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IS GERONTOCRACY HARMFUL FOR GROWTH? A COMPARATIVE STUDY OF SEVEN EUROPEAN COUNTRIES

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We study the relationship between gerontocracy and aggregate economic performance in a simple model where growth is driven by human capital accumulation and productive government spending. We show that less patient élites display the tendency to underinvest in public education and productive government services, and thus are harmful for growth. The damage caused by gerontocracy is mainly due to the lack of long-term delayed return on investments, originated by the lower subjective discount factor. An empirical analysis using public investment in Information and Communication Technologies (ICT) is carried out to test theoretical predictions across different countries and different economic sectors. The econometric results confirm our main hypotheses.

JEL classification codes: J1, O4
Key words: gerontocracy, economic growth and aggregate productivity, education, ICT

I. Introduction

Over the last twenty years, per capita income growth rates have ceased to converge across OECD countries, and there has been a surge of academic research and policy attention about the causes underlying differences in economic growth performance

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across these countries. While productivity has accelerated in emerging economies and, most notably, in the United States, it has substantially slowed down in continental Europe and Japan (OECD 2004). Focusing on Europe, it is easily observed that, since the mid-1990s, economic performance has experienced a significant contraction compared to earlier periods. The economic literature developed so far has provided various explanations for such a sclerosis (Blanchard 2002; Gordon 2004). The most commonly cited causes of the slow growth concern the rigidity of the European economic model, the burden of taxation, the strict dependency of citizens on the welfare system, and the evidence that Europe has used some of the past productivity improvements to increase leisure rather than income. In particular, a wide consensus has been reached among researchers regarding the "European model", which, despite its successes during the post-war era, is proving to be inadequate now that economic development is increasingly based on innovation, and national firms can no longer be protected from foreign competition. Moreover, several researchers point out that the adoption of important general purpose technologies associated with the Information and Communication Technologies (ICT) revolution has been hindered or impeded in Europe by an excessively regulated labor market and an insufficient level of competition (van Ark et al. 2008). Although this productivity crisis is a common feature of a number of European economies, remarkable differences emerge from cross-country comparisons.[1]

Most recently, a new strand of literature has emerged, proposing that a large share of the heterogeneity in productivity growth across countries (and within Europe in particular) could be attributed to the economic and political élites' capacity of managing a country (Caselli and Morelli 2004; Mattozzi and Merlo 2007). Along these lines of thinking, the élites' responsibilities, with respect to the institutional, social, and technological delays accumulated in the recent past, have become an issue in the European economic panorama.

In contrast to this literature, our claim in this paper is that the élites' responsibility does not exclusively derive from their simple tendency to maintain the status quo. It is also due to their inability to seize the opportunity offered by new technologies and to implement the best choice for the economy as a whole, which is a direct consequence of the obsolescence of their personal human capital. Indeed, as pointed out by Messner and Polborn (2004), many political or economic reforms resemble

[1] For example, OECD (2004) reports that, compared with the previous decade, hourly labor productivity picked up in a group of economies, including Norway, Portugal, Germany, Finland, and Sweden, while it remained stable or reduced in the others.

investment projects in their return streams; initially, there is a cost to be borne, but eventually there will be benefits. In this frame, young people will be able to enjoy the benefits longer and hence will be more inclined to favor reforms than older people. It then follows that, among individuals of different ages, the oldest ones will not be in favor of change because they suffer the costs without being able to reap much of the benefits. Therefore, we define a gerontocratic society as a place where the decision-making process and the political environment are dominated by the oldest individuals, with negative consequences on economic performance in periods of rapid change and instability, when innovation and flexibility are at a premium.

The inability of an older ruling class in managing innovation is therefore a key feature of our research. Existing literature on labor economics provides further support in favor of this idea. Several studies show that a negative link between size and productivity exists, and it is even more pronounced in the ICT sector (see Daveri and Maliranta 2007). Indeed, workforce ageing is known to entail skill deterioration and lessened ability to adapt and learn new things. One possible explanation relies on the tendency of cognitive abilities to deteriorate with age. Although this decline is not uniform across abilities, after a certain age threshold, further advancements in age are seemingly associated with lower productivity at work. Beyond that threshold, further increases of experience add little or nothing to the working ability of a given worker. There are no reasons to believe that power élites are excluded from this process.

Along this line of reasoning, our work is also related to the literature on interest group politics, where existing powerful interest groups may impede the introduction of new technologies in order to protect their economic rents (Acemoglu and Robinson 2006; Alesina and Rodrik 1994, Fernandez and Rodrik 1991). In these contributions, political élites block technological and institutional developments because of a political replacement effect. Innovations often erode élites' incumbency advantages, increasing the likelihood that they will be replaced. Fearing replacement, political élites are unwilling to initiate change and may even block economic development. Moreover, the theoretical model we develop belongs to the broad literature that studies the links between different political variables and economic growth (Bellettini et al. 2009, Hashimzade and Davis 2006, Hopenhayn and Muniagurria 1996, Krusell and Rios-Rull 1999, Krusell et al. 1997). In particular, Hashimzade and Davis (2006) provide an interesting example of how political uncertainty might impede economic growth. The main conclusion of their theoretical work is that an increase in political instability produces growth-reducing policies that lead governments to invest less in activities that support human capital accumulation. Along the same line of reasoning, through a simple model very close to the one developed by these authors, we argue that gerontocracy, involving an elder ruling class with a shorter life horizon, results in lower investments in human capital and in productive public services and thereby depresses economic development.

Our aim with this paper is to study whether the aggregate economic performance of a country can be negatively affected by the age of its political élite. We propose then a "toy" model in which we study how élite's patience influences the adoption of growth promoting policies. We conjecture that older élites are more impatient, i.e., have a lower subjective discount. The goal of the model is to highlight the mechanism that originates investments in education and productive government spending.[2] For the same reason, we do not allow for any other differences (e.g., ideologies, organization, etc.) between the élites' that alternate in the office. Although we are aware that such an approach could sound oversimplified, we are confident that this parsimonious conceptualization is suitable to isolate the effect that politicians' preferences (induced by their age) has per se on growth.

Through our simple model, we show that a more impatient ruling class, whose interests are less devoted to long-term delayed return on investment, may weaken the human capital accumulation process because of inadequate public education policies and may hinder private sector productivity growth because of poor expenditure in productive services. We conjecture that the term structure of élites subjective discount rates displays a decreasing pattern. In this sense, we argue that gerontocracy is harmful for growth. Using standard comparative statics analysis, we derive testable restrictions on the growth reduced form equation that we test in the empirical part of the paper. To measure the impact of politicians' age on economic growth, we combine information from a group of European countries on socio-economic characteristics and background of the political élites —which we identify with the parliamentarians— with information from a rich industry-level data set. Our main goal is to exploit differences in politicians' age across countries to estimate the

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[2] This paper is not an attempt to explain the origin of a gerontocratic society. This implies that, for us, the (average) age of the ruling class is not an endogenous variable. The analysis of this phenomenon is on our research agenda but is out of the scope of this exercise. Here we conjecture that a link between gerontocracy and subjective discount exists and try to explain the effect of this on productivity growth. There are several ways to endogenize the politicians' age structure. In models of representative democracy, legislation and policy are responsive to the preferences of the median voter in the legislature (see, e.g., McCubbins, Noll, and Weingast 2007). Insofar, as the median representative that decides policy is representative of the median voter in the population at large, gerontocracy is perhaps the endogenous result of an ageing population.

effect that gerontocracy exerts on the allocation of public spending on productive investments and thus on economic growth.

The plan of the article is the following. Section II lays out the baseline model and discusses the links among the élites' patience, public investments and economic growth. Our main conclusion is that a gerontocracy, which is characterized by a higher impatience, is an important source of innovation-retarding policies and therefore depresses economic development. Therefore, it can be seen as plausible explanations of the growth differentials across countries. Section III discusses the data. The countries involved in our study are Denmark, Finland, France, Italy, Germany, Netherlands and the UK. Due to limitations on the availability of political data, we have not been able to extend the analysis to all EU countries. Our sample, however, represents a large share of the European economy and population. Section IV presents the empirical analysis, which corroborates our theoretical predictions while section V concludes the work.

II. Theoretical model

In this section, we present a simple theoretical model that extends the framework proposed by Hashimzade and Davis (2006) by taking into account the role of public productive services, along with the public investment in education, as engine of the human capital accumulation.

Demography. In a discrete-time $t \in \{0, 1, \ldots, \infty\}$ economy, a continuum of measure 1 of consumers/workers, who lives forever, produces a single homogenous good. Similar to Glomm and Ravikumar (1997), in each period agents allocate their time between education (e) and production ($1-e$).

Technology. Production function requires the use of human capital and government purchases and can be written as follows:

$$Y_t = AG_t^{\eta}\left[(1-e)H_t\right]^{1-\eta}, \tag{1}$$

where $A>0$ is the constant social marginal return of human capital, $(1-e)H_t$ is the stock of human capital at time t (i.e., efficiency of labor hour), G_t is the productive government spending (e.g., the provision of productive services, the roll-out and adoption of broadband, antitrust legislation, etc.) available at the beginning of period t, and $0<\eta<1$.[3]

[3] The public factor in equation (1) is a common external input, i.e., G is a pure public good.

Human capital accumulation is determined according to the following production function:

$$H_{t+1} = H_t + \phi(H_t, E_t), \tag{2}$$

where –without loss of generality– no depreciation is assumed. E_t is the public investment in education and ϕ is the learning technology described by the following homothetic function:

$$\phi(H_t, E_t) = e\zeta H_t^{\alpha} E_t^{1-\alpha}, \tag{3}$$

with $\zeta > 0$ and $0<\alpha<1$. Output is taxed at fixed rate τ. This implies that the following condition, representing the government budget constraint, must hold:

$$\tau Y_t = G_t + E_t + (R_t^g + R_t^r) = \sigma_{gt}\tau Y_t + \sigma_{et}\tau Y_t + (1-\sigma_{gt}-\sigma_{et})\tau Y_t, \quad \text{with } (\sigma_{gt}+\sigma_{et}) < 1 \ \forall t, \tag{4}$$

where σ_{gt} and σ_{et} are the share of revenues allocated to finance productive government spending, and public education, respectively. It then follows that the share $(1-\sigma_{gt}-\sigma_{et})$ is used to finance expenditure that produces no benefit for the community, and it can be seen as private benefit (or appropriation of tax revenues) enjoyed by the élites. We denote with R_t^g the *government rent*, enjoyed by the politicians in charge, and with R_t^r the *retirement rent*, received in the case of electoral loss. We assume that the retirement rent is constant and lower than R_t^g, with $R^r < R_t^g - R^r$. Finally, $C_t^p = (1-\tau)Y_t$ is consumed by the consumers/workers.

Political environment. We consider an environment where two parties randomly alternate in office. To keep matter simple, we assume that the two parties face the same exogenous probability π of being voted out and replaced. At each time t the government in charge chooses σ_{gt} and σ_{et}. At time zero, political élite knows their status $\epsilon_0 \in \{l, w\}$. When $\epsilon = l$ the incumbent government has lost the election. We assign at this event a positive probability π. In addition, with probability $(1-\pi)$, $\epsilon = w$, and the incumbent government remains in charge. In the former case ($\epsilon = l$), the political élite receives the retirement rent R^r, while in the latter ($\epsilon = w$) it allocates again tax revenues between productive government spending, public education, and its own (unproductive) rent.

A. The optimization process

The political élite, belonging to the "government in charge", maximizes:

$$\theta U\left(R_t^g\right)+(1-\theta)U\left(C_t^p\right), \tag{5}$$

where U is the strictly concave twice differentiable per-period utility,

$$R_t^g \equiv \left(1-\sigma_{gt}-\sigma_{et}\right)\tau Y_t - R^r \tag{6}$$

is the government rent, C_t^p is the private consumption, and θ is the weight the government assigns to government rent and private consumption. Therefore, θ can be interpreted as a measure of politicians' "selfishness" (i.e., the higher θ, the higher the degree of "selfishness"). Notice that, in this environment, the controls σ_g and σ_e at date t depend only on the current state H, so that

$$\sigma_{gt}=\sigma_g\left(H_t\right) \text{ and } \sigma_{et}=\sigma_e\left(H_t\right). \tag{7}$$

This implies that any given policy generates a stochastic law of motion for the state:

$$H_{t+1}=\Xi\left(H_t,\sigma_{gt},\sigma_{et}\right), \tag{8}$$

which will be stationary if σ_g and σ_e are stationary.

Following the standard notation used in the literature, we denote the variables at time t and t+1 as those without and with primes. The functional equation associated to the maximization problem faced by a government in charge at the beginning of period t is

$$V(H,\epsilon)=\max_{\{\sigma_e,\sigma_g\}_{t=0}^{\infty}}\left\{\left[\theta U\left(R^g\right)+(1-\theta)U\left(C^p\right)\right]+\beta\mathbb{E}\left[V\left(H',\epsilon'\right)\mid\epsilon\right]\right\}, \tag{9}$$

subject to

$$Y=AG^{\eta}\left[(1-e)H\right]^{1-\eta}, H_0>0,\ H'=\Xi\left(H,\sigma_g,\sigma_e,\epsilon\right), C=(1-\tau)Y,$$

$$R^g = \begin{cases} \left(1-\sigma_g-\sigma_e\right)\tau Y - R^r & if \ \epsilon = w \\ R^r & if \ \epsilon = l \end{cases}, \tag{10}$$

where β is the subjective discount factor ($\beta = \frac{1}{1+\rho}$, where ρ is the rate of time preference); H_0 is pre-determined at time t = 0, R_0^g and H_1 are chosen, and the uncertainty is due to the risk of an electoral loss in the subsequent period. It than follows that associated with the solution (9) is a *policy vector* defined by $\Psi = \left\{\left(\sigma_{g1}, \sigma_{e1}\right), \left(\sigma_{g2}, \sigma_{e2}\right), \ldots\right\}$. Notice that the value function (9) is the present discounted value of the incumbent ruling class evaluated along the optimal program.

The following assumptions are maintained for the remainder of this section.

Assumption 1. $H \in \mathcal{H} \subset \mathcal{R}$, $\left(\sigma_g + \sigma_e\right) \in (0,1)$ *and* $E, G \in \mathcal{A} \subset \mathcal{R}$.

Assumption 2. $U : X \to \mathcal{R}$ *is a strictly increasing, twice continuously differentiable and concave utility function, with* $U'(0) = \infty$ *and* $U'(\infty) = 0$.

Assumption 3. *Retirement rent* $R^r < \frac{1}{2} R_t^g$.

B. Equilibrium and comparative statics

Here we are interested in analyzing the long-run effects of gerontocracy. Therefore, we focus on the stationary equilibrium which involves time-invariant decision rules in the infinite horizon. This concept uses a recursive representation of the political élites' problem.

Definition 1. *Given the initial* H_0 and $H_t \in \Gamma\left(H_{t-1}\right) \subset \mathcal{H}$ *, with* Γ *continuous and compact-valued, a Balanced Growth Path (hereafter* BGP*) for the economy is a collection of sequences* $\left\{H, Y, C^p, R^g, \sigma_g, \sigma_e, G, E, e\right\}_{t=0}^{\infty}$ *such that:*

(i) H evolves according to (8)*;*

(ii) the government budget is balanced: $\tau Y_t = G_t + E_t + R_t^g + R^r$;

(iii) politicians solve problem (9–10).

Let now V_l denote the value of an electoral loss, which occurs with probability π, and V_w the value of being (re)elected, which occurs with probability $(1-\pi)$. Then, the optimal value function V for the political élites' optimization problem (9–10) is the solution to the following Bellman equation, subject to (10):

$$\max_{\{\sigma_e,\sigma_g\}_{t=0}^{\infty}} \theta U\left(R^g(H)\right)+(1-\theta)U\left(C^p(H)\right)+\beta\upsilon\left[\pi V_l(H')+(1-\pi)V_w(H')\right]. \tag{11}$$

With interior equilibrium, the first order conditions and the envelope condition for the political élites' problem are respectively:

$$[FOC] \qquad \frac{\partial V}{\partial \sigma_g}=0 \Rightarrow \frac{\partial U}{\partial \sigma_g}+\beta\left[\pi\frac{\partial V_l}{\partial H'}\frac{\partial H'}{\partial \sigma_g}+(1-\pi)\frac{\partial V_w}{\partial H'}\frac{\partial H'}{\partial \sigma_g}\right]=0\ , \tag{12}$$

$$[FOC] \qquad \frac{\partial V}{\partial \sigma_e}=0 \Rightarrow \frac{\partial U}{\partial \sigma_e}+\beta\left[\pi\frac{\partial V_l}{\partial H'}\frac{\partial H'}{\partial \sigma_e}+(1-\pi)\frac{\partial V_w}{\partial H'}\frac{\partial H'}{\partial \sigma_g}\right]=0, \tag{13}$$

$$\begin{aligned}[ENV] \qquad \frac{\partial V}{\partial H}=&\ \frac{\partial Y}{\partial H}\left[\theta U'\left(R^g\right)\left(1-\sigma_g-\sigma_e\right)\tau+(1-\theta)U'\left(C^p\right)(1-\tau)\right]\\ &+\beta\left[\pi\frac{\partial V_l}{\partial H'}\Xi'+(1-\pi)\frac{\partial V_w}{\partial H'}\Xi'\right]\end{aligned} \tag{14}$$

Conditions (12)–(14), together with the transversality condition

$$\lim_{t\to\infty}(\beta)^t\frac{\partial U(\cdot)}{\partial H}H_t=0 \tag{15}$$

and the initial condition of the economy fully characterize the solution of the political élites' problem.

Finally, the assumption of identical governments implies that they choose the same optimal level of σ_e and σ_g, which is constant along the BGP, where all the per capita variables grow at the same rate given by

$$\gamma=\zeta e\left[A^{1/(1-\eta)}\ \ \sigma_e\sigma_g{}^{\eta/(1-\eta)}\ \ \tau(1-e)\right]^{1-\alpha}. \tag{16}$$

Simple algebra provides the following proposition.

Proposition 1. *Along the* BGP, *the growth rate of per capita variables is increasing in the amount of tax revenues used to finance education, and productive services:*

$$\left.\frac{\partial\gamma}{\partial\sigma_e}\right|_{BGP}>0 \text{ and } \left.\frac{\partial\gamma}{\partial\sigma_g}\right|_{BGP}>0.$$

Proof 1. *See the online appendix.*
Recalling that along BGP, $H' = H(1+\gamma)$, Proposition 1 also implies:

$$\frac{\partial H'}{\partial \sigma_e} = H\left(\frac{1-\alpha}{\sigma_e}\right)\gamma, \tag{17}$$

$$\frac{\partial H'}{\partial \sigma_g} = H\left(\frac{1-\alpha}{1-\eta}\frac{\eta}{\sigma_g}\right)\gamma. \tag{18}$$

Finally, in order to obtain explicit solutions for σ_e and σ_g, we assume that the politicians' preferences are logarithmic. Solving (12–14) with respect σ_g and σ_e yields:

$$\sigma_g^* = \eta\ \frac{\beta(1-\pi)(1-\alpha)}{\theta+\beta(1-\pi)\ (1-\alpha)}, \tag{19}$$

$$\sigma_e^* = (1-\eta)\frac{\beta(1-\pi)(1-\alpha)}{\theta+\beta\ (1-\pi)(1-\alpha)}. \tag{20}$$

Proposition 2. *Along the* BGP, *the optimal government spending in productive services σ_g^*, and education σ_e^* declines with politicians' impatience. Thus, the more impatient is the political élite the lower is the equilibrium growth rate γ.*

Proof 2. *See the online appendix.*

Overall, the main task of our toy model is to isolate the optimizing behavior of the political élites. A political élite behaves as a single agent and solves an optimization problem over an infinite horizon. In order to be able to analyze our main question in a meaningful way, we first solve the élites' optimization problem. This allows to identify a link between the subjective discount rate of the cabinet in charge (β) and the policies implemented. Then, we add an aggregate technology that ensures perpetual growth, driven by productive government services, and investment in education. The provision of both government services and public education is financed by a tax on income, whose revenues are also used to finance the élites' unproductive rent R^g. As will be more clear in the following paragraph, this assumption is crucial to highlight the trade-off faced by the policy maker and the role of gerontocracy. Each rational government will choose the amount of tax revenues to invest in innovation and education that will guarantee a rent R^g as large as possible, under the uncertainty of being re-elected in the subsequent election.

The way we bring the toy model to the data is the following. We conjecture that the patience (which negatively affects the subjective discount rate) declines with age.[4] This implies that an older élite weights future returns less and, therefore, is the more reluctant to adopt potential growth enhancing policies. If this conjecture on the linkage between politicians' age and their discount factor is correct, then public investments do respond to changes in the ruling class age structure, which affect the size of the unproductive rent enjoyed by the élite. The empirical content of Proposition 2 is then that the older the political élite, the lower the public resources devoted to productive services and education, human capital accumulation declines and economic growth slows considerably.

III. The data

The data used in the empirical analysis have been collected from different sources. In the following, we provide a description of the data and discuss the procedures adopted to merge data from different sources into a single dataset.

The first source is the DataCube dataset, obtained from the EURELITE network, that contains information on personal characteristics of national parliamentarians in several European countries from 1983 to 2004.[5] DataCube includes about fifty variables related to the social and political background of national parliaments members. Unfortunately, this dataset does not provide any information on government' member ages. Therefore, in our empirical exercise, we proxy gerontocracy with the average age of the members of national parliaments of each country.[6] Beyond some basic socio-demographic variables (i.e., occupation, education, age, and sex), the dataset includes information on politicians' background, with particular attention to the pre-parliamentary political experience, including political and administrative

[4] Laboratory and field studies of time preference identify a decreasing slope in the term structure of subjective discount rates. The interested reader can refer, among the others, to : Angeletos et al. (2001), Laibson, (1997) and O'Donoghue and Rabin (1999).

[5] For more information on the EURELITE network see http://www.eurelite.uni-jena.de/eurelite/portrait/introduction.html.

[6] There may be other ways to proxy for gerontocracy. Given our data, we do not think that using the (average) age of the parliamentarians rather than that of the government members matters for our exercise. In fact, we did not find any argument to support the idea that, at the country level, there exists a significant difference in terms of age between these two groups of politicians. However, we are aware that, for this to be true, the members of the cabinet must be a randomly selected subset (in terms of age) of the Parliament.

appointments at the local level (town, county, and region), parliamentary career (i.e., age at entry into parliament and the number of successful elections), leading party functions, and government appointments.

The second source is represented by the EU-KLEMS dataset, which contains variables measuring output, productivity, employment (skilled and unskilled), physical capital, ICT investments, and technological change at the industry level, for all European Union member states from 1970 onwards.[7] At the lowest level of aggregation, data were collected for 71 industries. The industries are classified according to the European NACE revision 1 classification. Since the level of detail varies across countries, industries and variables, due to data limitations, we choose a level of aggregation that produces 25 industries, which for our purposes have been further grouped into 6 "macro" sectors (Manufacturing, Electrical machinery and telecommunication, Finance and business services, Retail and distribution services, Personal and social services, and Other goods producing industries).[8] The availability of data at the industry level is extremely important for our analysis, as we believe that the relationship between the level of gerontocracy, investments in ICT, and economic growth may be quite heterogeneous across the many sectors of the economy. Industry level data will then be able to capture such heterogeneity better than aggregate measures, such as the per capita GDP. EU-KLEMS also provides information on the so-called "non-market economy". This aggregate includes data from the following sub-sectors: public administration, education, and health and social services. In our regressions, we proxy public ICT investment by the sum of the ICT investments undertaken by those sub-sectors. All variables and definitions are provide in Table 1.

As the number of countries covered and the time span of the EU-KLEMS are both larger than those available in the EURELITE dataset, the merging procedure of these two sources has produced a sample that includes 7 countries (Denmark, Finland, France, Germany, Italy, the Netherlands and the UK) and 25 industries, with a time span ranging from 1983 to 2004, for a total of 3,500 potential observations. However, as for some variables — like gross operating surplus — data are missing in the early years in some countries, the actual sample consists of 3,416 observations. Finally, we have added a variable accounting for public expenditure on education

[7] For more information on the EU-KLEMS dataset see http://www.euklems.net/.

[8] We decided to keep the electrical machinery and telecommunication sector separated from the aggregated manufacturing sector because we believe that in this sector the correlation between investment in ICT and TFP growth could be particularly relevant.

at the country level, as provided by EUROSTAT and UNESCO.[9] For our purposes, this variable has been standardized with respect to GDP. However, since we do not have information on the German public education expenditure before the pre-unification period, in our empirical analysis we split our sample in two sub-samples. The first sub-sample, comprising 2,916 observations, spans the whole period from 1984 up to 2004 and includes data from all country but Germany. The second sub-sample, comprising 1,485 observations, spans the sub-period from 1995 up to 2004, but includes data from Germany. Finally, we obtain a sub-sample of control,

Table 1. Data definitions and sources

Variables	Source
Gerontocracy related variables	
log(*gerontocracy*) = log of the politicians' mean age	EURELITE
log(*newcomers*) = log of the newcomers' mean age	EURELITE
background = % of politicians with local/national political backbround	EURELITE
female = % of female politicians	EURELITE
Growth accounting variables	
log(*tfp*) = log of TFP (value added based) growth (1995=100)	EU-KLEMS
log(*ict*) = log of ICT capital services (1995=100)	EU-KLEMS
log(*nict*) = log of non-ICT capital services (1995=100)	EU-KLEMS
log(*gict*) = log of non-market sector ICT capital services (1995=100)	Authors w/EU-KLEMS
log(*hhs*) = log of hours worked by high-skilled persons engaged (share in total hours)	EU-KLEMS
log(*hms*) = log of hours worked by medium-skilled persons engaged (share in total hours)	EU-KLEMS
log(*hls*) = log of hours worked by low-skilled persons engaged (share in total hours)	EU-KLEMS
log(h_{29}) = log of hours worked by persons engaged aged 15-29 (share in total hours)	EU-KLEMS
log(h_{49}) = log hours worked by persons engaged aged 29-49 (share in total hours)	EU-KLEMS
log(h_{+50}) = log of hours worked by persons engaged aged 50 and over (share in total hours)	EU-KLEMS
gos = Gross operating surplus (in millions of local currency)	EU-KLEMS
log(*marketopenness*)= log of exports plus imports as % of GDP	PWT 6.1
Education variables	
pexpedupe = public expenditure on education as a percentage of total public expenditure	EUROSTAT
pexpedugdp = public expenditure on education as a percentage of GDP	EUROSTAT

[9] Data source: http://appsso.eurostat.ec.europa.eu for the period 1995-2004 and http://www.uis.unesco.org/Education/Pages/default.aspx for the period 1983-1994.

Table 2. Summary statistics

Variable	Definition	Sample 1	1983:2004	Sample 2	1995:2004	Sample 3	1995:2004
		Mean	*Std. dev.*	*Mean*	*Std. dev.*	*Mean*	*Std. dev.*
background	% of politicians with local/regional political background	60.27	17.71	59.33	15.5	60.19	16.55
female	% of female politicians	20.54	12.11	24.72	11.12	23.8	11.78
gerontocracy	politicians' mean age	48.32	1.92	48.74	1.99	44.58	2.11
newcomers	newcomers' mean age	43.63	3.03	44.6	2.59	44.65	2.78
hhs	hours worked by high-skilled workers (% of total hours)	10.37	9.47	11.38	9.72	12.21	10.18
hms	hours worked by medium-skilled workers (% of total hours)	64.17	17.39	67.7	14.7	68.13	15.68
hls	hours worked by low-skilled workers (% of total hours)	25.45	16.52	21.02	13.01	19.66	13.4
h_{29}	hours worked by persons engaged aged 15-29 (% total hours)	27.63	7.82	24.44	7.26	24.92	7.6
h_{49}	hours worked by persons engaged aged 29-49 (% total hours)	53.99	7.83	55.58	7.27	55.28	7.61
h_{+50}	hours worked by persons engaged aged 50 and over (% total hours)	18.38	6.4	19.98	6.72	19.8	7
tfp	TFP (value added based) growth, 1995=100	100	57.1	104.84	17.76	104.63	17.21
gos	gross operating surplus	0.18	0.12	0.18	0.11	0.18	0.12
ict	ICT capital services, volume indices, 1995 = 100	117.59	105.52	191.08	109.9	197.89	114.84
nict	non ICT capital services, volume indices, 1995 = 100	98.41	18.39	109.22	16.21	110.08	16.63
gict	public ICT capital services, volume indices, 1995 = 100	119.93	110.3	208.28	102.82	213.92	107.57
tax	taxes (minus subsidies on production) over gross output	0.01	0.02	0.01	0.03	0.01	0.02
marketopenness	exports/gdp (constant US$)	0.34	0.13	0.33	0.13	0.37	0.14
$\log(pexpedu)_{gdp}$	public expenditure on education as a % of GDP	5.8	1	5.66	1.25	5.85	1.26
Observations		2916		1485		1269	

Note: Sample 1 refers to the period 1983-2004 and it includes only DNK, FIN, FRA, ITA, NLD and UK Sample 2 includes all countries, but it spans a shorter period from 1995 to 2004. Finally, Sample 3 contains data from all the countries included in Sample 1 but with respect the sub-period period 1995-2004.

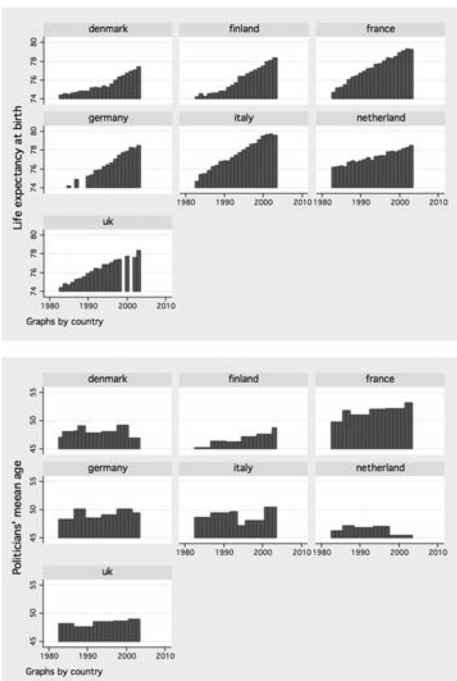
comprising 1,269 observations, that spans the sub-period from 1995 up to 2004, but does not include Germany.

Table 2 reports all summary statistics. According to our data, only 21% of the national representatives are female, and the average age is about 48 years. About 60% of parliamentarians in the sample has a university degree. Furthermore, about 60% of them had previous local/regional background activity in terms of being a representative elected by citizens, and about 60% have been elected in the same place of origin. Figure 1 shows a detailed picture of the cross-country differences in life expectancy and politicians' age in the sample, with France showing the oldest parliament and the Netherlands the youngest.

Concerning the economic data, we see that workers with average skills account for about two-thirds of total hours worked, followed by low skilled and high skilled workers. In particular, high skilled workers account for only 13% of total hours (for each sector, see Table A1 in the online appendix).

For a better understanding of our data and the relationships between them, we have also computed unconditional correlation coefficients between gerontocracy

Figure 1. Life expectancy at birth and politicians' mean age, our sample



and TFP growth and between ICT (both private and public) and TFP growth. In Table A2, the (*n*,*m*) cell shows the average correlation between the TFP growth of industry *n* and the level of gerontocracy attributed to country *m*. The general negative impact exerted by gerontocracy is quite transparent when looking at the last row of the table, which reports the correlation column average by country. In particular, this detrimental effect seems to be stronger and larger in the Electrical machinery and telecommunication sector. Notice that (on average) the older the politicians are, the larger the negative correlations.

As suggested by our theoretical model, a positive correlation between public ICT and TFP growth should emerge from the data, with the former positively affecting the latter and being complement with the private ICT. The unconditional correlation coefficients reported in Table A3 seem to confirm our theoretical predictions, with public ICT and TFP strongly correlated, and with public and private investments in ICT being complementary (see Figure A1, in the online appendix, where we plot the (log of) public and private ICT).

In Table A4 we observe the correlation between private ICT and TFP. Even in this case, the positive correlation seems to hold, and it is stronger in those sectors where we expect ICT to be a major driver for TFP.

Finally, a different picture emerges if we look at the correlation between the (log of the) age of the newcomers (which provides a measure of the demographic dimension of the political turnover) in each national Parliament and the TFP growth. The results reported in Table A5 suggest that the problem is not the politicians' age *sic et simpliciter*. In comparison with the previous table, correlations are much more tenuous and are often positive. A possible explanation could be that older newcomers, during their working life (presumably in the private sector), have acquired skills and competences that (partially or completely) compensate for the human capital obsolescence due to ageing.

IV. The empirical analysis

A. The econometric strategy

In this section, we present the econometric strategy used to test the main hypothesis of our theoretical model, namely that gerontocracy negatively affects economic growth due to its incapacity to provide sufficient investments in innovation (public and private) and education. However, as we lack adequate information on education expenditure, we limit the empirical analysis to the study of the effect of gerontocracy on innovation, thus assuming that the level of expenditure in education is given.[10] Therefore, our empirical model will be specified to estimate the impact of gerontocracy on public productive investments and, only indirectly, on TFP growth.

The primary econometric strategy discussed here is based on a reduced form three-equation system, while alternative approaches will be assessed in subsection C. The toy model is used to provide restrictions on the number of equations, the choice of the endogenous variables, and the set of regressors. First of all, since the model describes an economy where growth is driven by productive government spending (which we identified with the public investment in ICT) and public education, the TFP growth equation can be expressed as follows:

$$\begin{aligned} \log\left(tfp_{ijt}\right) = &+\alpha_1 \log(pexpedu_{jt-1}) + \alpha_2 \log(ict_{ijt-1}) + \alpha_3 \log(gict_{jt-1}) + \alpha_4 du95 \\ &+\alpha_5 du95 \bullet \log(ict_{ijt-1}) + \alpha_6 S_{ijt-1} + \alpha_7 X_{jt} + \eta_{ijt}, \end{aligned} \tag{21}$$

where i is the sector, j is the country, and t is time; *tfp* is the TFP growth index; *pexpedu* is the public expenditure on education; *ict* is the private ICT capital service, while *gict* is the public ICT capital service.

Furthermore, S is a vector of sector-specific variables (share of labor input with different skills and share of workers with different age) and X is a vector of other controls at the country level, such as market openness and country dummies. Following the empirical evidence reported in van Ark et al. (2008) and Dahl et al. (2011), we include in our TFP equation the dummy variable (*du*95) and its interaction with *ict* to captures a structural break that could have changed the productivity trend from 1995 onward.

Since the toy model has showed that older politicians are more willing to pursue an (unproductive) rent rather than public investment, because of their shorter lifespan, and hence lower incentive to accumulate public capital, we added the following equation to link this kind of productive public spending with the set of gerontocracy-related variables:

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[10] Unfortunately, homogeneous and comparable data on education expenditure at country level is available only in the aggregate, thus preventing us from distinguishing expenditures at different levels of education. In fact, we expect that expenditure at lower levels of education, although important for economic growth, may be positively related with gerontocracy and, in fact, could be aligned with vested interests of teacher unions for preserving a status quo where insiders obtain all the benefits, without caring about quality. On the contrary, the financing of higher education and research activities may be much less correlated with gerontocracy, as it usually leads to breakthroughs and innovations that are not in line with the idea of maintaining the status quo of a gerontocratic system. Based on simple descriptive statistics, our data do not show any correlation between gerontocracy and public expenditure on education.

$$\log\left(gict_{jt}\right) = \gamma_0 + \gamma_1 \log(pexpedu_{jt-1}) + \gamma_2 \log(gerontocracy_{jt-1}) \\ + \gamma_3 \log(newcomers_{jt-1)} + \gamma_4 background_{it-1} + \gamma_5 \log(female_{jt-1}) + \gamma_6 S_{ijt} + \gamma_7 X_{jt} + \xi_{ijt}, \tag{22}$$

where *gerontocracy* is the politicians' mean age, *newcomers* is the mean age of the politicians who are in office for the first time, *background* is the percentage of politicians with local/regional political background, and log is the percentage of female politicians.

Finally, the interaction between private ICT and public ICT is captured by:

$$\log\left(ict_{ijt}\right) = \beta_0 + \beta_1 \log(pexpedu_{jt-1}) + \beta_2 \log(gict_{jt}) + \beta_3 S_{ijt} + \beta_4 X_{jt} + \varepsilon_{ijt}. \tag{23}$$

To avoid potential endogeneity problems between TFP growth and ICT variables, whenever reasonable, regressors have been lagged one period, while the potential endogeneity between ICT variables and gerontocracy has been controlled through the use of country dummies, which should wipe out all the time invariant unobserved heterogeneity at the country level.

Given our system of equations (21)–(23), we can easily see that gerontocracy affects private ICT only through public ICT (*gict*). At the same time, gerontocracy affects TFP through both private and public ICT. Therefore, the total effect of gerontocracy on TFP is given by the following relationship:

$$\frac{\partial TFP}{\partial gerontocracy} = \left(\alpha_3 \gamma_2\right) + \left(\alpha_2 + \alpha_5 du95\right) \beta_2 \gamma_2,$$

where the first term on the right side of the equation reflects the (direct) effect of gerontocracy on TFP through the public ICT investment and the second term is the (indirect) effect through the private ICT investment.

As we assume a recursive structure for our empirical model, the parameters have been estimated using the SUR technique (Zellner 1962, Zellner and Huang 1962 and Zellner 1963). In the following, we present the results obtained by pooling all countries and sectors and later we discuss the results obtained fitting our model by sector or country.

B. Results

Here, we present and comment on the empirical results of our analysis. We first discuss the results obtained with the pooled data (all sectors and countries). Then, we introduce and compare the results by sector and country. Finally, we present some robustness checks that should help reinforce the conclusion of our study. All analyses have been carried out using the three different samples discussed in section III.

Estimates from the pooled data

Table 3 presents the estimates of the parameters in equations (21)–(23) for the pooled data, using the three samples. Overall, the results clearly corroborate our theoretical predictions, with the gerontocracy variable that negatively affects public ICT, that in turn affects TFP. This result is robust across sub-samples. Furthermore, coherently with our theoretical predictions, gerontocracy affects TFP through the public ICT investment channel. In fact, as can be seen in the top panel of Table 4, using the pooled data, a 1% increase in the level of gerontocracy reduces the TFP index by an amount ranging from 0.314% to 0.438%, depending on the sample employed. By disentangling the total effect into its direct and indirect components, we note that the direct effect is what really drives the result. Finally, by comparing the different samples, we notice in Table 3 that the negative effect of gerontocracy has decreased over time (by comparing the countries of sample 1 across the two periods) and it seems to have an important effect in Germany (by comparing samples 2 and 3 across the same period).

Consistently with the idea that the attitude to innovate declines with the politicians' age, from Table 3 we see that past experience of political government at the local/regional level (*background*) seems to be negatively related to *gict*. In particular, it negatively and significantly affects the TFP growth index in sub sample 2 and 3 (with elasticity equal to -0.435 and -0.855 respectively), i.e., when the role of public ICT capital is stronger, while its effect is positive but light (with elasticity 0.196) in sample 1, when the impact of *gict* on TFP is relatively smaller. This may be partly explained by thinking that being elected to national parliament can be seen as the culmination of a political career spent largely at the local or regional level. Under this perspective, *background* proxies politicians' age: therefore, the same argument used for *gerontocracy* can be applied to explain its effect on productive public spending.

Our estimates document that public ICT capital is a main determinant of the TFP growth index. The parameter of *gict* is positive and significant in each sample; it is definitely greater than that of the private ICT. In particular, the contribution of the private ICT is positive and not significant when the time horizon is longer

Table 3. SUR parameter estimates - pooled data

	Sample 1 - 1983:2004			Sample 2 - 1995:2004			Sample 3 - 1995:2004		
	log(*tfp*)	log(*ict*)	log(*gict*)	log(*tfp*)	log(*ict*)	log(*gict*)	log(*tfp*)	log(*ict*)	log(*gict*)
$\log(hhs)_{t-1}$	0.0123	0.0317**	0.0524***	0.00398	0.0109	0.00646	0.0153	-0.012	0.0033
$\log(hms)_{t-1}$	0.135***	0.165***	0.135***	0.0856**	0.0134	0.0378*	0.0544	0.0812	-0.000403
$\log(hls)_{t-1}$	-0.0112	0.0739***	0.131***	0.0264**	0.0117	-0.0055	0.0294**	0.00366	0.00756
$\log(h_{29})_{t-1}$	0.1393***	0.196***	-0.167***	0.0975***	0.206***	0.0151	0.112***	0.162**	-0.00295
$\log(h_{49})_{t-1}$	0.2074***	0.311***	-0.313***	0.371***	0.310**	-0.0159	0.356***	0.320**	0.00908
$\log(h_{50+})_{t-1}$	0.0784***	0.0302	-0.126***	0.0221	0.122**	0.0469***	0.0399	0.093	0.00338
$\log(gerontocracy)_{t-1}$			-4.5578***			-5.0014***			-3.294***
$\log(newcomers)_{t-1}$			0.9068***			0.6866***			0.386***
$\log(background)_{t-1}$			0.1963***			-0.4346***			-0.855***
$\log(female)_{t-1}$			0.0123			0.0290*			0.0275*
$pexpedu_{t-1}$	-0.0211**	0.0229	0.184***	-0.0633***	-0.0692*	-0.004	-0.0623***	-0.0786**	0.00332
$\log(ict)_{t-1}$	0.0104			-0.0720***			-0.0580***		
$du95_{t-1}$	0.0178***								
$du95 \cdot \log(ict)_{t-1}$	-0.0083**								
$\log(nict)_{t-1}$	-0.0981***	0.287***		-0.0744**	0.702***		-0.0452	0.601***	
$\log(gict)_{t-1}$	0.0783***	0.606***		0.196***	0.647***		0.183***	0.714***	
gos_{t-1}	0.2194***	0.169**		0.287***	-0.0969		0.307***	-0.190*	
$\log(marketopeness)_{t-1}$	0.2020***			0.0623			-0.0511		
trend		0.0468***	0.118***		0.0309***	0.110***		0.0217**	0.121***
constant	2.9171***	-95.96***	-218.8***	2.437***	-64.89***	-196.7***	2.200***	-46.41**	-221.5***
Observations	2,803	2,803	2,803	1,336	1,336	1,336	1,144	1,144	1,144
R - squared	0.150	0.831	0.929	0.161	0.685	0.967	0.156	0.685	0.979

Note: Country dummies included in all estimates. Sample 1 includes DNK, FIN, FRA, ITA, NLD and UK from 1983 to 2004. In sample 2 we add GER but limit the time period from 1995 to 2004. Sample 3 includes countries of Sample 1 but spans from 1995 to 2004. *** Indicates significance at the 1% level ** significance at 5%, * significance at 10%.

Table 4. Elasticities of TFP growth with respect to gerontocracy: pooled data and by sector

Sample	Direct effect via *gict*	Indirect effect via *ict*	Total effect
Pooled data (2,803 obs., 1,144 obs., 1,336 obs.)			
Sample 1 -1983:2004	-0.481***	0.043	-0.438***
Sample 3 -1995:2004	-0.341***	-0.008	-0.349***
Sample 2 -1995:2004	-0.313***	-0.002	-0.314***
Electrical machinery and TC (249 obs., 96 obs., 112 obs.)			
Sample 1 -1983:2004	-0.685***	0.026	-0.659***
Sample 3 -1995:2004	-0.217	-0.101	-0.116
Sample 2 -1995:2004	-0.483***	0	-0.483***
Manufacturing (1,290 obs., 480 obs., 560 obs.)			
Sample 1 -1983:2004	-0.548***	0.031	-0.516***
Sample 3 -1995:2004	-0.14	0.006	-0.134
Sample 2 -1995:2004	-0.094	0.001	-0.093
Finance and business services (238 obs., 88 obs., 104 obs.)			
Sample 1 -1983:2004	-0.826***	0.495***	-0.330**
Sample 3 -1995:2004	-0.113	0.021	-0.092
Sample 2 -1995:2004	-0.147*	0.008	-0.137*
Retail services (468 obs., 192 obs., 224 obs.)			
Sample 1 -1983:2004	-0.940***	0.269***	-0.671***
Sample 3 -1995:2004	-0.200*	0.003	-0.197*
Sample 2 -1995:2004	-0.218**	-0.075	-0.294**
Personal and social service (258 obs., 96 obs., 112 obs.)			
Sample 1 -1983:2004	-0.133*	-0.012	-0.145**
Sample 3 -1995:2004	-0.253**	-0.088	-0.341**
Sample 2 -1995:2004	-0.592***	-0.119	-0.711***

Note: Sample 1 includes DNK, FIN, FRA, ITA, NLD and UK from 1983 to 2004. In Sample 2 we add GER but limit the time period from 1995 to 2004. Sample 3 includes countries of Sample 1 but spans from 1995 to 2004. *** Indicates significance at the 1% level ** significance at 5%, * significance at 10%.

(i.e., sample 1), while it is negative and significant when we focus on the last decade of our dataset, irrespective of the presence of Germany in the dataset. This result is consistent with the literature on TFP growth in the European countries. In fact, along a time span similar to the one taken into account in the present analysis, van Ark et al. (2008) show that the effect of private ICT on TFP growth for the continental European countries is zero up to the mid-1980s, significantly negative during 1991-1996 and zero after that, leading the authors to conclude that ICT has at best had no effect on TFP index.

Estimates document the substitutability between ICT (public and private) capital and non-ICT capital (*nict*), which enters into the TFP equation with a negative (and also significant) parameter in all the (two of the three) samples employed. Furthermore, they show that, over the whole period, the TFP growth index increases with the share of medium skilled workers (*hhms*), while all employees contribute to the investment in private and public ICT (with some differences). On the contrary, when we consider the shorter samples, highly skilled workers never play a role.

Similarly to what happens in the political arena, our estimates suggest that age affects the contribution of the workforce (i.e., the labor productivity) to the TFP and private ICT, given that the parameter associated to lower ages (h_{29} and h_{49}) is generally greater than the one associated with h_{+50}. The worker age does not seem to have an effect on the public ICT equation.

Finally, looking at education (the second channel through which gerontocracy may affect economic performance according to our theoretical model), our results do not support the idea that public expenditure on education –whose limits we have previously described– unambiguously enhances TFP. Regressions ran with alternative aggregate measures (i.e., the share of the total public expenditure, TPE) confirm that, regardless of the proxy employed, the final impact of *pexpedu* on TFP growth is inconclusive.

Estimates using data by sector and countries

The results presented so far, although interesting, provide only an aggregate picture of the relationship between gerontocracy, ICT, and TFP. However, we know that it can be highly heterogeneous across the many sectors of the economy and/or by country. As already discussed in the previous sections, some of the relationships between ICT and TFP may be stronger or weaker depending on the specific sector/country where they apply. Therefore, in what follows, we first present elasticity results obtained by splitting our pooled samples by sector, and later we comment on the results by country.[11]

Table 4 provides the elasticities of TFP growth with respect to *gerontocracy* by sector. Estimates show that *gerontocracy* mainly hampers ICT intensive sectors, such as “Electrical machinery and telecommunication” and “Manufacturing”, and the “Retail services” (with significant elasticities in the range from -0.516 up to -0.671, in sample 1). Moreover, in contrast with the other sectors, the impact on

[11] The full set of parameter estimates by sector and country are available upon request from the authors.

"Personal and Social services" has grown along the period under observation (with elasticities moving from -0.145 in sub sample to -0.711 in sub sample 2).

We don't find evidence of the indirect effect "via private ICT", which is almost always non-significant or positive.

Finally, elasticities computed by country, reported in Table 5, show that the loss in terms of TFP growth has been particularly relevant in the UK (-1.611) and Italy (-4.160), and dramatic in Germany and Finland, where the estimated elasticities of TFP growth with respect to our measure of gerontocracy have been greater than 14% and 17%, respectively.[12]

Table 5. Elasticities of TFP growth with respect to Gerontocracy: by country

Country	Sample	Period	Obs.	Direct effect via *gict*	Indirect effect via *ict*	Total effect
Denmark	Sample 1	1983:2004	480	0.254	0.079	0.333
Finland	Sample 1	1983:2004	480	-15.026***	-2.501	-17.528***
France	Sample 1	1983:2004	480	0.038	-0.02	0.172
Germany[a]	Sample 2	1995:2004	192	-12.273**	-2.26	-14.533**
Italy[b]	Sample 1	1983:2004	415	-4.160***	0	-4.160***
Netherland	Sample 1	1983:2004	468	-1.312***	0.919***	-0.393
UK	Sample 1	1983:2004	480	-1.646***	0.035	-1.611***

Notes: ab Due to constancy over time, some variables have not been included as controls in the gict equation for Germany and Italy: therefore, they are slightly different from those of other countries. *** Indicates significance at the 1% level, ** significance at 5%, * significance at 10%.

C. Robustness checks

In order to check the robustness of our results to different model specifications, in this section, we briefly present all the alternatives we have estimated and compare the results with the baseline specification presented in the previous section.[13]

Our first robustness check has been devoted to analyzing the role of gerontocracy variables as regressors in the private ICT equation (23). In fact, although according to our theoretical model the set of gerontocracy-related variables should not affect

[12] These results must be interpreted with caution since, in contrast to pooled and sector estimates, country estimates are not robust to changes in the definition of the sample.

[13] As our results are robust to the alternative specifications used, for sake of brevity we do not present and discuss in detail all the parameter estimates. However, they are available upon request from the authors.

private ICT, we have run a model specification that includes them. Results have shown that these variables are never statistically significant, and, in any case, the magnitude of the parameter estimates has always been very low across samples, sectors, and countries.

We have checked if alternative specifications, involving gerontocracy variable interactions and politicians' background variables could have had an effect on the overall results. According to our results, adding these interactions produces slightly less accurate estimates, but the main results do not change significantly with respect to those reported in the previous section. This effect has been noticed in particular in the estimates by sector and by country, and in our view this should simply reflect a problem of efficiency (due to small sample size in presence of an increased number of parameters to be estimated).

As a further robustness check, we have also estimated a model in which the lagged logarithm of private ICT enters as regressor in the *gict* equation. While the overall results and economic conclusions do not change, it is interesting to note that with this new specification there is a strong feedback effect between *ict* and *gict*, self reinforcing each other. No change is observed in terms of a gerontocracy effect on TFP.

We have also adjusted *gerontocracy* and *newcomers* for country specific life expectancies, in order to account for different interpretations of the politicians' age according to country specific social norms imposed by different countries average ages. Actually, these are further ways to control for endogeneity. All results are fully confirmed in terms of sign, magnitude and significance. Alternatively, we add the (log of the) population's median age to the set of regressors in equation (22). The results are in line with those obtained in the baseline specification, and the elasticity of the TFP growth with respect to gerontocracy varies between -0.397 and -0.382. We also run regressions replacing our measure of gerontocracy with the population median age. Even in this case, the signs and the magnitudes of the elasticities are consistent with the theory, and the elasticity of the TFP growth with respect to this other proxy for gerontocracy is equal to -0.429 in sample 1, -0.919 in sample 2, and -0.462 in sample 3 (see Table A6 in the online appendix).[14]

We attempted to control for the cabinet's political orientation by adding a dummy variable, which is equal to 1 if the Prime Minister belongs to a conservative party (e.g., the Tories in UK, Democrazia Cristiana or Forza Italia in Italy, Christlich Demokratische Union in Germany, Rassemblement pour la République in France,

[14] Data for life expectancy and population median age are obtained by EUROSTAT.

etc.) and 0 otherwise. The effect of this dummy on the TFP growth is slightly negative (i.e., a right-wing government is correlated to a decrease of 0.007% of the TFP index) in sample 1 and slightly positive in the other two samples (0.009% and 0.005%, respectively) while the elasticities of TFP with respect to gerontocracy do not change significantly (see Table A7 in the online appendix).[15]

Moreover, as our education variable does not produce convincing results, we have estimated our model using a measure of education expenditure obtained as ratio to TPE rather than to GDP. Even in this case, education appears to affect private and public ICT not in an unambiguous way, while the results in terms of gerontocracy remain in line with those presented in the previous section.

V. Conclusions

In this paper, we argue that when relatively young people cease to be the engine of an economy, long-run economic growth is endangered. Over the last three decades, many European economies have fallen into an old-age trap, a self-reinforcing mechanism whereby élites, generally the most aged individuals, have used control of the political system to exclude new generations, who are reasonably the most dynamic and innovative part of the population, from the access to power.

While we do not analyze this mechanism formally (i.e., we do not explain what the determinants of gerontocracy are), nor we do focus on some possible "positive" consequences that gerontocracy may have on a society as a whole, for example in reducing inequalities, we focus our effort on exploring the possible linkages between the age of the ruling class and the long-run growth rates both theoretically and empirically.

To achieve this goal, we have developed a simple endogenous growth model where the long-run growth rate is directly affected by public productive services and public investment in education. Moving from the conjecture that an older élites displays a higher impatience rate, the main testable hypothesis derived from our theoretical model is that the older the ruling class, the lower the public investment in education and productive services.

[15] This result is rather obvious. In fact, our sample includes six high-income liberal democracies along the period 1983-2003. These countries are quite "homogenous" with respect to the characteristics of the political environment, i.e., average electoral volatility, party closeness, etc. Our estimates show that in these countries the swing of the *political pendulum* (left to right and vice versa) does not matter a lot. On the contrary, it may matter in the comparison across countries. In our empirical analysis, however, this feature is already captured by the country dummies.

The empirical analysis corroborates these findings. Estimates indicate that, on average, a decrease of gerontocracy unambiguously increases TFP, with elasticities ranging between -0.314% and -0.438%, depending on the sample employed. Furthermore, we find gerontocracy affects TFP via *gict*, i.e., what we called the “direct effect” is always negative, and this result holds using both the pooled data or the data by country and sector. In addition, the negative effect of *gerontocracy* on TFP growth is stronger in those sectors, such as electrical machinery and telecommunication, retail service and manufacturing, where ICT is expected to be essential. Our estimates indicate that the consequences of gerontocracy have been more severe in Germany, Finland, and Italy compared to the other European countries included in our sample. These results are robust to different alternative model specifications and estimators, although sometimes the magnitudes of the effect have changed.

Finally, in terms of our future agenda, there are several extensions to our approach that are worth pursuing. In the theoretical model, for instance, we introduce several assumptions aimed at obtaining an analytically friendly framework. The next step will be to test how robust these results are when these simplifications are relaxed. In particular, we plan to address in a subsequent work the formal attempt to endogenize the gerontocracy. Moreover, from an empirical standpoint, we delegate to a further paper the extension of our data set in order to include information on the managers employed in the private sector.

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