Documentos de Trabalho

Working Paper Series

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NIPE WP 16/ 2018

NÚCLEO DE INVESTIGAÇÃO EM POLÍTICAS ECONÓMICAS
UNIVERSIDADE DO MINHO

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URL:
http://www.nipe.eeg.uminho.pt/

«This work was carried out within the funding with COMPETE reference nº POCI-01-0145-FEDER-006683 (UID/ECO/03182/2013), with the FCT/MEC's (Fundação para a Ciência e a Tecnologia, I.P.) financial support through national funding and by the ERDF through the Operational Programme on "Competitiveness and Internationalization – COMPETE 2020 under the PT2020 Partnership Agreement»

Optimal policies, middle class development and human capital accumulation under elite rivalry

Elena Sochirca* and Pedro Cunha Neves†

Abstract

We build a dynamic model with endogenous middle class development, human capital accumulation and policy choices, in order to analyse the interactions between the optimal policies implemented by the rulling elite and the key drivers of economic growth in the presence of elite rivalry. We consider that: (i) the specific policy choices depend on economic and political incentives of the elite; (ii) the individuals' decisions regarding their childrens' education are endogenously determined by specific economic and political factors. Our results suggest that, contrarily to the economically motivated policies, the politically motivated policy choices imply inneficient economic outcomes and limit the development of the middle class and human capital accumulation. The results also show that higher middle class and human capital accumulation growth rates can lower the degree of elite rivalry by reducing the level of the optimal tax rate, increase public investments in education and yield positive changes in all economic outcomes.

1 Introduction

Successful economic performance has been traditionally associated with the implementation of a spectrum of supply- and demand-oriented policies, designed to support the key sectors of economic activity and provide a strong foundation for sustainable economic growth. The vast experience gathered from numerous countries shows that physical and human capital accumulation, middle class development and implementation of

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efficient growth-enhancing policies are fundamental economic and social factors contributing to this objective. These factors, on their turn, are crucially determined by the establieshed economic and socio-political environment.

In this paper we examine the interaction between middle class development, human capital accumulation and policy choices in the presence of elite rivalry. Regarded as a negative form of political competition, elite rivalry is generally associated to (both economic and political) competition for power between the political elite and other political groups, aimed at keeping the rulling elite in office and in control for as long as possible. In this case, policy choices are determined by the goals pursued by the political elite and not by the general interest or by economic efficiency considerations, compromising long-term investments and leading to poor aggregate economic performance (see, for example, Alesina & Rodrik, 1992, Alesina & Perotti, 1994, Dixit & Londregan, 1995, Acemoglu & Robinson, 2006, Acemoglu, 2006, Sochirca *et al.*, 2017).

In particular, we analyse the two-way relationship between elite rivalry and two major growth engines - middle class development and human capital accumulation. First, we want to see how the presence of elite rivalry conditions the growth of the middle class and the accumulation of human capital. Second, we examine in what way higher growth rates of middle class and human capital influence the economic and political inefficiencies generated by the presence of elite rivalry; we also identify the factors which, in our analytical framework, can determine the magnitude of that influence.

With this objective, we develop a dynamic model with endogenously determined human capital accumulation, demographic changes and policy choices. The main features of the model are based on both previous theoretical research and recent empirical evidence on the relationship between institutions, middle class and economic growth. The analytical framework builds on the model in Sochirca *et al.* (2017), in which elite rivalry translates into excessive increases in the tax rate (as in, e.g., Acemoglu, 2006, 2009). In the present model, we enrich the setup by specifically considering that changes in demographic structure are endogenously determined. They are defined, on the one hand, by the endogenous individual decisions regarding the offspring level of education and, on the other hand, by the policies endogenously determined by the rulling elite. The resulting demographic structure will then define the elite's probability to maintain control of politics. Endogeneising demographic structure together with educational and policy choices allows us to analyse the above-referred important aspects of the interaction between middle class development, human capital accumulation and policy choices in the presence of elite rivalry.

From an empirical perspective, the analysis performed in this paper is relevant essentially for two main reasons. First, existing data show that, although the middle class growth has slowed down in the developed

countries, it has been increasingly more intensive in emerging economies (Kharas, 2010; Young, 2013; Summers, 2016; Milanovic, 2016), including some of the most populous countries in the world, such as China, India and Brazil.[1] This implies that the share of the middle class in the world population is increasing considerably. Our theoretical model provides the analytical framework for determining some of the implications of this globally important process. Second, existing empirical data is not clear on how higher growth rates of the middle class interact with policy efficiency, especially in what regards public goods provision (Loayza *et al.*, 2012; Desai, 2015; Birdsall, 2015; Kharas, 2017). Our theoretical model allows examining this interaction as well.

The obtained results suggest that in the presence of elite rivalry, i.e. in a situation of politically motivated excessive tax rates, production and human capital accumulation are discouraged, the incentives for educating children are reduced and, consequently, the development of the middle class is limited. These negative effects are aggravated with the increase in the degree of elite rivalry. Our results also suggest that increases in the growth rates of the middle class and human capital accumulation have an overall positive effect on the economy, as they contribute to lowering the degree of elite rivalry and reducing policy inefficiencies in the medium-long term. The magnitude of this effect tends to depend positively both on the fraction of tax revenues that the political elite invests in public education and on the these investments' effectiveness in reducing the individual cost of educating children.

The structure of this paper is the following. In Section 2 we present the model settings and derive equillibrium output, wages, human capital accumulation, endogenous demographic changes and the optimal policies of the rulling elite. In Section 3 we derive and discuss the results regarding the interaction between optimal policies, the size of the middle class and human capital accumulation in the presence of elite rivalry. The conclusions are summarized in Section 4.

2 Model settings

We develop a dynamic model with human capital accumulation and demographic changes in a two-sector economy. The population consists of three classes of agents: unskilled workers, skilled workers, and the

[1] The middle class is generally growing in the developing countries, but the numbers are particularly high in Asia, where it is estimated to come to represent two-thirds of the global middle class population by year 2030. On the contrary, in the developed north-american and european economies, the middle class is large but stagnating (Kharas, 2017).

political elite. Given the traditionally observed strong association between the level of human capital and social-class membership, we consider that the skilled workers constitute the middle class (see, for example, Doepke & Zilibotti, 2005; Doepke & Zilibotti, 2008; Goldthorpe & McKnight, 2004; Lopez-Calva & Ortiz-Juarez, 2011).[2] We denote each group by U, M and P, respectively, and assume that each has a discount factor equal to $\beta \in (0,1)$.

The final good, Y, is produced by two substitute technologies - the skilled and unskilled productive activities, respectively. While both types of workers participate in (exclusively) either skilled or unskilled production, we assume that the role of the elite in the economy is purely political. More specifically, the elite holds the political power in the society, makes specific policy choices, and is not directly involved in the production of the final good. We also assume that, in each period, skilled and unskilled workers are differentiated by the human capital stock they accumulate. The latter depends, on the one hand, on their parents' choice regarding their education and, on the other hand, on the policies adopted by the political elite. Demographic changes in our model are then defined by the endogenous changes in the relative size of the skilled workers' group, under the influence of specific political and economic factors. Our model thus endogenously links political choices, demographic transformations and economic growth.

2.1 Productive activities and wages

Two substitute technologies can be used for producing the final good - the unskilled technology employing unskilled workers, and the skilled technology employing skilled (i.e. middle-class) workers. The output for each technology, Y^u and Y^m, is given by:

$$Y_t^u = (K_t^u)^\alpha (U_t)^{(1-\alpha)} \tag{1}$$

$$Y_t^m = (K_t^m)^\alpha (H_t \cdot M_t)^{(1-\alpha)} \tag{2}$$

where the upper-scripts u and m refer to the unskilled and the skilled production technology, respectively. As equations (1) and (2) show, each production technology uses technology-specific physical capital, K_t^u or K_t^m, and unskilled or skilled labour, given by the amount U_t and M_t, respectively. Additionally, the skilled-technology production is augmented by the level of human capital, H_t, accumulated by the middle class. The shares of physical capital and labour in production are given by α and $1-\alpha$, respectively.

[2] Thus, throughout the paper we use the terms "skilled workers" and "middle class" as synonimous.

We assume that the model starts with a working population $U_0 > 0$ and $M_0 > 0$, and that at each t the output tax rate, τ_t, applied for raising state revenues, and the capital stocks, K_t^u and K_t^m, used in final-good production, are endogenously determined in $t-1$. Taxes are progressive in the sense that they are applied only to the final good produced by the skilled workers. Thus, in each t, a fraction τ_t of the skilled production, Y_t^m, is collected as tax revenues by the political elite.

Denoting by $k^i \equiv \frac{K^i}{G^i}$ the capital stock *per* unit of human capital (for $i = u, m$ and $G^u = U_t$ and $G^m = H_t M_t$), equations (1) and (2) can be written in the intensive form, $y^i \equiv f(k^i) = (k^i)^\alpha$. Following Acemoglu (2009), we assume that taxes are set and announced by the elite before the production decisions on the capital stocks and the amount of labour are taken,[3] and derive the optimal capital stock *per* unit of human capital for the unskilled and skilled technology:[4]

$$k^{u*} = \left(\frac{\beta^{-1} + \delta - 1}{\alpha}\right)^{\frac{1}{\alpha-1}} \tag{3}$$

$$k^{m*} = \left(\frac{\beta^{-1} + \delta - 1}{\alpha(1-\tau_t)}\right)^{\frac{1}{\alpha-1}} \tag{4}$$

Then, the technology-specific net output can be written as:

$$Y_t^u = U_t \cdot \left(\frac{\beta^{-1} + \delta - 1}{\alpha}\right)^{\frac{\alpha}{\alpha-1}} \tag{5}$$

$$Y_t^m = (1-\tau_t) \cdot H_t \cdot M_t \cdot \left(\frac{\beta^{-1} + \delta - 1}{\alpha(1-\tau_t)}\right)^{\frac{\alpha}{\alpha-1}} \tag{6}$$

From expressions (4) and (6) we can see that the tax rate reduces the output of the skilled workers in two ways. On the one hand, it implies that a part of output will be transferred to the state; on the other hand, it lowers the incentives to employ higher levels of k^m.

Assuming competitive labour markets, both unskilled and skilled workers are paid their marginal product for the labour they supply (inelastically) to produce the final good. Accounting for the above derived capital

[3] As we will show in Subsection 2.3, the output tax is endogenously determined depending on the specific incentives of the political elite.

[4] We also consider that in each period t a fraction δ of capital depreciates.

stocks *per* unit of human capital, (3) and (4), wages at time t for unskilled and skilled workers are given by:

$$w_t^u = (1-\alpha) \cdot \left(\frac{\beta^{-1} + \delta - 1}{\alpha} \right)^{\frac{\alpha}{\alpha-1}} \tag{7}$$

$$w_t^m = (1-\tau_t) \cdot (1-\alpha) \cdot H_t \cdot \left(\frac{\beta^{-1} + \delta - 1}{\alpha(1-\tau_t)} \right)^{\frac{\alpha}{\alpha-1}} \tag{8}$$

Given the negative effect of τ on the skilled-technology output, it is straightforward that the tax rate will also have a negative impact on the wages of skilled workers, as shown in equation (8).

2.2 Human capital accumulation and demographic change

Each skilled worker's human capital stock at time $t+1$ results from both private and public resources, which were devoted to its accumulation in the previous period. In particular, the knowledge or the human capital accumulation function, H_{t+1}, is given by:[5]

$$H_{t+1} = w_t^{\gamma} E_t^{\phi} \tag{9}$$

Equation (9) shows that the accumulation of human capital depends, on the one hand, on the amount of parental income invested in children's education, w^{γ}, and, on the other hand, on the public investments in education by the political elite, E_t^{ϕ}. Referring to any government expenditures aimed at improving educational quality and infrastructure, and at providing equality of access and opportunity, E_t is determined by a proportion of tax revenues collected by the elite from the skilled productive activities. Parameters $\gamma \in (0,1)$ and $\phi \in (0,1)$, defining the corresponding contributions of private and public investments to human capital accumulation, are assumed exogenous.

Moreover, the aggregate amount of human capital will also depend on the dimension of the middle class, who in fact are the ones accumulating knowledge in the economy. On its turn, the dimension of the middle class is determined by the parents' decisions on whether their children will become skilled *or* unskilled workers; and this choice depends on the additional effort that parents are willing to make in order to educate their offspring.

Following Barro & Becker (1989)and Acemoglu (2009),[6] we consider that a representative individual's

[5] Similar specifications for the human capital accumulation function (based on empirical evidence) can be found in Lucas, 1988; Card & Krueger, 1992;Meghir & Palme, 2005; Carneiro *et al.*, 2010; Sochirca *et al.*, 2017.

[6] Extensions of the fertility choice model in Barro & Becker (1989) can be found, for example, in Tamura (1996) and Strulik (2004).

life-time utility depends on three main factors: own consumption; the number of children and their future income, determined by their level of education; and the costs of rearing children to be skilled *versus* unskilled workers.[7] Formally, the utility function of a representative individual in t can be written as:[8]

$$c_t^{\beta}\left[w_{t+1}\cdot n_{t+1}-\frac{1}{2}\left(\varphi_0\cdot(1-e_t)+\varphi_1\cdot H_{t+1}\cdot e_t\right)\cdot n_{t+1}^2\right] \tag{10}$$

where c_t is the (discounted) consumption of the final good by the individual, n_{t+1} is the number of reared children in t,[9] w_{t+1} is their income in $t+1$,[10] φ_0 and φ_1 are parameters related to the costs of having unskilled and skilled children respectively, and e_t is the effort exerted for educating children. The cost of having unskilled children, φ_0, is fixed and here normalized to 1. The cost of having skilled children is assumed to be directly proportional to the level of human capital, H_{t+1}, necessary for working with the skilled production technology, and inversely proportional to the investments in public education, such that $\varphi_1=(\xi E_t)^{-1}$. This captures the idea that public investments in education can reduce the private burden of educational costs, which is particularly relevant for the unskilled parents who decide to educate their children (and, being more financially constrained than the skilled parents, are more dependent on public investments in education).[11] We also consider that, regardless of the human capital level in the economy, raising skilled children is more costly than raising unskilled children. That is, $\varphi_1>\varphi_0$, which implies that $\xi E_t<1$.

A representative individual can exert either the effort $e_t=0$ or $e_t=1$, that is, she can decide to have unskilled or skilled children, respectively.[12] The optimal number of offspring is then determined by maximizing the individual utility function. With c_t^{β} normalized to 1 and recalling equations (7) and (8), the optimal number of unskilled and skilled children will be given by:[13]

$$n_{t+1}^u=(1-\alpha)\cdot\left(\frac{\beta^{-1}+\delta-1}{\alpha}\right)^{\frac{\alpha}{\alpha-1}} \tag{11}$$

[7] Henceforth, we will refer to rearing children to become skilled or unskilled workers, simply as having skilled or unskilled children.

[8] The cost of having children (who will become either skilled or unskilled workers) is also assumed to be convex in order to reflect the idea that the cost of raising an additional child is increasing in the number of children.

[9] Note that the number of children in period t is denoted with the subscript $t+1$ to reflect the idea that they will determine the adult population in $t+1$.

[10] That is, when they become either skilled or unskilled workers.

[11] See, for example, Banerjee & Newman, 1993; Galor & Moav, 2004; Foellmi & Oechslin, 2008

[12] This dichotomic presentation of the exerted effort is a simplification adopted in order to keep the model analytically treatable. In reality, this effort is continuous and the distinction between a skilled and an unskilled worker in some cases may not be so clear. For example, a more detailed modelling approach could assume that there exists a threshold below which workers are considered to be unskilled.

[13] Note that, similarly to production decisions, the optimal number of skilled children, n_{t+1}^m is decided after observing the tax rate announced by the elite for the next period, τ_{t+1}.

$$n_{t+1}^{m} = (1-\tau_{t+1}) \cdot (1-\alpha) \cdot \xi E_t \cdot \left(\frac{\beta^{-1} + \delta - 1}{\alpha(1-\tau_{t+1})} \right)^{\frac{\alpha}{\alpha-1}} \tag{12}$$

As equations (11) and (12) show, contrarily to the optimal number of unskilled children, n_{t+1}^{u}, the optimal number of skilled children, n_{t+1}^{m}, depends on the elite's fiscal and public education policies, τ and E . Note that n_{t+1}^{m} will determine M_{t+1}, i.e. the size of the middle class (the number of skilled workers) in $t+1$, and, together with n_{t+1}^{u}, the pattern of demographic change. Thus, the size of the middle class and the demographic changes will also be endogenously affected by the elite's policy choices regarding τ and E. In the following sections we discuss in more detail various implications of specific policies implemented by the elite.

2.3 Optimal policy and elite rivalry

A key objective of this paper is to analyse whether the elite's optimal policy choices depend on the development of the middle class and human capital. Therefore, in this section we derive the optimal policies implemented by the elite, keeping in mind the discussion and results from Section 2.2.

When deriving the optimal policy, a fundamental question is to distinguish the type of incentives, i.e. economic or political, which will define the elite's optimal choice. Different incentives will lead to specific policy choices with different outcomes in terms of economic efficiency (Alesina & Rodrik, 1992; Persson & Tabellini, 1992; Dixit & Londregan, 1995; Rodrik, 1999; Acemoglu & Robinson, 2001; Acemoglu, 2006). On the one hand, policies based primarily on economic considerations should improve economic performance and promote economic growth. In the framework of our model, such policies are expected to strengthen the middle class, contribute to human capital accumulation, and increase the final output (and wages) produced by skilled workers. Such policies will also benefit the elite, enabling them to collect higher tax revenues. On the other hand, policies based primarily on political incentives will have a negative impact on the key economic outcomes. This may happen when a stronger middle class is perceived by the elite as a direct threat to its political dominance, implying that concerns about keeping political power in the future will predominate over economic efficiency considerations. In such political economy context, elite rivalry effects will be generated. We consider each of these two scenarios, i.e. the absence and the presence of elite rivalry, and derive the elite's optimal policy choice for each scenario.

The fiscal policy of the elite is defined by the choice of the tax rate, $\tau_t \in (0,1)$, and of public investments in education, E_t. The latter are given by the fraction θ of the collected tax revenues. Given that the parameter $\theta \in (0,1)$ is assumed exogenous in the model, the elite's choice of E_t is conditioned by the previously chosen

τ_t, which determines the amount of tax revenues that the elite will collect. Therefore, in this section, we focus on the derivation of the optimal fiscal policy, τ. We leave the discussion of the fiscal policy effects on public investments in education and on the main economic outcomes for Section 3.

As in Sochirca *et al.* (2017), we consider that every period t, the elite maximizes the current value of its revenues net of expenses, and, in the presence of political incentives, also the endogenous probability of remaining in power in the next period. Formally, we can write the maximization problem of the elite when choosing the tax rate τ_t as:

$$V^p(P) = \max_{\tau_t} \{T_t^p - E_t + \beta \left[(1 - \rho_t(\tau_t))V^p(P) + \rho_t(\tau_t)V^p(M)\right]\} \tag{13}$$

where:

i)$V^p(P)$ and $V^p(M)$ represent the utility of the elite when itself and the middle class, respectively, hold the political power, such that $V^p(P) - V^p(M) > 0$;[14]

ii) T_t^p represents the tax revenues of the elite, given by:

$$T_t^p = \tau_t \cdot H_t \cdot M_t \left(\frac{\beta^{-1} + \delta - 1}{\alpha(1 - \tau_t)}\right)^{\frac{\alpha}{\alpha - 1}} \tag{14}$$

iii) E_t represents the public expenditures in education, corresponding to:

$$E_t = \theta \cdot T_t^p \tag{15}$$

iv) $\rho_t(\tau_t)$ is the probability that the elite loses political power to the middle class in period t. In this paper, the probability $\rho_t(\tau_t)$ is endogenous, and given by:

$$\rho_t(\tau_t) = \frac{n_t^m}{n_t^u} = \xi E_{t-1} \left(1 - \tau_t\right)^{\frac{1}{1-\alpha}} \in [0, 1] \tag{16}$$

As equation (16) shows, the probability of political power shifting from the elite to the middle class in period t is given by the ratio between the optimal numbers of skilled and unskilled children in $t-1$. Recalling that this ratio determines the middle class and the unskilled workers groups in period t,[15] this probability specification captures the idea that the likelihood of the elite to lose power in t increases with the relative size of the middle class. Moreover, given that both n_t^m and n_t^u depend on the respective future wages (see the

[14]Given that in each individual period t the positive difference between $V^P(P)$ and $V^P(M)$ can not be excessive, we consider that $V^P(P) - V^P(M) < 1$.

[15]See footnote 12.

derivation of equations (11) and (12)), ρ_t also implicitly depends on the economic power of the middle class. Thus, as the middle class becomes larger and more powerful, the probability that the elite will be removed from power increases.

Equation (16) also illustrates how the policy choices of the elite influence the likelihood of maintaining political control. On the one hand, a higher current tax rateτ_t lowers ρ_t, as it allows the elite to limit both the number and economic power of skilled workers in period t (see equations (8) and (12)). On the other hand, higher public investments in education in the past, E_{t-1}, represent a threat to the elite's control of political power, given that a higher E_{t-1} both increases the skilled workers' wages and reduces the cost of rearing skilled children, thus contributing to a higher n_t^m.

Optimal policy choice in the absence of elite rivalry

In the absence of elite rivalry, the elite is not concerned with the future distribution of political power when choosing the optimal tax rate. That is, $\frac{\partial \rho_t}{\partial \tau_t} = 0$ in the maximization problem (13) and thus the first order condition is given by:

$$\frac{\partial V_t^p(\cdot)}{\partial \tau_t} = \frac{\partial T_t^p}{\partial \tau_t} - \frac{\partial E_t}{\partial \tau_t} = 0$$

Considering equations (14) and (15), the above first order condition yields the following optimal solution for the output tax in period t:

$$\tau_t^* = 1 - \alpha \tag{17}$$

This level of τ maximizes the elite's revenues in period t, as it corresponds to taxing at the peak of the Laffer curve. The elite will not choose a lower value of τ because in this case it would lose part of potentially available revenues. Also, the elite will not choose a higher τ, since it would considerably reduce production and, consequently, the tax base.

Given that the tax rate $\tau = 1 - \alpha$ is chosen subject to economic and not political considerations of the elite, it also does not generate economic inefficiencies.[16]

Optimal policy choice in the presence of elite rivalry

In the presence of elite rivalry, the elite cares about the probability of losing political power and uses fiscal policy to influence ρ_t. In this case, the first order condition becomes:

[16] For a more detailed discussion of this result, see Acemoglu (2006) and Sochirca *et al.* (2017).

$$\frac{\partial V_t^p(\cdot)}{\partial \tau_t} = \frac{\partial T_t^p}{\partial \tau_t} - \frac{\partial E_t}{\partial \tau_t} - \beta \frac{\partial \rho_t}{\partial \tau_t} \left[V^p(P) - V^p(M) \right] = 0$$

where $\frac{\partial T_t^p}{\partial \tau_t}$, $\frac{\partial E_t}{\partial \tau_t}$ and $\frac{\partial \rho_t}{\partial \tau_t}$ are calculated based on equations (14), (15) and (16). This yields the following expression for the optimal output tax rate under elite rivalry, τ_t^{ER}:

$$\tau_t^{ER} = 1 - \alpha + \frac{\alpha \cdot \frac{\theta}{1-\theta} \cdot \xi \cdot \left(\tau_{t-1} \cdot (1 - \tau_{t-1})^{\frac{\alpha}{1-\alpha}} \right) \cdot \beta \left[V^p(P) - V^p(M) \right] \cdot (1 + g_t^H)^{-1} \cdot (1 + g_t^M)^{-1}}{1 + \frac{\theta}{1-\theta} \cdot \xi \cdot \left(\tau_{t-1} \cdot (1 - \tau_{t-1})^{\frac{\alpha}{1-\alpha}} \right) \cdot \beta \left[V^p(P) - V^p(M) \right] \cdot (1 + g_t^H)^{-1} \cdot (1 + g_t^M)^{-1}} \tag{18}$$

Denoting by $\Upsilon_t \equiv \frac{\theta}{1-\theta} \cdot \xi \cdot \left(\tau_{t-1} \cdot (1 - \tau_{t-1})^{\frac{\alpha}{1-\alpha}} \right) \cdot \beta \left[V^p(P) - V^p(M) \right] \cdot (1 + g_t^H)^{-1} \cdot (1 + g_t^M)^{-1}$, equation (18) can be rewritten as:

$$\tau_t^{ER} = 1 - \alpha + \frac{\alpha \cdot \Upsilon_t}{1 + \Upsilon_t} \tag{19}$$

Inspecting equations (18) and (19), the following three results can be highlighted. First, given that $0 < \frac{\alpha \cdot \Upsilon_t}{1+\Upsilon_t} < 1$, the optimal tax rate set in elite rivalry conditions is strictly higher than the optimal tax rate without elite rivalry, $\tau = 1 - \alpha$. This by itself is not a new result, as the same was verified in Acemoglu (2006) and Sochirca *et al.* (2017). The intuition for this is simple and is related to the fact that the elite will tax above the economically efficient level of $1 - \alpha$ in order to weaken the middle class and increase the probability of remaining in power.

Second, expression (18) is a non-linear non-homogenous difference equation, in which τ^{ER} in t depends on τ^{ER} in $t - 1$, a result that is new. This implies that there is an inter-temporal coherence in the elite's fiscal policy, given that the elite must consider the tax rate applied in the previous period in order to set the optimal tax rate in the current period. In fact, this is a rather usual policy-making practice in most countries, as policy-makers will consider the last period's tax rate when fixing or adjusting the tax rate for the next period.

Third, the optimal tax rate in each t depends on the growth rates of human capital accumulation and of the middle class, g_t^H and g_t^M, both endogenous in our model. This is also a new result. Thus, the current analytical framework allows us, not only to examine how the elite's optimal policy choices affect economic performance and outcomes, but also to analyse how the optimal policies are themselves influenced by the engines of endogenous economic growth. We will discuss these interactions in more detail in the next section.

3 Interaction between optimal policies, the middle class and human capital accumulation under elite rivalry: results and discussion

In this section we discuss how economic growth, driven by human capital accumulation and the development of the middle class, and policies implemented by the elite interact in a context of elite rivalry. In particular, in Section 3.1 we consider the effects of fiscal policy on the key variables of the model in a context of elite rivalry. In Section 3.2 we analyse the reverse causality effects, that is, how the policies implemented under elite rivalry change when the middle class becomes stronger and the level of human capital in the economy increases.

3.1 Policy effects on economic outcomes under elite rivalry

We summarize in *Proposition 1* the effects of fiscal policy on economic outcomes under elite rivalry:

Proposition 1: *A higher tax rate under elite rivalry will reduce the tax revenues collected by the elite, T^p, the amount of public investments in education, E , the wages of the middle class, w^m, human capital accumulation, H, and the number of skilled children, n^m .*

The proof for this proposition is verified by the partial derivatives of T_t^p, E_t, w_t^m, H_{t+1} and n_t^m with respect to τ_t.[17] Using equations (14), (15), (8), (9) and (12), the partial derivatives are:

$$\frac{\partial T^p}{\partial \tau} = H \cdot M \cdot \left(\frac{\beta^{-1}+\delta-1}{\alpha(1-\tau)}\right)^{\frac{\alpha}{\alpha-1}} \cdot \left(1 - \frac{\alpha\tau}{(1-\alpha)(1-\tau)}\right)$$

$$\frac{\partial E}{\partial \tau} = \theta \cdot H \cdot M \cdot \left(\frac{\beta^{-1}+\delta-1}{\alpha(1-\tau)}\right)^{\frac{\alpha}{\alpha-1}} \cdot \left(1 - \frac{\alpha\tau}{(1-\alpha)(1-\tau)}\right)$$

$$\frac{\partial w^m}{\partial \tau} = -H_t \cdot \left(\frac{\beta^{-1}+\delta-1}{\alpha(1-\tau_t)}\right)^{\frac{\alpha}{\alpha-1}}$$

$$\frac{\partial H}{\partial \tau} = \phi \cdot E^{\phi-1} \cdot \frac{\partial E}{\partial \tau} \cdot (w^m)^{\gamma} + \gamma \cdot (w^m)^{\gamma-1} \cdot E^{\phi} \cdot \frac{\partial w^m}{\partial \tau}$$

[17] To simplify the notation, the index t will be dropped from the expressions presented in this section.

$$\frac{\partial n^m}{\partial \tau} = -\xi E \cdot \left(\frac{\beta^{-1} + \delta - 1}{\alpha(1-\tau)} \right)^{\frac{\alpha}{\alpha-1}}$$

It is easy to see that all these partial derivatives are negative for any $\tau > 1 - \alpha$. This implies that, in the presence of elite rivalry, tax revenues, public investments in education, middle-class wages, human capital accumulation, and the number of skilled children will be strictly lower than in the absence of elite rivalry, since $\tau^{ER} > 1 - \alpha$.

The intuition for these results is the following. Increasing the tax rate above the level of $\tau = 1 - \alpha$ will reduce the tax revenues collected by the elite, since in this case they will be taxing beyond the peak of the Laffer curve. Nevertheless, the elite still prefers a higher tax because this decreases their probability of being removed from power. The negative effect on public investments in education (which represent an exogenous fraction of the collected tax revenues) is then straightforward. Because higher tax rates lower the production incentives and output for the skilled-technology, they will also reduce the middle-class wages. On their turn, lower public investments in education and wages - both employed to invest in human capital - will reduce the accumulation of knowledge in the economy. Finally, higher taxes also lower the number of skilled children and the size of the middle class - on the one hand, rearing a skilled child becomes more costly due to lower public investments in education; on the other hand, the expected return to skilled labour in the future will be reduced due to the decrease in middle-class wages. Thus, educating children will be economically less attractive.

Taking into account that skilled labour and human capital accumulation are the main forces that drive aggregate production (see equations (1) and (2)), taxes increased by the presence of elite rivalry will negatively affect economic growth.

3.2 Effects of the middle-class and human capital growth rates on optimal policy under elite rivalry

Having examined how the elite's optimal choice of the tax rate affects their investments in education and the key economic outcomes, we now turn to the reverse causality analysis.

Recall that the optimal tax rate under elite rivalry, τ^{ER}, is given by the non-linear non-homogeneous difference equation (18). Here, we are not interested in finding a classical difference equation solution, that

is, in obtaining an expression for the tax rate τ^{ER} as a function of t. Instead, we are interested in analysing the behaviour of τ^{ER} with respect to the endogenous factors that define it, *i.e.* the growth rates of the middle class and of human capital accumulation. We divide this analysis in two parts: first, we will analyse the effects of the two growth rates on the optimal fiscal policy and, second, we will analyse their effects on the elite's public investments in education.

3.2.1 Effects on the optimal fiscal policy, τ^{ER}

We state in *Proposition 2* the effects of g^M and g^H on the optimal fiscal policy.

Proposition 2: *Higher growth rates of middle class and of human capital accumulation, g^M and g^H , will reduce the level of the optimal tax rate set by the elite in the presence of elite rivalry.*

This analysis is performed for the steady-state level of τ^{ER}, i.e. considering in equation (18) that $\tau^{ER} \equiv \tau_t = \tau_{t-1}$. Consequently, (18) becomes an implicit equation and thus, to take the partial derivatives of τ^{ER} with respect to g^M and g^H, we use the implicit function theorem. Let us define $F(\cdot)$ as:

$$F(\cdot) = \tau^{ER} - (1-\alpha) - \frac{\alpha \cdot \Upsilon(\tau^{ER})}{1+\Upsilon(\tau^{ER})} \tag{20}$$

with $\Upsilon(\tau^{ER}) \equiv \frac{\theta}{1-\theta} \cdot \xi \cdot \left(\tau^{ER} \cdot (1-\tau^{ER})^{\frac{\alpha}{1-\alpha}}\right) \cdot \beta \left[V^p(P) - V^p(M)\right] \cdot (1+g^H)^{-1} \cdot (1+g^M)^{-1}$ (see equation (18))

By the implicit function theorem, we have that $\frac{\partial \tau^{ER}}{\partial g^j} = -\frac{\partial F(\cdot)/\partial g^j}{\partial F(\cdot)/\partial \tau^{ER}}$ (where $j = H,\ M$).

Taking the respective partial derivatives yields:

$$\frac{\partial F(\cdot)}{\partial \tau^{ER}} = 1 - \frac{\alpha \cdot \Upsilon \cdot \left(\frac{1-\alpha-\tau^{ER}}{(1-\alpha)(1-\tau^{ER})}\right)}{\tau^{ER}(1+\Upsilon)^2} > 0, \; given\; that\; \tau^{ER} > 1-\alpha$$

$$\frac{\partial F(\cdot)}{\partial g^H} = \frac{\alpha \cdot \Upsilon}{(1+g^H)(1+\Upsilon)^2} > 0$$

$$\frac{\partial F(\cdot)}{\partial g^M} = \frac{\alpha \cdot \Upsilon}{(1+g^M)(1+\Upsilon)^2} > 0$$

Thus, from the implicit function theorem, we can infer that $\frac{\partial \tau^{ER}}{\partial g^H} = -\frac{\oplus}{\oplus} < 0$ and $\frac{\partial \tau^{ER}}{\partial g^M} = -\frac{\oplus}{\oplus} < 0$.

This means that the optimal tax rate tends to be lower when the middle class and human capital grow rapidly. In fact, when the key drivers of aggregate production are growing at higher rates, the skilled-technology production is more intensive. During this phase, the tax base in the economy also grows more intensively, which enables the elite to collect higher tax revenues. These will increase even more if the elite reduces the tax rate.[18] This represents a strong economic incentive for the elite, which, in this specific context, will prevail over its political interests. In fact, when the tax rates are initially high, i.e. when$\tau = \tau^{ER} > 1-\alpha$, the probability of losing power is already relatively low. Therefore, a further increase in the tax rate in order to (marginally) reduce the probability of losing power is less valuable for the elite than an increase in their tax revenues generated by a reduction of τ^{ER} during an intensive phase of economic growth. Thus, higher middle class and human capital accumulation growth rates contribute to lowering the tax rate level, even in the presence of elite rivalry.

Additionally, we can also examine how the magnitude of the above verified reduction in τ^{ER} induced by higher g^M or g^H depends on specific parameters of the model. We are particularly interested in analysing how this magnitude is affected by the fraction of tax revenues that the political elite invests in public education, θ, and by these investments' effectiveness in reducing the individual cost of educating children, ξ. In order to do that and using the above-derived expressions (by the implicit function theorem), we take the partial derivative of the absolute value of $\frac{\partial \tau^{ER}}{\partial g^j}$ (with $j = H, M$) with respect to parameters θ and ξ. Denoting $|\frac{\partial \tau^{ER}}{\partial g^j}|$ by Ψ^j we have:

$$\frac{\partial \Psi^j}{\partial \theta} = \frac{\alpha \cdot \left(\tau^{ER}\right)^2 \cdot (1+\Upsilon) \cdot (1-\Upsilon)}{(1+g^j)\left[\tau^{ER} \cdot (1+\Upsilon)^2 - \alpha \cdot \Upsilon \cdot \left(\frac{1-\alpha-\tau^{ER}}{(1-\alpha)(1-\tau^{ER})}\right)\right]^2} \cdot \frac{\Upsilon}{\theta(1-\theta)}$$

$$\frac{\partial \Psi^j}{\partial \xi} = \frac{\alpha \cdot \left(\tau^{ER}\right)^2 \cdot (1+\Upsilon) \cdot (1-\Upsilon)}{(1+g^j)\left[\tau^{ER} \cdot (1+\Upsilon)^2 - \alpha \cdot \Upsilon \cdot \left(\frac{1-\alpha-\tau^{ER}}{(1-\alpha)(1-\tau^{ER})}\right)\right]^2} \cdot \frac{\Upsilon}{\xi}$$

Both partial derivatives are positive if $\Upsilon < 1$. Recalling that $\Upsilon(\tau^{ER}) \equiv \frac{\theta}{1-\theta} \cdot \xi \cdot \left(\tau^{ER} \cdot (1-\tau^{ER})^{\frac{\alpha}{1-\alpha}}\right) \cdot \beta\left[V^p(P) - V^p(M)\right] \cdot (1+g^H)^{-1} \cdot (1+g^M)^{-1}$, we can see that the condition $\Upsilon < 1$ is always satisfied for values of $\theta \leq 0.5$. Thus, when the political elite does not invest in public education significantly more than 50% of its tax revenues,[19] we can conclude that the magnitude of the reduction in τ^{ER} induced by higher g^M or g^H becomes more pronounced when the fraction of tax revenues invested in public education and the

[18] A corollary of the analysis in Section 3.1 is that, under elite rivalry, a lower tax rate increases tax revenues.

[19] Note that, the condition $\Upsilon < 1$ is also satisfied for some values of $\theta > 0.5$, given that the remaining compenents of $\Upsilon(\tau^{ER})$ all assume values below 1.

effectiveness of these investments in reducing the individual cost of educating children increase.

3.2.2 Effects on the public investments in education, $E(\tau^{ER})$

Proceeding similarly to the above analysis in Subsection 3.2.1, here we take the partial derivatives of E with respect to g^H and g^M to determine the effects of human capital accumulation and middle class growth rates on the elite's public investments in education. We sum up these effects in *Proposition 3* as follows:

Proposition 3: *Higher growth rates of middle class and of human capital accumulation, g^M and g^H , will increase the elite's public investments in education in the presence of elite rivalry.*

Using the implicit function theorem and composite derivation, and recalling that, when $\tau > 1-\alpha$, $\frac{\partial E}{\partial \tau^{ER}} < 0$, $\frac{\partial \tau^{ER}}{\partial g_H} < 0$ and $\frac{\partial \tau^{ER}}{\partial g_M} < 0$, we have:

$$\frac{\partial E}{\partial g_H} = \frac{\partial E}{\partial \tau^{ER}} \cdot \frac{\partial \tau^{ER}}{\partial g_H} > 0$$

$$\frac{\partial E}{\partial g_M} = \frac{\partial E}{\partial \tau^{ER}} \cdot \frac{\partial \tau^{ER}}{\partial g_M} > 0$$

Both partial derivatives are positive, which means that public investments in education will be higher when middle-class and human capital accumulation growth rates are high, even under elite rivalry conditions. Here, the line of reasoning is similar to the intuition for *Proposition 2*. In particular, the increase in the tax revenues collected by the elite (induced, on the one hand, by the growth of the middle class and of human capital accumulation and, on the other hand, by favouring economic *versus* political incentives) will also increase public investments in education, given by a fraction of those revenues.

Recalling that in the presence of elite rivalry a lower tax rate will induce positive changes in all economic outcomes, higher values of g^H and g^M also contribute to reducing the inefficiencies in the elite's optimal policy choices generated in the presence of elite rivalry.

The model thus predicts that the growth and development processes that the countries undergo, and that are characterized by episodes of intensive middle class and human capital growth, contribute to lower the degree of elite rivalry and reduce policy inefficiencies in the medium-long term.

4 Conclusions

In this work we develop a dynamic model with endogenously determined human capital accumulation, demographic changes and policy choices, building on Acemoglu (2009) and Sochirca *et al.* (2017). Our main objective is to analyse the interactions between the optimal policies implemented by the elite, the development of the middle class and human capital accumulation driving the process of economic growth, in the presence of elite rivalry.

In this extended model, production, wages, human capital accumulation and the optimal policy choices of the elite are determined endogenously. Contrarily to Sochirca *et al.* (2017), in this model we also endogeneize the size of the middle class. Both unskilled workers and the middle class are considered to compose the total labour force producing the final good. We let both the unskilled and skilled workers decide the future social-class membership of their children, subject to the (endogenous) influence of specific economic and political factors. This allows us to examine the endogenous demographic transformations generated by changes in the middle class. Thus, this model provides a framework for, not only identifying the effects of fiscal and public education policies on the key variables of the model in a context of elite rivalry, but also for analysing the reverse causality effects, namely how the policies implemented under elite rivalry change when the middle class becomes stronger and human capital accumulation in the economy increases.

One general conclusion of this model, which is in line with the results in related literature, is that economic considerations in optimal policy choices imply more efficient outcomes. On the contrary, the consideration of political interests has distorting economic effects induced through an excessive tax rate set by the elite to weaken the middle class and increase the probability of remaining in power. That is, in the presence of elite rivalry, the implemented policies are economically inefficient, and these inefficiencies are aggravated with the increase in the degree of elite rivalry.

Our framework also generates several results that are new in the literature. First, in the presence of elite rivalry, the current tax rate depends on past tax levels, implying that there is an inter-temporal coherence in the elite's optimal fiscal policy. In fact, this result finds sufficient support in the usual policy-making practices of most countries, by which the last period's tax rate(s) will be usually considered when fixing the tax rate(s) for the next period. Second, in the presence of elite rivalry, the model yields an optimal tax rate that depends on the endogenously derived middle class and human capital accumulation growth rates. This particular result allows us to understand how the optimal policies under elite rivalry are themselves influenced by the considered engines of endogenous economic growth.

In particular, we find that the optimal tax rate set under elite rivalry tends to be lower when the middle

class and human capital grow rapidly. This is due to a more intensive skilled-technology production and the subsequent more intensive increase of the tax base in the economy, which presents additional tax revenues opportunities for the elite. And when the tax rates are already high (i.e. above the economically efficient level), the strong economic incentive of the elite to collect higher tax revenues prevails over their political incentive to increase the probability of maintaining political power. Thus, even under elite rivalry conditions, the political elite will choose a lower tax rate.

We also find that higher growth rates of the middle class and of human capital accumulation have a similar positive effect on public investments in education as well. On the one hand, this is due to increased tax revenues collected by the elite and, consequently, to increased public investments in education, represented by a fraction of those (higher) revenues; on the other hand, this positive effect is further enhanced by the effect of a lower tax rate.

Finally, we also find that the magnitude of the positive influence of higher middle class and human capital growth rates tends to depend positively both on the fraction of tax revenues that the political elite invests in public education and on these investments' effectiveness in reducing the individual cost of educating children.

Thus, we can conclude that, in the presence of elite rivalry, a lower tax rate induces positive changes in all economic outcomes. Adjusting the tax burden according to changes in the development of the middle class and the accumulation of human capital can also help balance the economic and political interests of different social groups. In sum, these new results allow us to conclude that a more intensive rate of increase in the key factors driving economic growth contributes to lowering the degree of elite rivalry and reducing policy inefficiencies in the medium-long term.

The results of our analysis also call for further research and empirical testing. For example, as regards the emerging economies, the key conclusions of the model imply that in countries where the middle class and human capital are growing at higher rates, the implemented policies tend to be economically more efficient and thus more growth-promoting than in countries where their growth rates are lower. Also, the model implies that there is an inverse relation between the level of taxes and the growth rate of the middle class and of human capital accumulation. These conclusions could be empirically tested in a cross-country study focusing mainly on emerging or developing economies, in which elite rivalry issues are more prevalent.

Acknowledgments: E. Sochirca acknowledges valuable comments by Francisco Veiga, the financial support from Fundação para a Ciência e a Tecnologia (FCT), Portugal, through the post-doctoral grant SFRH/BPD/109307/2015, and the funding with COMPETE reference n. POCI-01-0145-FEDER-006683 (UID/ECO/ 03182/2013), with the FCT/MEC's (Fundação para a Ciência e a Tecnologia, I.P.) through

national funding and by the ERDF through the Operational Programme on Competitiveness and Internationalization - COMPETE 2020 under the PT2020 Partnership Agreement. P. Neves acknowledges financial support from FCT, Portugal, and FEDER/COMPETE 2020, through grant UID/ECO/04007/2013 (POCI-01-0145-FEDER-007659).

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