotes the probability that in period $t$ political power will permanently shift from the elite to the middle-class social group, and $V^\tau(E)$ and $V^\tau(M)$ denote the utility of the elite when they and the middle-class are in control of politics, respectively. Note that exclusive access to rents from human capital accumulation and natural resources, $\pi^e_t(H)$, ensures that the utility of the politically powerful social group is higher than the utility of any other social group, implying that $V^\tau(E) > V^\tau(M)$ in our model.

The probability of the elite losing political power in the next period as modeled as a function of the magnitude of the middle-class social group and the net income level (i.e. revenues from productive activities deducted of labour costs) of a representative middle-class entrepreneur:

\(^\uparrow\)Governments subjected to frequent destabilizing episodes of political rivalry may become considerably costly to economic performance, in particular as concerns the provision of public goods. This may happen in the case of either a too weak or a too strong state. The former entails that none of the conflicting political groups is sufficiently strong to secure control over implemented policies, and the latter implies that one excessively strong social group struggles to keep its political (and economic) control through misleading practices. From this perspective, states with intermediate levels of strength, i.e. intermediate values of $\omega$, can be viewed as most capable (and most interested) to reap the benefits of public policies.

\(^\uparrow\)In our model, any possible variations in these ratios is assumed exogenous.
\[ \theta(\tau) = S^m \cdot C^m(\tau) \in [0, 1] \] (12)

which captures the potential political power of the middle class and where \( C^m(\tau) = \alpha A_t \cdot G_t \cdot \left( \frac{\beta^{1+\delta-1}}{\alpha(1-\tau)} \right)^{\frac{1}{\delta}} \) with \( \frac{\partial \bar{\theta} (t)}{\partial C^m} > 0 \), implying that when the middle-class entrepreneurs are richer they are more likely to gain power.\(^{19}\) Although it is also true that \( \frac{\partial \bar{\theta} (t)}{\partial S^m} > 0 \), as previously stated, \( S^m \) is exogenous in our model (as is the number of all social groups members).\(^{20}\)

**Optimal policy choice**

The first order condition for an interior solution for the tax rate, \( \tau_t \), is \( \frac{\partial V^*(\tau)}{\partial \tau} = 0 \). We can solve the elite’s maximization problem first, for an equilibrium policy without political economy considerations, and then accounting for the effects of political rivalry on optimal policy choice.

**i) without political rivalry**, the probability that the elite will lose power is exogenous to the model, i.e. \( \frac{\partial \theta}{\partial \tau} = 0 \) and the elite’s maximization problem is given by:

\[ \frac{\partial V^*(\tau)}{\partial \tau} = 2T_e - 2E_e \]

Solving this for an interior solution, in period \( t-1 \) the elite will choose for period \( t \) an output tax of:

\[ \tau^*_e = 1 - \alpha \] (13)

As we will show in our comparative statics analysis, this is the optimal tax policy that at the same time maximizes elite’s utility and does not generate political rivalry effects and economic distortions.

**ii) with political rivalry**, the probability that the elite will lose power in the next period is endogenous, i.e. \( \frac{\partial \theta}{\partial \tau} < 0 \), and new political economy effects arise. In this case, the elite’s maximization problem becomes \( \frac{\partial V^*(\tau)}{\partial \tau} = 2T_e - 2E_e - \beta \frac{\partial \bar{\theta}}{\partial \tau} [V^*(E) - V^*(M)] \), with \( \frac{\partial \theta}{\partial \tau} = -S^m \cdot \frac{A_t \cdot G_t \cdot (\beta^{1+\delta-1})^{\frac{1}{\delta}}}{\alpha(1-\tau)^{-1}} \).

This yields an optimal output tax of:

\[ \tau^*_PR = \Theta + 1 - \alpha \] (14)

Comparing the two optimal solutions, (13) and (14), it can be seen that \( \tau^*_PR \) is strictly higher than \( \tau^* \) by the factor \( \Theta \equiv \frac{\alpha^2 S^m \beta [V^*(E) - V^*(M)]}{(1 - \frac{\beta}{\alpha})^\omega} \).\(^{21}\) Yet, setting a higher tax rate does not bring more tax revenues for the elite and has distortional effects on the resulting economic outcomes. In fact, it can be verified that the elite’s current income, \( T_e \), increases with \( \tau \) only for \( \tau < 1 - \alpha \), the maximum tax rate being collected when \( \tau = 1 - \alpha \). As we will show in our comparative statics analysis, all economic allocations in the presence of political rivalry become inefficient. Nevertheless, in a political economy context the

\(^{19}\) With greater resources the middle class may be more successful in attaining their collective interests (see Acemoglu, 2006)

\(^{20}\) We follow this assumption because our main goal is not to examine how and why \( S^m \) and \( S^e \) change, but rather their influence on the political power distribution and the resulting different policies and growth paths.

\(^{21}\) Note that, because in each period \( [V^*(E) - V^*(M)] \) assumes an infinitesimal value, the condition \( \tau^*_PR < 1 \) is satisfied.
elite will still choose to set higher, distortionary taxes as this would weaken its potential political rivals - the middle class,\textsuperscript{22} thus increasing the probability of the elite to remain in power for the next period and continue taking profit from all the benefits implied.

2.4 Income inequality

This section is devoted to the analysis of income inequality in our model based on two endogenously defined key variables - the income growth rate (derived based on equilibrium wages and human capital accumulation calculated in Section 2.2) and the critical level of income (derived following the approach in Glomm & Ravikumar (2003)).

**Income growth rate and critical level of income**

Considering the wages of two workers from the same generation, it can be easily seen, from expression (6), that differences in the level of incomes can only arise from different levels of accumulated human capital. Although in line with endogenous economic theory and our model’s assumptions such an analysis of inequality is not very interesting. On the other hand, the analysis of income inequality between two different generations is much more insightful. In particular, recalling expression (6), we can use the human capital accumulation function (7) together with the optimal learning choice (9) to define individual income at $t+1$, $w_{t+1}$, and, consequently, the income growth rate of a workers’ family, $\frac{w_{t+1}}{w_t}$, as follows:\textsuperscript{23}

$$\frac{w_{t+1}}{w_t} = \frac{\left[ (1-\alpha) \cdot E_\zeta \cdot A_{t+1} \cdot \left( \frac{\beta-1+\delta-1}{\alpha(1-\gamma)} \right) \right]^\frac{\alpha}{\alpha-1}}{w_t^{1-\frac{\gamma}{\sigma}} + \left[ (1-\alpha) \cdot E_\zeta \cdot A_{t+1} \cdot \left( \frac{\beta-1+\delta-1}{\alpha(1-\gamma)} \right) \right]^\frac{\alpha}{\alpha-1} \cdot w_t^{1-\gamma}}$$

(15)

Inspection of expression (15) shows that the relation between preferences and parental income parameters, $\sigma$ and $\gamma$, is crucial for defining the behaviour of $\frac{w_{t+1}}{w_t}$ over time. In this respect, as in Glomm & Ravikumar (2003), we need to consider two distinct situations: i) $\gamma < \sigma$, and ii) $\sigma < \gamma$.

In the first case, when $\gamma < \sigma$, we have that expression (15) is decreasing in $w_t$. Then, comparing the income growth rate for a poor and a rich working family, we can see that income will grow at superior rates for workers with lower incomes than for those with higher incomes. Consequently, over time, incomes will converge and income inequality will decline. The intuition behind this result is simple. The parameter $\gamma$ can be interpreted as the sensitivity of a worker’s human capital investments to his or her parents’ income. Thus, with a small $\gamma$, parental income does not have a strong influence on their children’s accumulation of human capital. This means that, for a worker, parental heritage is less important than his or her own individual preferences regarding education, and there is a high potential for social mobility even for workers coming from a less favourable background.

In the second case, when $\sigma < \gamma$, parental income has a greater role and affects more strongly the next generation’s human capital accumulation than when $\gamma < \sigma$. Because parents with higher income can

\textsuperscript{22}Recall that, in our model, the potential political power of the middle-class is captured by (12), which is decreasing in $\tau$.

\textsuperscript{23}Note that the analytical expression obtained for the income growth rate is similar to that in Glomm and Ravikumar (2003), although the economic mechanisms considered for its derivation are distinct.
devote more resources to their children's education and their contribution weighs more, human capital accumulation for families with lower parental incomes is more limited. Such conditions on initial income distribution are more propens to deepening income inequality over time. More specifically and contrary to the first case, the behaviour of $\frac{w_{t+1}}{w_t}$ over time is not monotonic: when $\sigma < \gamma$, we can see from expression (15) that $w_t$ has a dual (positive and negative) effect on the income growth rate. The critical level of income, $w^{CT}$, can then be used to represent an inflection point, below which $\frac{w_{t+1}}{w_t}$ is increasing in $w_t$ and above which $\frac{w_{t+1}}{w_t}$ is decreasing in $w_t$:

$$w^{CT} = \left( \frac{\gamma - \sigma}{\sigma(1 - \gamma)} \right)^{\frac{\sigma}{\sigma(1 - \gamma)}} \cdot \left( 1 - \alpha \right) \cdot E_t^c \cdot A_{t+1} \cdot \left( \frac{\beta^{-1} + \delta - 1}{\alpha(1 - \tau)} \right)^{\frac{\alpha}{\alpha - 1}} \cdot \left( 1 - \alpha \right) \cdot E_t^c \cdot A_{t+1}$$ (16)

Comparing the income growth rate for a poor and a rich working family, their actual income relative to the critical income level in the economy will now define the behaviour of $\frac{w_{t+1}}{w_t}$ over time. In particular, when both poor and rich working families’ incomes are below the level of $w^{CT}$, income will grow at inferior rates for workers with lower incomes than for those with higher incomes. Consequently, incomes will continue diverging and income inequality will increase. However, this pattern is inverted when both working families’ incomes exceed $w^{CT}$. Once the critical income level is overcome, the behaviour of the income growth rate induces income convergence (as in the case when $\gamma < \sigma$), the gap between higher and lower incomes narrows and income inequality starts to decrease.

In the context of our research, critical income effects are considered accounting for the endogenous fiscal and public investments in education policies, in a political rivalry environment. Moreover, the lower (higher) is the critical income level, the easier (more difficult) it is to attain income convergence, and, in this sense, $w^{CT}$ can be treated as an income inequality indicator. Naturally, from a public policy perspective, the time necessary to achieve and overcome a given critical income level by both poor and rich families is rather important for inequality concerns. For example, when $w^{CT}$ in the economy is high relative to actual wages paid to (poorer) workers and economic conditions are unfavourable and do not improve, inequality may persist indefinitely. We develop a more detailed analysis of these issues below.

In sum, when $\sigma < \gamma$, the income growth rate $\frac{w_{t+1}}{w_t}$ is a strictly decreasing function of $w_t$ only if $w_t > w^{CT}$. Consequently, it is easier to achieve income convergence over time for lower values of $w^{CT}$ or for more rapidly increasing values of $w_t$. This dynamic analysis is similar to that in Glomm and Ravikumar (2003). However, our model’s extended analytical framework enables a richer analysis and a detailed consideration of political implications, as regards income inequality and public policy.

The role of public policy

Because in this paper we adopt a political economy perspective to study income inequality, the above discussed elements have important institutional implications to be considered. In particular, in order to illustrate the importance of public policy in the framework of our model, we can compare two countries with different characteristics as regards individual preferences for learning and the importance of parental heritage. More specifically, we consider country $A$ with $\gamma < \sigma$ and country $B$ with $\sigma < \gamma$.

As referred above, the relation $\gamma < \sigma$ implies that individual preferences on learning have a dominating role relative to parental income in a worker’s human capital accumulation. In this light, in country $A$ where parental heritage is less important (either for cultural, economic or other reasons), the role of
public policies implemented by the political elite is crucial, since individual learning choice is directly affected by the adopted fiscal and public education investment policies. In particular, as regards income inequality and economic growth concerns, these policies can either promote or discourage human capital accumulation and inequality can be either deepened or reduced. For example, as we will further show, the presence of political rivalry can discourage both the individual learning choice and public investments in human capital accumulation. The effect of fiscal and public education investment policies on inequality and growth will be positive only as long as taxation is nondistortionary, that is, there is no political rivalry.

Now consider country $B$ with $\sigma < \gamma$. In this case, human capital accumulation for families with lower parental income is more limited, and, we have seen above, there exists a critical income level, which further conditions the path of inequality evolution over time. Consequently, even more than in the previous case, for country $B$, fiscal and public education investments policies pursued by the political elite are primarily important. Securing efficient policies that would either lower the critical income level or improve economic environment so as to facilitate social mobility and accelerate achieving and overcoming $w^{CT}$, thus reducing inequality and promoting growth, becomes fundamental. And, as we will show in our comparative statics analysis, investing in public education can achieve both a lower $w^{CT}$ and a better economic environment. Indeed, when fiscal policy is directed towards human capital accumulation and is non-distortionary, inequality decreases and economic growth increases.

These implications for public policy resulting from the relation between income inequality and parameters $\gamma$ and $\sigma$ could also provide an interesting perspective and motivation for an empirical cross-country study.

3 Comparative statics analysis: effects of public investments and political rivalry

In our comparative statics analysis we will focus on the effects of the two endogenously derived policies, pursued by the elite, on the key variables of our model: the analysis in Section 3.1 is dedicated to the effects of public investments in human capital accumulation, while Section 3.2 focuses on the discussion of fiscal policy effects under conditions of political rivalry. The full expressions of all the derivatives presented in Sections 3.1 and 3.2 can be found in the Appendix.

3.1 Effects of public investments in human capital accumulation

One of the main objectives of our paper is to show that public investments in human capital accumulation are beneficial for economic growth and development and for reducing inequality. In fact, recalling expressions (5), (6), (7), (9) and (16), it can be verified that $\frac{\partial F(K^*,G)}{\partial E}$, $\frac{\partial w_{t+1}}{\partial E}$, $\frac{\partial H_{t+1}}{\partial E}$, $\frac{\partial (1-l)}{\partial E}$ are all positive and $\frac{\partial w^{CT}}{\partial E}$ is negative.

The intuition behind these results is the following. As it should be expected, higher investments in public education, $E$, stimulate the individual learning choice, $(1-l_t)$, since the availability of a better public education system in its complex nature (as specified in Section 2.2) is more appealing to the young.
population. That is, increasing investments in public education not only improves the instrument for human capital accumulation - public education, but also increases personal motivation to use it. Consequently, the stock of accumulated human capital, $H$, grows both directly with higher $E$ and with increased individual learning incentives. The endogenous growth theory classic effects of an increased human capital stock are further verified, i.e. higher worker productivity, wages and final output. Moreover, the inverse relation between $E$ and $w^C$ emphasized above implies that inequality is more easily overcome with public education investments, which serve as a social mobility promoter. This is particularly important in what regards vertical and inter-generational social mobility.

### 3.2 Effects of political rivalry

In this section, we will focus on political rivalry between the elite and other potentially politically powerful groups as a key factor distorting the implemented fiscal policy. More specifically, we will show that there is a strong negative impact of political rivalry on economic allocations and actions when goals pursued by the elite, instead of economic efficiency considerations, determine the policy choice. We divide the political rivalry effects into three groups: 1) equilibrium output, wages and elite transfer; 2) public investment in education, equilibrium schooling choice and human capital accumulation; and 3) critical income level and income inequality.

#### 3.2.1 Equilibrium output, wages, and elite transfer

As it should be expected, equilibrium output, (5), and wages, (6), decrease when taxes increase and our model in fact yields $\frac{\partial F(K^*, G)}{\partial \tau} < 0$ and $\frac{\partial w^t}{\partial \tau} < 0$. Since, as we have shown above, the tax rate corresponding to a political rivalry case is necessarily higher than the optimal, non-distortionary tax rate, and it is known in advance, it is straightforward that political rivalry has a direct negative impact on equilibrium output and wages. That is, anticipating a politically motivated excessive tax rate discourages the economic incentives of the middle class. Similarly, it also directly negatively affects the current income of the elite since for $\tau > 1 - \alpha$ we get $\frac{\partial T^e}{\partial \tau} < 0$. Nevertheless, recalling (12) and that $V^e(E) > V^e(M)$, the elite is willing to accept the trade-off between a decrease in their current tax income and an increase of the probability to remain in power, thus maintaining control over policy and preserving exclusive access to rents from human capital accumulation.

#### 3.2.2 Public investment in education, equilibrium learning choice and human capital accumulation

In Section 3.1 we have seen that an increase in the tax rate, ceteris paribus, increases the investments in public education, which increases the optimal learning choice. However, this positive result is verified only for $\tau < 1 - \alpha$ and is maximized at $\tau = 1 - \alpha$. Once political rivalry is introduced, it can be verified that investments in public education are negatively affected by further increases in the tax rate, i.e. $\frac{\partial E^t}{\partial \tau} < 0$ for $\tau > 1 - \alpha$. This happens because, under conditions of political rivalry, investments in public education are distorted, given that the amount corresponding to $\frac{1-\alpha}{\alpha} \cdot \frac{\xi}{\gamma}$ of collected tax revenues, $T^c_e$, is now lower,
since $\frac{\partial T_{e}}{\partial \tau} < 0$ for $\tau > 1 - \alpha$. This relation between $\tau$ and $E$ is of a particular importance given that, as mentioned in Section 3.1, public investments in education influence all variables in our model. Thus, when political pressure for redistribution and not economic considerations determine the policy choice, induced negative variations in public education investments are reflected in distorted values of the main economic variables.

Furthermore, an increase in the tax rate has a dual effect on the learning choice: a negative impact, both directly and via a decrease in the workers’ wage ($\frac{\partial w_{l}}{\partial \tau} < 0$), and a positive impact via an increase in public investments in education ($\frac{\partial E_{l}}{\partial \tau} > 0$ for $\tau < 1 - \alpha$). It can be verified that below a certain level of $\tau$ (inferior to $1 - \alpha$), the positive effect of increased public investments in education predominates and the individual learning choice is encouraged. However, increasing the tax rate beyond a certain level cancels out the positive public education investments effect and negatively affects individual learning choice, reducing potential human capital accumulation and future income and deepening income inequality. This is verified by the negative partial derivative of the optimal learning choice with respect to $\tau$, namely $\frac{\partial(1-l_{t})}{\partial \tau} < 0$ for $\tau > \frac{1}{\gamma(1-\alpha)+\alpha(\gamma+2)}$ and, thus, for $\tau > 1 - \alpha$.

This result presents two important conclusions. On the one hand, it indicates that even for values of $\tau$ inferior to the political rivalry level, increases beyond a certain point will discourage the optimal learning choice for young individuals and will condition potential human capital accumulation. Consequently, occurring episodes of political rivalry will severely aggravate these negative impacts. On the other hand, it shows that the parameters $\varsigma$ and $\gamma$ play an important role in determining the changes in the individual learning choice induced by changes in fiscal policy. More specifically, the closer the parameter $\varsigma$ is to 1, the closer the values of $\tau$, from which $\frac{\partial(1-l_{t})}{\partial \tau} < 0$ verifies, are to the optimal tax rate level, $\tau = 1 - \alpha$ and, consequently, the more it is possible to minimize $\frac{\partial(1-l_{t})}{\partial \tau} < 0$. Thus, even the negative impacts of increasing the tax rate above a certain level can in fact be attenuated by a higher importance of public education for human capital accumulation.\footnote{In its turn, the weight of parental income in human capital accumulation, $\gamma$, has an opposite effect. Namely, the closer the parameter $\gamma$ is to 1, the further the values of $\tau$, from which $\frac{\partial(1-l_{t})}{\partial \tau} < 0$ verifies, are from the optimal tax rate level, and, consequently, the effect of $\frac{\partial(1-l_{t})}{\partial \tau} < 0$ is amplified. Therefore, when excessive importance is attributed to parental income in what regards human capital accumulation, negative impacts on individual learning choice (and future human capital accumulation) can be caused even by small increases of the tax rate above a certain level.}

The effect of an increase in the output tax rate on human capital accumulation, $\frac{\partial H_{t+1}}{\partial \tau}$, is inferred by observing the effects on its constituting elements, $E_{l}$, $w_{l}$ and $1-l_{t}$. As it was shown above, $\frac{\partial E_{l}}{\partial \tau} < 0$ for $\tau > 1 - \alpha$, $\frac{\partial w_{l}}{\partial \tau} < 0$, and $\frac{\partial(1-l_{t})}{\partial \tau} < 0$ for $\tau > \frac{1}{\gamma(1-\alpha)+\alpha(\gamma+2)}$. Consequently, for certain values of $\tau$ (even below the political rivalry level), the effect of an increase in the output tax rate on human capital accumulation is negative, $\frac{\partial H_{t+1}}{\partial \tau} < 0$, and will be aggravated by the presence of political rivalry.

\footnote{Naturally, even when the role of public education is primarily important in human capital accumulation, the option of private investments, captured by parental income, should not be discarded. Families with higher incomes can always profit from their favourable conditions.}
3.2.3 Critical income level and income inequality

Excessive taxation generated by political rivalry also increases the critical income level, thus making it more difficult to achieve income convergence and prolonging income inequality over time:

$$\frac{\partial w_{CT}}{\partial \tau} > 0 \text{ for } \tau > \frac{(1-\alpha)}{\alpha+\varsigma} \text{ and implicitly for } \tau > 1 - \alpha.$$ 

The analysis of this result is similar to the analysis regarding the political rivalry impact on individual learning choice. In particular, the result obtained here indicates that even increases of $\tau$ below the political rivalry level but beyond a certain point will raise critical income and deepen inequality. These negative impacts will be severely aggravated by the presence of political rivalry. Similarly, the result of $\frac{\partial w_{CT}}{\partial \tau} > 0$ for $\tau > \frac{(1-\alpha)}{\alpha+\varsigma}$ shows that the perceived importance of public education determines the magnitude of changes in the critical income level induced by different fiscal policies. In particular, the closer the parameter $\varsigma$ is to 1, the closer the values of $\tau$, from which $\frac{\partial w_{CT}}{\partial \tau} > 0$ verifies, are to the optimal tax rate level, $\tau = 1 - \alpha$, which allows minimizing $\frac{\partial w_{CT}}{\partial \tau} > 0$. This means that even the negative impacts of increasing the tax rate above a certain level can in fact be attenuated by a higher importance attributed to public education in human capital accumulation.

4 Conclusions

In this paper, our research was directed towards first, studying the effects of political rivalry on the evolution of human capital accumulation and income inequality and, second, examining how different political incentives may affect the resulting policies and economic allocations.

Regarding our first research objective, we have found that occurring episodes of political rivalry reduce human capital accumulation through their negative impact on public investments in education, workers’ wages and individual learning choice, and increase income inequality, by decreasing wages, raising the critical income level and affecting the income growth rate.

As regards our second research objective, we have found that different political incentives have distinct effects on the resulting policies and economic allocations. When the incentives of the elite refer to elementary revenue extraction, it is in their interest to have a highly productive middle-class and increasing human capital accumulation, as this enables collecting higher output-tax and additional elite exclusive revenues. This determines the elite to choose non-distortionary fiscal policies with an optimal tax rate that does not generate political economy effects, i.e. inequality is not deepened and both human capital accumulation and economic growth are not distorted. Consequently, the resulting public education investments policy is non-distortionary, generating positive effects by motivating individual learning choice, increasing human capital accumulation, wages and final output, and also fighting inequality. In fact, public education investments can be used as a social mobility promoter (most importantly as regards vertical and inter-generational social mobility), enabling income convergence and overcoming inequality.

However, when there is a decoupling between economic and political power, goals pursued by the elite, instead of economic efficiency considerations, will determine the policy choice. In this case, the elite’s incentive to remain in power for the next period generates political rivalry. This political rivalry induces excessive taxation, which leads to an inefficient redistribution policy and reduces public education investments, both resulting in distortionary economic allocations and actions. Consequently, human capital accumulation and the associated positive growth effects are distorted, and inequality is deepened.
Also, we have shown that the public education investments and parental income parameters play an essential role in determining the next generation’s human capital accumulation, thus having relevant public policy implications especially under conditions of political rivalry. In particular, we have found that when excessive importance is attributed to parental income, negative impacts on individual learning choice and future human capital accumulation can be caused even by small increases of the tax rate above a certain level. A greater role of parental income also implies that human capital accumulation for families with lower parental income is more limited and a more uneven income distribution is more propense to deepening income inequality over time. On the contrary, when parental income is less important than a worker’s individual preferences regarding education, the availability of a publicly provided education offers a high potential for social mobility even for workers coming from a less favorable background. These results and conclusions provide an interesting perspective and motivation for empirical testing.

Moreover, we can also identify some venues for future research. For example, the skill biased technological change theory can provide a new approach to analysing the political rivalry effects on inequality and human capital accumulation through the composition of the labour force. In particular, depending on political distortions, economic growth can be biased towards a more or less skilled labour. We can also consider including population growth in the model, assuming that the increase in income, resulting from persistent human capital accumulation, could be devoted to raising more children. Another research possibility is to consider the growth rate of aggregate labour-augmenting productivity, as an endogenous variable interacting with human capital accumulation. Also, since parameters defining the importance of public investments in human capital, parental income and individual learning preferences are crucial for some of the results obtained in this paper, another future challenge could be to endogenize them, taking into account their determining factors and how they can be influenced by public policy.

References


Appendix

The appendix presents the full expressions of the partial derivatives of the key model variables with respect to public investments in education, $E_t$, and output tax rate, $\tau$, as follows:

1) \[ \frac{\partial(1-l_t)}{\partial E} = \frac{(1-\sigma)}{\gamma} E_t^{(1-\sigma)} \left( (1-\alpha) A_{t+1} w_t \left( \frac{\sigma - 1}{\alpha(1-\gamma)} \right) \right)^{(1-\sigma)} \left( 1+ \left( (1-\alpha) A_{t+1} w_t \left( \frac{\sigma - 1}{\alpha(1-\gamma)} \right) \right)^{(1-\sigma)} \right) \]

2) \[ \frac{\partial H_{t+1}}{\partial E} = \zeta E_t^{\gamma-1} \cdot w_t^{\gamma} \cdot (1 - l_t) + E_t^{\gamma} \cdot w_t^{\gamma} \cdot \frac{\partial(1-l_t)}{\partial E} \]

3) \[ \frac{\partial F(K^*, G_{t+1})}{\partial E} = A_{t+1} \cdot \left( \frac{\beta^{-1} + \delta - 1}{\alpha(1-\gamma)} \right)^{\frac{\gamma}{\alpha}} \cdot \frac{\partial H_{t+1}}{\partial E} \]

4) \[ \frac{\partial w_{t+1}}{\partial E} = (1 - \alpha) A_{t+1} \cdot \left( \frac{\beta^{-1} + \delta - 1}{\alpha(1-\gamma)} \right)^{\frac{\gamma}{\alpha}} \cdot \frac{\partial H_{t+1}}{\partial E} \]

5) \[ \frac{\partial E_t}{\partial \tau} = \frac{1}{\gamma} \gamma \cdot E_t^{-\frac{1}{\gamma}} \cdot \left( \frac{\sigma - \sigma}{\sigma(1-\gamma)} \right)^{\frac{\gamma}{\alpha}} \cdot \left[ (1 - \alpha) A_{t+1} \cdot \left( \frac{\beta^{-1} + \delta - 1}{\alpha(1-\gamma)} \right)^{\frac{\gamma}{\alpha}} \right]^{-\frac{1}{\gamma}} \]

6) \[ \frac{\partial F(K^*, G)}{\partial \tau} = -\frac{\alpha}{1-\alpha} A_t H_t \cdot (1 - \tau)^{-1} \cdot \left( \frac{\beta^{-1} + \delta - 1}{\alpha(1-\gamma)} \right)^{\frac{\gamma}{\alpha}} \]

7) \[ \frac{\partial T_t}{\partial \tau} = -\alpha A_t H_t \cdot (1 - \tau)^{-1} \cdot \left( \frac{\beta^{-1} + \delta - 1}{\alpha(1-\gamma)} \right)^{\frac{\gamma}{\alpha}} \]

8) \[ \frac{\partial E_t}{\partial \tau} = \zeta(1-\alpha) \cdot \frac{\partial E_t}{\partial \tau} \]

9) \[ \frac{\partial H_{t+1}}{\partial \tau} = \zeta E_t^{\gamma-1} \cdot w_t^{\gamma} \cdot (1 - l_t) + E_t^{\gamma} \cdot w_t^{\gamma} \cdot \frac{\partial(1-l_t)}{\partial E} \]

10) \[ \frac{\partial(1-l_t)}{\partial \tau} = \frac{1}{\gamma} \gamma \cdot E_t^{-\frac{1}{\gamma}} \cdot \left( (1-\alpha) A_{t+1} E_t^{\gamma} w_t \left( \frac{\sigma - 1}{\alpha(1-\gamma)} \right) \right)^{(1-\sigma)} \left( 1+ \left( (1-\alpha) A_{t+1} E_t^{\gamma} w_t \left( \frac{\sigma - 1}{\alpha(1-\gamma)} \right) \right)^{(1-\sigma)} \right) \]

11) \[ \frac{\partial E_t}{\partial \tau} = \frac{\partial E_t}{\partial \tau} \cdot w_t^{\gamma} \cdot (1 - l_t) + \frac{\partial w_{t+1}}{\partial \tau} \cdot E_t^{\gamma} \cdot (1 - l_t) + \frac{\partial(1-l_t)}{\partial \tau} \cdot E_t^{\gamma} \cdot w_t^{\gamma} \]

12) \[ \frac{\partial w_{t+1}}{\partial \tau} = \left[ \left( \frac{\gamma - \sigma}{\alpha(1-\gamma)} \right)^{\frac{\gamma}{\alpha}} \cdot \left( (1 - \alpha) A_{t+1} \cdot \left( \frac{\beta^{-1} + \delta - 1}{\alpha} \right)^{\frac{\gamma}{\alpha}} \right) \right]^{-\frac{1}{\gamma}} \cdot E_t^{\gamma} \cdot (1 - \tau)^{\frac{\gamma}{\alpha}} \cdot \left( \frac{\alpha(\gamma + 1)}{1-\alpha(\gamma + 1)} \right) \]
<table>
<thead>
<tr>
<th>No.</th>
<th>Authors</th>
<th>Title</th>
<th>Publication Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>465</td>
<td>Mariana Cunha and Paula Sarmento</td>
<td>Does Vertical Integration Promote Downstream Incomplete Collusion? An Evaluation of Static and Dynamic Stability</td>
<td>August 2012</td>
</tr>
<tr>
<td>464</td>
<td>Andreea Stoian and Rui Henrique Alves</td>
<td>Can EU High Indebted Countries Manage to Fulfill Fiscal Sustainability? Some Evidence from the Solvency Constraint</td>
<td>August 2012</td>
</tr>
<tr>
<td>463</td>
<td>João Correia-da-Silva and Joana Pinho</td>
<td>The profit-sharing rule that maximizes sustainability of cartel agreements</td>
<td>August 2012</td>
</tr>
<tr>
<td>462</td>
<td>Ricardo Biscaia and Paula Sarmento</td>
<td>Cost inefficiency and Optimal Market Structure in Spatial Cournot Discrimination</td>
<td>August 2012</td>
</tr>
<tr>
<td>461</td>
<td>Pedro Cosme Costa Vieira</td>
<td>A low cost supercritical Nuclear + Coal 3.0 Gwe power plant</td>
<td>August 2012</td>
</tr>
<tr>
<td>460</td>
<td>Duarte Guimarães, Ana Paula Ribeiro and Sandra Silva</td>
<td>Macroeconomic Fundamentals of Poverty and Deprivation: an empirical study for developed countries</td>
<td>May 2012</td>
</tr>
<tr>
<td>459</td>
<td>Vera Catarina Rocha</td>
<td>The Entrepreneur in Economic Theory: From an Invisible Man Toward a New Research Field</td>
<td>May 2012</td>
</tr>
<tr>
<td>457</td>
<td>Duarte N. Leite, Sandra T. Silva and Oscar Afonso</td>
<td>Institutions, Economics and the Development Quest</td>
<td>April 2012</td>
</tr>
<tr>
<td>456</td>
<td>Máario Alexandre Patrício Martins da Silva</td>
<td>The Knowledge Multiplier</td>
<td>April 2012</td>
</tr>
<tr>
<td>455</td>
<td>Sara Santos Cruz and Aurora A. C. Teixeira</td>
<td>Methodological approaches for measuring the creative employment: a critical appraisal with an application to Portugal</td>
<td>April 2012</td>
</tr>
</tbody>
</table>

Editorial Board [wps@fep.up.pt](mailto:wps@fep.up.pt)

also in [http://ideas.repec.org/PaperSeries.html](http://ideas.repec.org/PaperSeries.html)