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ABSTRACT: We study, theoretically and empirically, the link between voters' support for public education and pensions when agents are free to choose between public and private education. We show that the (inter-generational) redistributive component in the retirement system creates a link between pensions and education. Specifically, the current investment in education increases future productivity and, hence, future tax proceeds. This channel applies for households that chose private education too. Consequently, the support for publicly financed education grows together with the generosity and degree of redistribution of the retirement system. The empirical analysis uses repeated cross-country surveys to confirm the model predictions.

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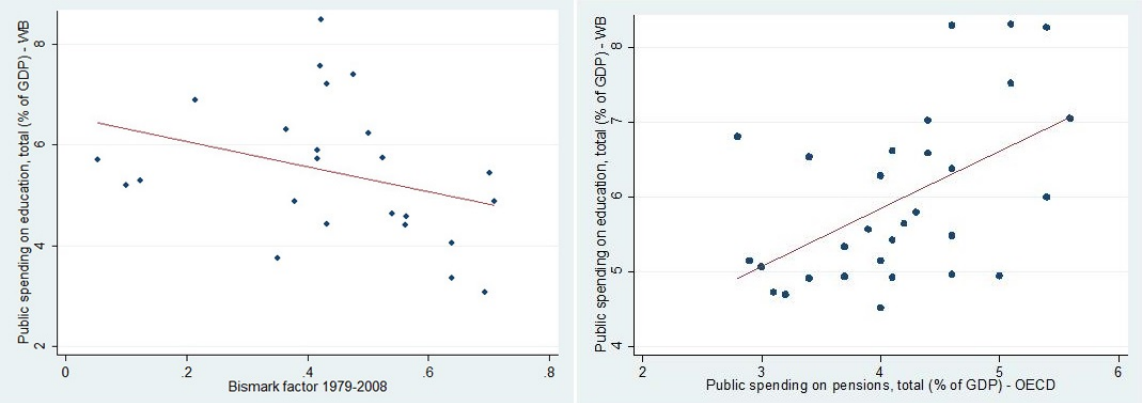
1 Introduction

Education and pensions are used for inter- and intra-generational redistribution. They constitute major components of the annual budget. The incessant need to free additional resources out of tightened budgets may explain why most western governments are contemplating reforms to both the education and the pension systems. However, voter preferences cannot be ignored by elected politicians: both pensions and education come under very close scrutiny, which limits the policy space of politicians with re-election concerns.

Public spending in education correlates (Fig. 1) negatively with the Bismarkian factor (contributory component of the pension) and positively with the total spending in pensions. Our paper contributes to the literature on the political economy of publicly provided goods, by combining voters' concerns for the provision of public education and pensions. In particular, we investigate the interconnection between public spending in education and pensions, when citizens are also offered a private-education alternative. We are specifically interested in looking at how the voters' support to publicly-funded education may vary depending on the characteristics and generosity of the retirement scheme.

Figure 1: Public spending on education (% of GDP) in OECD countries with above-average spending on pensions versus: [left] Bismarck factor and [right] spending on pensions (% of GDP)



Note: Authors' calculations based on World Bank, OECD and Krieger and Traub's (2011, 2013) data.
[left] Correlation Education-Bismark ≈ -0.33; [right] Correlation Education-Pensions ≈ 0.52
See appendix B for more details.

Education provides private benefits to students and public education may help to level the playing field for new generations. Together with parents' altruism towards their own children, this may explain some support for a publicly funded system. However, the political equilibrium may depend on the presence of a private alternative (Epple and Romano, 1996a,b; Cohen-Zada and Justman, 2003) and, possibly, also on how private school is financed (Epple and Romano, 1998; Chen and West, 2000; Gradstein and Justman, 2005; Piolatto, 2010; Epple et al., 2018; Akyol, 2016). Beyond that, education produces positive externalities, e.g. it helps to reduce social conflicts (Gradstein, 2000). More importantly, education affects productivity, income and economic growth (Romer, 1986; Gradstein and Justman, 1997; Sanchez-Losada, 2000; Baum and Lake, 2003; Barro, 2013).

Investing in education becomes a way to increase the productivity of future labour force. Our model shows that citizens are able to reappropriate part of the spending in education

through the pension system as long as it includes a 'pay-as-you-go' (inter-generation redistributive) component.[1] When this is the case, citizens start to care about the quality of education of all the young, not just of their offspring, because a larger investment in education today affects the state ability to finance pensions tomorrow. This mechanism affects positively the support for publicly funded education also among households who opted for a private-education school. The importance of such redistribution channel depends on the magnitude of the retirement system. Consequently, the generalised support for publicly funded education hinges on the combination of the Bismark (contributory) component of pensions and of the size of the pension scheme. Our empirical analysis tests and confirms the model's predictions.

In our two-period stylised model, adults choose the type of eductation for their offspring (private or public) and vote over the income tax rate that finances current public education. Agents are concerned by their current and future consumption, where the latter depends on pensions. We take the tax rate that finances pensions as exogenous (Section 2.1 discusses this assumption), yet agents can influence their future pensions by investing in the education of young agents, as this increases future average income and, therefore, the level of inter-generational redistribution. We investigate the extent to which incentives to invest in education are affected by the pension system and, more particularly, by the importance of its contributory and redistributive components.

We conclude that the agents' support for publicly funded education is i) decreasing in the Bismarck (contributory) component of pensions and ii) increasing in the magnitude/generosity of the pension system. Hence, the lower the degree of inter-generational redistribution characterising the pension system, the less willing agents are to invest in public education. Furthermore, agents care more about public education as the stake in their pensions increases.

In order to provide a formal test for these theoretical predictions, we combine micro-level and country-level data. We exploit four waves of a survey on public opinion about public policies run between 1985 and 2006 in 13 countries among a nationally representative sample of individuals including, on aggregate, more than 30,000 respondents. By employing several different specifications and progressively less parsimonious set of control variables, we provide strong validation of the theoretical predictions. Namely, our results confirm that the support for publicly financed education is decreasing in the Bismarckian factor (estimated by Krieger and Traub, 2013) while it is increasing in the generosity of the pension system measured as the public expenditure (% of GDP) on old-age pensions.

Lancia and Russo (2016) consider a setting similar to our. Their dynamic theoretical model focuses on the generational conflict between workers and pensioners over the allocation of budget. Current pensioners are not interested in education spending, while workers are only interested in future pensions. They study the conditions under which the implementation of public education and social security survive voting in a small open economy. What crucially distinguish our work from theirs is the fact that we allow parents to chose between public and private education, that we explicitly model the degree of redistribution of the pension system (through the Bismark factor) and that we test our predictions using individual-level data.

Our work is also related to Bishnu and Wang (2017), who study how investments in education and pensions has general equilibrium effects. Their focus is specifically on the

[1] In most OECD countries, pension systems include a pay-as-you-go component, albeit with varying degrees of redistribution. Kritzer and Jankowski (2010) provide an overview of the salient characteristics of all European countries' pension systems.

welfare consequences of it. We are also close in spirit with Bellettini and Ceroni (1999) who, in the words of the authors, 'show that redistributive and growth-oriented policies, although competing for scarce tax revenues, might go hand in hand and bring about fast economic growth. In particular, the aim of [their] paper is not to provide a positive theory for the existence of social security systems, but rather to show how to design a social security system which may foster public investment and economic growth.'

The idea that education, affecting growth, allows to increase the tax proceeds that will finance future pensions is not new. Kaganovich and Zilcha (1999) focus on the optimal allocation of fixed tax proceeds between education and social security. Bellettini and Ceroni (2000); Pecchenino and Pollard (2002) and Zhang and Zhang (2004) study the impact of social security and education on growth; Soares (2003) studies the preference of agents for public investment in education and how they allocate their time between education and working. Boldrin and Montes (2005, 2009) undertake normative studies of education and pensions and the optimal intergenerational transfer scheme. Poterba (1998); Echevarría (2004); Sanz and Velázquez (2007); Cattaneo and Wolter (2009); Rattsø and Sørensen (2010) and Gonzalez-Eiras and Niepelt (2012) look at how a change in the composition of society (age distribution, life expectancy, etc.) affects the provision of pensions and education, given a fixed budget. Those authors disregard the political feasibility of policies aimed at financing public education. Instead, we focus on how forward-looking adults change their behaviour and invest in young's education, to guarantee a sustainable pension system in the future.

The paper is structured as follows. Section 2 presents the model. In Section 3 we bring the model predictions to the data. Section 4 concludes. Proofs are in appendix A.

2 The model

The aim of this work is to study the interaction between the willingness to invest in education and the pension system. We propose a stylised model that includes several elements and, as customary, we introduced some assumptions that simplify the structure. In the interest of readability, we postpone to Section 2.1 the discussion about possible limitations of the model.

We consider a two period model that could be easily interpreted as a reduced form of an OLG model.[2] For the sake of parsimony, we assume no population growth and no discount of the future.[3] In period 0 each adult works and votes over the tax to finance public schools. They allocate their income between own consumption (current and future) and their child's education. In period 1, adults have retired and enjoy their pension. Young agents attend school in 0, while in 1 they work and pay the tax to finance pensions. In our model, all the decisions are taken in 0 by adults, while young agents play no active role.

Compulsory education is both publicly and privately provided: the two are mutually exclusive. The quality of education, measured as per student expenditure, is denoted by X_P for the public sector and X_R for the private. $\overline{X}$ is the average quality of education, measured as the average spending on instruction. Our interest lies in adults' willingness to pay both for the education of their own offspring and to finance public education. We only need to focus on education in period 0, hence we do not need a time index for X. Public education is financed through a universal and proportional tax (t) on income (ω) and access to it is free.

[2]Focusing on a two period model allows to simplify the setting and the notation in a convenient way.

[3]Both assumptions have no qualitative impact on the results.

We assume the quality of education to be homogeneous amongst all public schools. Private schools are costly and adults choose the level of quality they wish to buy for their offspring.[4]

Adults vote on the tax rate for financing public education and how much to spend for their own child's education (in the case of public schooling, the expenditure is simply 0). The residual income is used to consume the numeraire good b. Adults (in 0) are concerned by their child's education X and their current and future consumption of the numeraire good (respectively b_0 and b_1), as in the models of 'intergenerational altruism'. Their life-time utility function is

$$U(b_0, b_1, X) = b_0 + b_1 + \lambda \omega_0^{\beta} \ln X. \tag{1}$$

The quasi-linear specification comes naturally: in this setting, consumption (b) is the numeraire, which should shift the indifference curves outward as consumption of it increases, without changing their slope. Consistently with that, the quasi-linear specification guarantees that the Marginal Rate of Substitution only depends on the consumption of education (X).

In Eq. (1), λ defines the weight of education relative to the consumption of the numeraire good while $\beta \geq 0$ determines how income and willingness to pay for education are related. With $\beta = 0$, all agents care equally about education, while if $\beta > 0$, the utility of education is increasing in income.

Adults' income in period 0 (ω_0) is exogenous and uniformly distributed amongst a unit mass of agents: $\omega_0 \sim U[0, 1]$. Investing in education affects young agents' productivity and therefore their income (received in period 1). To incorporate this feature in the model, we use a reduced form where young agents' income (ω_y) is increasing and concave in the education they received in 0 (hence, the Marginal Product of education is diminishing). In particular, we assume young's income in 1 to be

$$\omega_y = \omega_0 + X^{\phi}, \tag{2}$$

with $\phi < 1$. The average income of young agents in 1 is $\bar{\omega}_y$.

Pensions are adults' sole source of income in period 1 and are not taxed. Following Casamatta et al. (2000), the pension system comprises a contributory and a redistributive component. We denote by $\alpha \in [0, 1]$ the Bismarckian (or contributory) component, i.e. the share of a pension that depends on the agent's previous contributions. The remaining $(1 - \alpha)$ of the pension, the redistributive component, depends on the average contribution of the current workers. Using s to indicate the income tax that finances pensions, in period 0 each adult pays $s\omega_0$ to the pension system, of which $(1 - \alpha)s\omega_0$ is used to pay current pensions, while $\alpha s\omega_0$ is paid back to the worker in period 1 as a pension. Therefore, an adult in period 1 receives a pension $s(\alpha\omega_0 + (1 - \alpha)\bar{\omega}_y)$. We assume both α and s to be exogenous.

Then, adults' disposable income in period 0 is $(1 - t - s)\,\omega_0$, from which follows that their numeraire consumption in the first period is $b_0 = (1 - t - s)\,\omega_0 - X_R$, where $X_R = 0$ if a child attends public school.

Let n denote the share of students attending public school. The quality of public school X_P (corresponding to the per-student expenditure) follows directly from the public school budget constraint $nX_P \leq t\bar{\omega_0}$, and is:

$$X_P = \frac{t\bar{\omega_0}}{n}, \tag{3}$$

[4]Since public education is free, by revealed preferences, agents willing to attend a costly private school must perceive it to be of higher quality than public schools.

2.1 Discussion of the model design

Some of the modelling choices that we made deserve some comments: we regrouped them here. We will begin discussing Eq. (1) and, in particular, the role of β. Then we will spend some words about the Marginal Product of education and Eq. (2). Next, we will discuss the choice of keeping the choice of s exogenous. Finally, we will briefly speculate on why fertility may matter.

Role of β Looking at Eq. (1), the marginal utility of education depends on an agent (ω_0). Implicitly, this is based on the idea of a positive correlation between wealth and willingness to invest in the own child's education. This is consistent with the literature (see, for example, Griliches and Mason, 1972; Dur et al., 2004) and can be intended as a consequence of the preference of wealthy (and possibly well-educated) parents to invest in human capital and to enhance their offspring future productivity. However, by assuming $\beta \geq 0$ we are allowing income to impact the marginal utility of education either linearly ($\beta = 0$) or increasingly ($\beta > 0$). This assumption, again, is consistent with the literature: indeed, Tolley and Olson (1971) estimates that a 1% increase in non-human wealth leads to an increase in education expenditure of 1.65%.

Marginal product of education The assumption on the distribution of the initial income ω_0 is made to be able to compute the first moment and analytically solve the model in a closed form. The main results are robust to modifications in the distribution of income.

Furthermore, the functional form of Eq. (2) is only relevant to the extent that it ensures a strictly positive relationship between current investment in education and future income. The specific functional form of Eq. (2), especially when combined with Eq. (1), can indeed be considered a reduced form that accounts for the fact that earnings are positively correlated with education and that we observe a high intergenerational persistence of income.

The idea of income being positively correlated with education is widely supported in the literature (see Tolley and Olson, 1971; Card, 2001; Lemieux, 2006, and the references therein). A high persistence of income is found, amongst others, by Lee and Solon (2009) for the US. Mazumder (2005) estimates the US Intergenerational Income Elasticity (IIE) to be 0.61. Lefgren et al. (2012) estimates for Sweden are slightly lower (between 0.29 and 0.4). The reduced form that we use, combined with the fact that low income agents tend to prefer public education, would suggest a non-linear persistence of income, with a tendency to converge for low incomes. This is precisely reported by Bratsberg et al. (2007) for Denmark, Finland and Norway.

Voting on pensions: We assume the tax rate that finances pensions to be exogenous. Interested readers may refer to Casamatta et al. (2000) for a model on retirements with vote on s. Our setting fits with the idea that a change in the pension system requires more time and a larger consensus than, for example, the expenditure decision for education.[5] Proposition 2 studies the impact of a variation in s on our equilibrium (comparative statics).

Our decision to keep the pension tax fixed follows two rationales. First, within our stylised setting with selfish agents and no commitment, a decision upon tax s simply leads to a generational clash: each generation would like to extract surplus from the subsequent one and to leave nothing to the previous one. A corner solution is inevitable, unless imposing some (arbitrary) inter-generational agreement or assuming that the decision is the outcome

[5]For example, this occurs when a generation of adults chooses the pension tax rate that will apply for a sufficiently large period of time.

of some cooperative bargaining.[6] Shall we do that, results would follow directly from the imposed assumptions (i.e. results would be assumption-driven) and would bring no additional insights. Second, when decision are taken by majority voting, choosing over a two-dimensional policy is methodologically problematic.[7] The existence of a unique equilibrium depends on the specific voting design. In particular, which policy is voted first may matter (Cremer et al., 2004). Results may still be qualitatively robust, but the set of assumptions required to solve the model would be at least as arbitrary as the choice of keeping the variable exogenous. Given the purpose of our analysis, we believe that keeping s exogenous is both reasonable and convenient.

Fertility: In their work, Croix and Doepke (2009) show that households opting for a private education reduce their fertility to partially compensate for the additional source of expenditure that education represents. Therefore, the endogenous educational choice has an impact on the share of young attending public school. While we definitely agree that fertility could be intrinsically related to education, none of the attempts to endogenise the fertility decision in a tractable way within our setting provides novel insights. Still, based on what we learn from Croix and Doepke (2009), we can speculate that our model underestimates the share of students attending public schools. Since households opting for public education are also keener to support it through taxes, this also means that we expect a (weakly) positive correlation between fertility and the voters' support for expanding the public investment in education. Our empirical analysis (Table 2) shows that this is indeed the case.

2.2 Adults' utility maximising behaviour

In our model, the only active citizens are adults in period 0. In period 0, young agents are not allowed to vote and their consumption of education is decided by adults. Adults retire in period 1 and enjoy consumption, based on the decisions taken in period 0. We compute here the optimal adults' behaviour.

Adults first vote over the tax rate to finance public education, then they decide between public and private education, and finally they choose the share of budget to devote to consumption and to private education (where a zero share implicitly means choosing public education). It stands to reason that an agent prefers public to private education if and only if the utility derived is higher. This means that people attend a private school if and only if $U(b_0, b_1, X_R) \geq U(b_0, b_1, X_P)$.

Solving the model backward, we consider separately the optimal behaviour of an agent depending on which path is taken (i.e. public versus private education), starting with the choice for households that opt for public education. Once computed the preferred tax rate for both types of agent, we compute the conditions under which an agent prefers public to private education, given the tax rate. Finally, we study how total expenditure on education depends on the tax rate and derive some properties of the preferred tax by an agent.

Conditional on opting for public education, adults' consumption directly depends on the tax rate and, hence, on disposable income: we immediately obtain that $b_0 = (1 - t - s)\omega_0$, and $b_1 = s(\alpha\omega_0 + (1 - \alpha)\bar{\omega}_y)$. At the first stage of the decision process, the preferred tax rate

[6] The latter would be similar, in spirit, to what occurs, for example, in Lancia and Russo (2016).

[7] Lancia and Russo (2016); Bishnu and Wang (2017) avoid the issue by choosing a probabilistic voting design.

t to finance public education is the one that solves the following maximisation problem:

$$\max_t \; U(b_0, b_1, X_P) = b_0 + b_1 + \lambda \omega_0^\beta \ln X_P \tag{4}$$
$$s.t.\; b_0 = (1 - t - s)\omega_0$$
$$b_1 = s(\alpha\omega_0 + (1-\alpha)\bar{\omega}_y)$$
$$X_P = \frac{t\bar{\omega}_0}{n}$$

The first order condition is:

$$(1-\alpha)s\frac{\partial \bar{\omega}_y}{\partial t} + \lambda\omega_0^\beta \left(\frac{1}{t} - \frac{1}{n}\frac{\partial n}{\partial t}\right) = \omega_0. \tag{5}$$

Eq. (5) implicitly defines the preferred tax t_P to finance public education for an adult opting for the public school system. The right hand side represents the cost of an increase in tax rate t (i.e. the reduction in disposable income). On the left hand side, the first term accounts for how the agent's own future income is affected by a change in the average current consumption of education, via the redistributive component of pensions. The second term accounts for the direct utility change following a change in the quality of public education. More specifically, following an increase in t, the first term within the parentheses accounts for the increase in resources invested in public education, while the second one considers the variation of X_P due to the change in the number of students in public schools.[8]

Conditional on opting for private education, the maximisation problem of an adult consists instead in choosing the share of budget to devote to education, and the tax rate that would be optimal:

$$\max_{t, X_R} \; U(b_0, b_1, X_R) = b_0 + b_1 + \lambda \omega_0^\beta \ln X_R \tag{6}$$
$$s.t.\; b_0 = (1 - t - s)\omega_0 - X_R$$
$$b_1 = s(\alpha\omega_0 + (1-\alpha)\bar{\omega}_y)$$

The first order conditions are:

$$X_R = \lambda\omega_0^\beta \tag{7}$$

$$\frac{\partial \bar{\omega}_y}{\partial t} = \frac{\omega_0}{(1-\alpha)s} \tag{8}$$

Eq. (7) defines the preferred consumption of private education X_R, while Eq. (8) defines the preferred tax rate t_R of an adult opting for private education.[9] For an internal solution

[8]The proof of Proposition 3 will show that the preferred tax rate is convex in income. Notice that this is needed to derive the properties of the voting equilibrium, however, Propositions 1 and 2 only rely on the properties of the preferred tax by an individual, regardless of the type of voting equilibrium.

[9]Notice that Eq. (7) disregards any possible effect of a change in X_R on average income $\bar{\omega}_y$. One could then argue that the term $-\partial b_1/\partial X_R$ on the left hand side of the equation is missing. However, this term represents the change in the population average income due to a variation in the expenditure of a single agent. With atomistic agents (that is, with a sufficiently large population), this effect tends to zero rapidly and this effect is negligible.

we need $\frac{\partial \bar{\omega}_y}{\partial t} > 0$ and $\frac{\partial^2 \bar{\omega}_y}{\partial t^2} < 0$, which occurs if an increase in public expenditure in education induces a concave increase in total expenditure in education.

Knowing the preferred expenditure in private education, we can now study the condition under which an agent prefers private to public education, given a generic tax rate t. Agents choose private school if and only if $U(b_0, b_1, X_R) \geq U(b_0, b_1, X_P)$, that is, if $-X_R + \lambda \omega_0^\beta \ln X_R \geq \lambda \omega_0^\beta \ln \frac{t\bar{\omega}_0}{n}$. Then, we denote by $\tilde{\omega}$ the income for which an adult is indifferent to the two types of schooling:

$$\tilde{\omega} = \left(\frac{et\bar{\omega_0}}{\lambda n}\right)^{1/\beta} = \left(\frac{et}{2\lambda n}\right)^{1/\beta}, \tag{9}$$

where e is the Napier's constant (or Euler number). By construction, the number of agents attending public school (n) corresponds to all agents with income below $\tilde{\omega}$. Hence, $n = \int_0^{\tilde{\omega}} d\omega_0$ and we obtain that

$$\tilde{\omega} = n = \left(\frac{et}{2\lambda}\right)^{\frac{1}{\beta+1}}, \tag{10}$$

$$X_P = \left(\frac{\lambda t^\beta}{e 2^\beta}\right)^{\frac{1}{\beta+1}}. \tag{11}$$

Lemma 1. *The average income in period 1 of those who were young in period 0 is*

$$\bar{\omega}_y = \frac{1}{2} + \frac{\lambda^\phi}{\beta\phi + 1} + \left(\frac{e}{\lambda}\right)^{\frac{1-\phi}{\beta+1}} \left(1 - \frac{e^\phi}{\beta\phi + 1}\right) \left(\frac{t}{2}\right)^{\frac{\beta\phi+1}{\beta+1}} \tag{12}$$

Proposition 1. *An increase in the tax t always improves the quality of public school. This attracts more students to the public sector, which mitigates the increase in per capita expenditure, but nevertheless the total impact is positive. However, the total per capita expenditure in private and public education may fall, and this would have a negative impact on the average income in the subsequent period.*

Corollary. *The tax rate preferred by an adult is always higher when opting for the public education system. Furthermore, for adults opting for private education, the preferred tax rate is decreasing and convex in income.*

Proposition 1 has important policy implications: it says that an increase in the total expenditure for public education may be offset by a decrease in private expenditure. Hence, increasing the tax rate t may induce a reduction in future total wealth. This is because an increase in the tax to finance public education makes the individual's budget constraint more stringent and, at the same time, public school becomes more attractive. Therefore, fewer people attend a private school ($\tilde{\omega}$ increases). Given that, in equilibrium, the per pupil expenditure in private school is higher than that in the public sector, a shift from the private to the public sector may imply an overall fall in investment in education. This implies that the average income in the subsequent period also falls.

The condition $\beta > \frac{e^\phi - 1}{\phi}$ guarantees that an increase in the tax rate induces a higher aggregate expenditure on education. It requires that ϕ is sufficiently small compared to β. This means either that we need the desire for high quality education to be increasing rapidly in income, or that the returns on education are sufficiently small. Actually, the above-mentioned condition, together with $\phi \leq 1$, is both necessary and sufficient for the maximisation problem of adults preferring private education to be well behaved, and therefore we assume it to hold.

As discussed in Section 2.1, these assumptions seem consistent with results in Tolley and Olson (1971).

As a first step towards our analysis of the impact of the pension system on the choice to invest in public education, the following proposition studies the sign of the change in the preferred tax rate following a change in the parameters of the pension system (α and s).

Proposition 2. *Under the maintained assumption that $\beta > \frac{e^{\phi}-1}{\phi}$, the equilibrium tax rate t, decided by the majority vote of all adults, is decreasing in the Bismarckian factor α (the contributory component of the pension system) while it is increasing in the tax rate s that finances pensions.*

According to Proposition 2, both s and α impact all agents in a same way, regardless of their choice about the type of schooling. This means that all agents, including the decisive voter (regardless of his identity) will behave in a predictable way.

The intuition behind Proposition 2 is that voters care about their future consumption, which depends on the two components of the pension (the Bismarckian factor α and the redistributive component). The redistributive component of pensions depends on the population average income, which in turn depends on the average investment in education. Hence, agents are willing to invest in public education in order to raise the average level of education and, hence, their own future pension. The smaller α is (hence, the greater the degree of redistribution provided by the pension system is), the stronger this channel is. Consequently, lower levels of α coincide with a more vigorous support for the public investment in education. By contrast, the share of others' private-returns-on-education that an agent can appropriate through pensions decreases when α increases, hence, voters are less willing to sacrifice their own current consumption (by paying a higher tax on their income).

The magnitude of this effect depends on size of the pension scheme (s). In particular, the channel is stronger when s is larger. To better understand this, it is helpful to distinguish between the two components of the pension scheme (Bismarkian/contributory and redistributive). Concerning the Bismarckian component of the pension scheme, a change in s corresponds to an intertemporal shift of consumption within the same agent and, as such, it does not affect the voters' willingness to pay for public education. Nevertheless, for any $\alpha < 1$, the size of s is relevant through the redistributive component, because an increase of s implies an increase in the amount of the wealth that is redistributed across generations. Public education can be seen as an investment leading to an increase in the future average income, with $s(1-\alpha)$ being the share of the returns on the investment that agents are able to appropriate. Hence, s magnifies the importance of the redistributive component and induces adults to vote for a higher tax rate t.

Proposition 2 depends crucially on the condition that $\beta > \frac{e^{\phi}-1}{\phi}$. Intuitively, this condition ensures that the equilibrium total expenditure in education (hence, including private education) is increasing when public investment in education increases. Investments in private education are substantial: if an increase in the quality of public education were to attract too many households and divert too much money away from the educational system, the mechanism behind the model would backfire.

2.3 The voting equilibrium

The previous results are independent of the voting process and the identity of the decisive voter. We now analyse the voting equilibrium, focusing on the possible types of coalitions

that might form when voting on the tax t.

Although the richness of the model limits our possibilities of studying the voting equilibrium and of having a closed-form solutions, Proposition 3 does indicate the type of voting equilibrium that the model might generate.

Proposition 3. *When adults vote on t, two types of equilibrium may prevail:*
i) the median income voter ($\omega = \frac{1}{2}$) is decisive; all agents poorer than the median would prefer a higher tax rate, while the others would prefer a lower tax rate. This equilibrium occurs if and only if the median voter's preferred tax is larger than the one preferred by the agent with income $\tilde{\omega}$, i.e. $t_P^*(\frac{1}{2}) \geq t_P^*(\tilde{\omega})$.
ii) Otherwise, in the prevailing equilibrium the two opposing coalitions include: a) the richest agents in the population, together with agents in the neighbourhood of the median income voter (seeking for a reduction in the tax rate), opposed to b) the poorest agents in the population, together with agents in a neighbourhood of $\tilde{\omega}$ (all in favour of a rise of the tax rate).

In our model, agents with income below $\tilde{\omega}$ attend a (tuition-free) public school, while agents with income $\omega > \tilde{\omega}$ opt for a (costly) private education and invest more in education than the per pupil expenditure in the public sector. To understand the intuition behind the voters' behaviour, we must consider that two mechanisms are operating simultaneously: on the one hand, publicly financed education generates redistribution from the wealthier to the poorer agents in society via two channels (public schools and the redistributive component of pensions); on the other hand, richer agents care more for their children's education, and so are more willing to substitute consumption of the numeraire good for education than are other agents. The redistribution channel means poorer agents ask for higher taxes, while the other channel means the middle classes (the richest agents attending public schools) ask for higher taxes. If we combine the two effects, the tax preferred by an agent attending public school may either be decreasing in income over all its support, or it may be decreasing up to some income $\underline{\omega}$, and then increase for $\omega \in [\underline{\omega}, \tilde{\omega}]$.

When $t_P^*(\frac{1}{2}) > t_P^*(\tilde{\omega})$ (see Fig. 2 in the appendix), the redistribution effect is so strong that the first half of the population always favours a sufficiently high tax rate, so that we have the very standard result whereby the median voter is pivotal (although preferences are not unimodal). Poor agents are in favour of high taxation, since they profit from wealth redistribution and enjoy public education services, and wealthier agents prefer a lower taxation.[10]

For the alternative case, when $t_P^*(\frac{1}{2}) < t_P^*(\tilde{\omega})$ (see Fig. 3 in the appendix), a number of agents in public school are neither sufficiently poor to enjoy significant gains from redistribution, nor rich enough to be sufficiently willing to pay for private education. These agents have an 'intermediate' income, i.e. their income is in a neighbourhood of the median income; hence, they are neither the poorest nor the richest in the public school system. This group forms a coalition with the richest agents in the economy, with the aim of lowering the tax rate. This coalition opposes a coalition of the poorest adults (who gain from redistribution) and the middle classes with income in the neighbourhood of $\tilde{\omega}$.[11]

[10] This type of equilibrium appears, among others, in Epple and Romano (1996b) and Cohen-Zada and Justman (2003).

[11] Coalitions that are non-linear in income are not new in the education literature. In Epple and Romano (1996a); Piolatto (2010), an 'Ends Against the Middle' equilibrium occurs under the assumption of single crossing denoted slope rising in income (SRI).

3 Empirical Analysis

The theoretical framework presents interesting and novel insights about the link between voters' support for publicly provided education and the retirement system. According to the model predictions, the share of public resources (voted and) devoted to finance public education is decreasing in the contributory component of the pension system, the Bismarckian factor, while it is increasing in the pension system's generosity, i.e. the share of public resources used to finance public pensions (Proposition 2). Such prediction is robust to voters' income or schooling choice. Next, we present the methodology and data employed to test these findings, discuss our identification strategy, and finally present and comment the main results.

3.1 Identification strategy and data

Following the theoretical discussion, we test the predictions of Proposition 2 by employing micro data on individual preferences and attitudes towards the financing of publicly provided education. In particular, we rely on data extracted from repeated waves (1985, 1990, 1996, 2006) of the survey 'ISSP Role of Government' conducted and released by GESIS – Leibniz Institute for the Social Sciences. This repeated cross-section survey reports information on subjective preferences and attitudes towards government responsibilities and government spending, state intervention in the economy, civil liberties, political interest, trust and efficacy across several countries.[12] The relevant question used to define our dependent variable is:

'Listed below are various areas of government spending [including Education]. Please show whether you would like to see more or less government spending in each area. Remember that if you say 'much more', it might require a tax increase to pay for it.'

The set of possible answers included: 'spend much more'; 'spend more'; 'spend the same as now'; 'spend less'; 'spend much less'. This question has remained unchanged over the 1985-2006 period. For any respondent i, in country j, in period p, we code the answer to this question into the variable t_{ijp}, which we have re-scaled from 'spend much less' (1) to 'spend much more' (5) according to the answer. Thus, by defining t_{ijp} as an ordinal dependent variable measuring individual i's unobservable actual desired share of public resources to devote to public education (t^*_{ijp}), we can design an ordered response model:

$$t^*_{ijp} = \beta_1 \alpha_{jp} + \beta_2 s_{jp} + Y_{ijp}\beta_3 + X_{jp}\beta_4 + \theta_j + \tau_p + \varepsilon_{ijp} \tag{13}$$

$$t_{ijp} = \begin{cases} 1 \text{ if } t^*_{ijp} \leq w_1 \\ 2 \text{ if } w_1 < t^*_{ijp} \leq w_2 \\ 3 \text{ if } w_2 < t^*_{ijp} \leq w_3 \\ 4 \text{ if } w_3 < t^*_{ijp} \leq w_4 \\ 5 \text{ if } t^*_{ijp} > w_4 \end{cases} \tag{14}$$

[12] We included in our analysis the 13 countries for which all relevant measures of interest are available for the whole considered period. Namely, we encompass Australia, Czech Republic, France, Germany, Hungary, Israel, Norway, Slovenia, Spain, Sweden, Switzerland, United Kingdom and United States.

We estimate the coefficients in Eq. (13) as well as the cut-points in Eq. (14) through ordered logit models by means of maximum likelihood techniques. In order to measure the contributory component of the pension system (the Bismarckian factor), we use Krieger and Traub (2013) estimates,[13] which are computed using microdata (at the household level) taken from the Luxembourg Income Study (2008). Pensions are decomposed into two parts: the redistributive (flat) component, and the contributory (earnings-related) component. The Bismarckian factor, denoted as α, is the share of the pension which is contributory, while $1-\alpha$ is the redistributive share of the pension.[14] Thus, in Eq. (13) the term α_{jp} is the Bismarkian factor of country j in period p which we expect to negatively impact t^*_{ijp} (Proposition 2). We measure the generosity of the pension system s_{jp} in country j and period p as the public expenditure on (old age) pensions expressed as a share of GDP and collected from the OECD statistics database. According to Proposition 2 we expect a positive sign of coefficient β_2.

We control for several individual-level variables including demographic characteristics, labour market characteristics, political and religious attitudes that are likely to influence the individual support for expansions in the financing of public education. These variables, collected from the survey data, are included in vector Y_{ijp} with the purpose of filtering/polishing the effect of our two main explanatory variables on the dependent variable and thus providing more precise estimate of β_1 and β_2. Additional information on contextual country-level controls is collected in vector X_{jp} including GDP, Population (both collected from OECD statistics database) and Public Spending in Public Education (World Bank database). Table 1 presents a summary statistics of these variables. Finally θ_j and τ_p are respectively country-level fixed effects and time fixed effects, while ε_{ijp} is the error term. In order to ensure perfect coherence with the theoretical model, for our empirical analysis we restrict the sample of respondents to the surveys to include only people belonging to the labour force, i.e. by excluding students and retirees. Next section presents the results of the empirical analysis.

3.2 Results

Table 2 presents the results of our empirical analysis. Models 1-4 estimate alternative specifications of Eqs. (13) and (14) that include progressively less parsimonious set of control variables. More precisely, our baseline model in column (1) includes basic demographic controls, (2) adds further individual-level variables related to education and labour market status, (3) enriches the set of individual characteristics including political and religious attitudes while (4) adds country-level covariates. Finally, as a robustness check, (5) presents the results of the logit model obtained redefining the dependent variable in a dichotomous way and also includes all the covariates included in (4).

All specifications include both country and year fixed effects. The different number of observations is due to coverage of the surveys for the relevant questions, we use all the available observations in every regression. Table 2 also includes several indexes of goodness to fit (i.e. the log-likelihood; the McKelvey and Zavoina's R^2; the R^2_{Count} measuring the proportion of correct predictions; the Akaike's information criterion – AIC and the Bayesian information criterion – BIC) in order to guide model selection. These suggest that the fully fledged model in (4) outperforms any other ordered logit specifications, thus it is our preferred estimate of Eqs. (13) and (14).[15]

[13] Whenever necessary, data were complemented using Krieger and Traub (2011).

[14] See Appendix B for additional information.

[15] The logit model presented in column (5) tends to outperform the ordered-logit specifications in terms of

Table 1: Summary Statistics

	Observations	Mean	SD	Min.	Max.
Pref. Public Spending Education	36130	3.92	0.82	1.00	5.00
Bismarckian factor	36130	0.32	0.23	-0.09	0.73
Pension system's generosity	36130	6.20	2.02	2.97	10.54
Gender	36063	1.51	0.50	1.00	2.00
Age	35886	41.62	13.08	16.00	96.00
Age, squared	35886	1902.81	1175.54	256.00	9216.00
Marital status	34165	2.14	1.68	1.00	5.00
Household composition	32009	3.01	1.45	1.00	18.00
Children	36130	0.26	0.44	0.00	1.00
Highest education level	35830	2.73	1.41	0.00	5.00
Current employment status	35376	2.38	2.50	1.00	9.00
Employed in private sector	36130	0.42	0.49	0.00	1.00
Self-Employed	36130	0.08	0.27	0.00	1.00
Supervise other employee	36130	0.32	0.46	0.00	1.00
Political Attitudes	28904	3.62	1.78	1.00	7.00
Attendance to religious services	32267	6.00	2.11	1.00	8.00
GDP	36130	2343.28	3573.83	41.28	16047.56
Population	36130	59.07	76.37	1.99	298.38
Government spending in Public Education	28876	81.72	154.00	2.02	791.31

Using the interpretation we have given to the latent variable, it is possible to interpret the estimated coefficients in terms of the marginal effects of the regressors on the latent actual desired share of public resources to devote to public education (t^*_{ijp}). In every model both the Bismarckian factor and the proxy for the pension system's generosity are highly significant and their signs confirm the predictions of Proposition 2. In other words, the support for expansion of public spending in public education is lower the higher the contributory component of the pension system (the Bismarckian factor) and it is increasing in the generosity of the pension system.

As explained in Section 3.1, the control variables have been included as part of our identification strategy and filtering process in order to obtain better estimates of the main independent variables of interest. Thus, the interpretation of their impact on the dependent variable is not key for the purpose of this paper. Nevertheless, it is interesting to stress some results. Regarding individual characteristics, we find that support for an increase in public expenditure for education is stronger amongst members of large households and respondents with children. This result is consistent with the discussion about fertility in Section 2.1. The non-linear explanatory power of age appears in specifications (1) and (2), however, the effect is absorbed once political controls are introduced. Not surprisingly, more educated individuals are in favour of more spending in public education. Political attitudes also matter and estimates presents the expected signs: left-leaning voters are more favourable to expansions of public education than the right-leaning ones.[16]

Concerning macro-level control variables, we find that the existing level of public spending in education has a negative effect on support for further increases and so does the size of

indexes of goodness to fit, but the two approaches aren't directly comparable: the logit model, where the dependent variable is re-coded to be binary, is merely considered as a robustness check.

[16]For the full table, including the estimates for all the controls, see Montolio et al. (2022).

Table 2: Impact of Bismarckian factor and pension system's generosity on voters' support for increasing spending in public education (1985-2006)

Model	Ordered logit				Logit
	(1)	(2)	(3)	(4)	(5)
Bismarckian factor (α)	-1.026***	-1.176***	-1.659***	-1.255**	-1.446**
	(0.316)	(0.319)	(0.358)	(0.514)	(0.619)
Generosity pension system (s)	0.064***	0.075***	0.064**	0.473***	0.230**
	(0.025)	(0.025)	(0.028)	(0.089)	(0.114)
Female	0.085***	0.055**	0.085***	0.108***	0.105***
	(0.021)	(0.024)	(0.027)	(0.031)	(0.036)
Age	0.015***	0.011**	-0.000	-0.008	-0.003
	(0.005)	(0.005)	(0.006)	(0.007)	(0.008)
Age, squared	-0.000***	-0.000***	-0.000	0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Marital status					
Widowed	0.066	0.087	0.029	0.092	-0.015
	(0.068)	(0.069)	(0.079)	(0.092)	(0.103)
Divorced	0.202***	0.216***	0.200***	0.188***	0.226***
	(0.042)	(0.043)	(0.048)	(0.056)	(0.067)
Separated, but married	0.074	0.092	0.106	0.129	0.135
	(0.071)	(0.072)	(0.079)	(0.094)	(0.112)
Single, never married	0.073**	0.074**	0.083**	0.024	-0.014
	(0.033)	(0.033)	(0.038)	(0.043)	(0.050)
Household size	0.028***	0.035***	0.042***	0.056***	0.057***
	(0.009)	(0.009)	(0.011)	(0.013)	(0.016)
Children	0.116***	0.116***	0.133***	0.123***	0.102**
	(0.029)	(0.029)	(0.033)	(0.037)	(0.046)
Highest education level		0.097***	0.105***	0.096***	0.116***
		(0.009)	(0.010)	(0.011)	(0.013)
Employment status					
Employed-part time		0.107***	0.077*	0.048	0.063
		(0.036)	(0.040)	(0.045)	(0.054)
Unemployed		0.189***	0.115*	0.042	0.022
		(0.050)	(0.060)	(0.066)	(0.076)
Other		0.050	0.046	-0.020	-0.046
		(0.035)	(0.040)	(0.045)	(0.053)
Employed-private sector		-0.097***	-0.084***	-0.107***	-0.074**
		(0.025)	(0.028)	(0.031)	(0.037)
Self-Employed		-0.215***	-0.145***	-0.227***	-0.221***
		(0.046)	(0.050)	(0.061)	(0.066)
Supervise other employees		0.029	0.036	0.018	0.012
		(0.025)	(0.027)	(0.030)	(0.036)

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Model	Ordered logit				Logit
	(1)	(2)	(3)	(4)	(5)
Political attitudes					
Far left			0.650***	0.564***	0.655***
			(0.099)	(0.105)	(0.131)
Left, centre left			0.342***	0.350***	0.411***
			(0.038)	(0.043)	(0.048)
Centre, liberal			0.044	0.081	0.107*
			(0.048)	(0.055)	(0.064)
Right, conservative			-0.199***	-0.197***	-0.152***
			(0.039)	(0.045)	(0.049)
Far right			-0.064	-0.064	-0.001
			(0.133)	(0.146)	(0.151)
Other, no specific			0.423***	0.435***	0.328**
			(0.121)	(0.128)	(0.142)
Attendance at religious services					
Once a week			0.039	0.190	0.321*
			(0.147)	(0.152)	(0.169)
2 or 3 times a month			0.092	0.168	0.297*
			(0.152)	(0.160)	(0.176)
Once a month			0.198	0.329**	0.528***
			(0.156)	(0.162)	(0.184)
Several times a year			0.090	0.213	0.443***
			(0.146)	(0.150)	(0.166)
Once a year			0.030	0.175	0.282
			(0.158)	(0.163)	(0.184)
Less frequently			0.136	0.205	0.396**
			(0.145)	(0.149)	(0.165)
Never			0.250*	0.349**	0.490***
			(0.145)	(0.148)	(0.164)
GDP				0.004***	0.004***
				(0.001)	(0.001)
Population				-0.180***	-0.169***
				(0.051)	(0.063)
Public Education spending				-0.072***	-0.076***
(current level)				(0.008)	(0.010)
Observations	31727	31218	24666	19528	19952
Log-likelihood	-36250.97	-35555.13	-28272.05	-21878.59	-11644.80
Wald chi2 (all variables)	3200.62	3285.09	2279.94	2136.47	1656.77
p-value	0.000	0.000	0.000	0.000	0.000
$R^2_{M\&Z}$	0.10	0.11	0.10	0.12	0.13
R^2_{Count}	0.47	0.47	0.46	0.47	0.69
AIC	72561.95	71184.27	56642.10	43861.19	23387.60
BIC	72812.90	71493.17	57039.65	44270.93	23774.75

Note: Each model includes both Time and Country Fixed Effects. $R^2_{M\&Z}$ is McKelvey and Zavoina's R2; R^2_{Count} is the proportion of correct predictions; AIC, Akaike's information criterion; BIC, Bayesian information criterion. Robust standard errors in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

population, while GDP is positively associated with an increase in support for expansion of public expenditure in education. These additional results on the determinants of the support for publicly financed education tend to corroborate and in some cases extend previous evidence (e.g. Busemeyer and Iversen, 2014). As a further robustness check, a multilevel version of both the ordered logit and logit models is also performed, which confirms and reinforces the results of the main analysis. These results are reported in Appendix C.

4 Conclusions

Adults voluntarily use part of their income to finance the education of the young in an act which might be interpreted as *intergenerational altruism*. However, voters can be expected to want something in return from this investment in education. We have extended the standard model in which adults vote on the tax to finance public education by adding a second time period during which adults retire and when, if their pensions are redistributive, they might obtain some monetary benefits from the new generation being better educated.

We show that rational voters can increase their future consumption by investing in the education of the young, as the redistributive component of pensions depends on the young's future income. This induces all voters, including those opting for private education, to favour a positive tax to finance public education. Furthermore, by increasing the social returns on education, the preferred tax rate by any agent increases (compared to the case with no retirement concerns). We conclude (Proposition 2) that, regardless of the identity of the pivotal voter, when retirement concerns are introduced, the preferred tax rate for financing public education increases. This effect would be even greater if we assumed imperfect financial markets or should population grow faster than the intertemporal discount rate. We can expect an analogous effect to appear as long as education produces other positive externalities on society (i.e. less social conflict, or more technological and scientific progress, possibly leading to better infrastructures, medical treatment and services for the elderly).

The effect of pensions on preferences in education depends on the degree of redistribution provided by the pension system and on its absolute size. As a matter of fact, in a purely Bismarckian (purely contributory) pension system this effect disappears, as there is no link between the education of the young and the agents' own future pensions. However, under a redistributive pension system, any investment in current education results in an increase in future pensions. The larger the redistributive component of the pension system is, the greater this effect becomes. Hence, we show that voters agree on larger tax rates to finance education when the redistributive component is larger. Moreover, this effect is amplified when pensions represent a larger proportion of total life income. The motivating evidence in the introduction casually confirms these results at the macro-level, showing that over the last three decades, countries with a larger Bismarckian factor invested less in education, and that there is a positive correlation between expenditure in public pensions and public education. Our empirical analysis go further by formally testing the theoretical predictions of the model and by providing strong evidence of these relationships using micro-level data. More precisely, by exploiting four waves of surveys on public opinion about public policies repeated over a period of 20 years across 13 countries and national representative samples of individuals including on aggregate more than 30,000 respondents over the waves, we document that the support for expansions in the public financing of public education is decreasing in the Bismarckian factor and it is increasing in the generosity of the pension system. These results are robust to

different specifications and progressively less parsimonious set of control variables providing a strong validation of the theoretical predictions of Proposition 2.

The theoretical model provides additional predictions about the type of equilibrium that should emerge (Proposition 3). Depending on the value of the parameters, we may expect the voting equilibrium to result either in a standard class conflict - with poor voters in favour of more public education than the rich ones - or we may observe that part of the lower-middle class joins the richest in their attempt not to increase public education spending. The latter equilibrium is the result of two opposing forces: redistribution through education (decreasing in income) and the interest for a high quality public school (increasing in income among public school consumers only). Some intermediate-income agents may not be rich enough to care for a high quality public education system, but not poor enough to enjoy significant benefits from redistribution. These agents may form a coalition with agents opting for private education and ask for lower tax rates, while the upper-middle class, together with the poorest agents in society, asks more public education.

Note that changing the size of the redistributive component of pensions $s(1-\alpha)$ has a clear effect on welfare. Investing in education has positive returns, but the amount of current income devoted to education tends to be sub-optimal since adults do not benefit from the increase in wealth that education will produce among the young. With pensions, part of the returns on the investment is enjoyed by adults, which makes them more willing to reduce their current consumption. Still, the share of the return that they enjoy is proportional to $s(1-\alpha)$. Therefore, the benefit becomes more internalised the larger the redistributive part of the pension becomes. We conclude that aggregate welfare should increase when the redistributive part of the pension is larger.

Finally, the recent contribution by Andersen et al. (2021) studies the retirement system (in particular under pay-as-you-go) and the consequences of having agents with reference-dependent preferences and a pattern of time inconsistency. Our hope is that the future research will combine their approach with our and investigate how the investment in education can move the reference point of agents and induce a different pattern of consumption and saving.

References

Akyol, M., 2016. Do educational vouchers reduce inequality and inefficiency in education? Economics of Education Review 55, 149–167.

Andersen, T.M., Bhattacharya, J., Liu, Q., 2021. Reference-dependent preferences, time inconsistency, and pay-as-you-go pensions. Economic Inquiry 59, 1008–1030.

Barro, R.J., 2013. Education and economic growth. Annals of Economics and Finance 14, 301–328.

Baum, M.A., Lake, D.A., 2003. The political economy of growth: Democracy and human capital. American Journal of Political Science 47, 333–347.

Bellettini, G., Ceroni, C.B., 1999. Is social security really bad for growth? Review of Economic Dynamics 2, 796–819.

Bellettini, G., Ceroni, C.B., 2000. Social security expenditure and economic growth: an empirical assessment. Research in Economics 54, 249–275.

Bishnu, M., Wang, M., 2017. The political intergenerational welfare state. Journal of Economic Dynamics and Control 77, 93–110.

Boldrin, M., Montes, A., 2005. The intergenerational state education and pensions. Review of Economic Studies 72, 651–664.

Boldrin, M., Montes, A., 2009. Assessing the efficiency of public education and pensions. Journal of Population Economics 22, 285–309.

Bratsberg, B., Røed, K., Raaum, O., Naylor, R., Jäntti, M., Eriksson, T., Österbacka, E., 2007. Nonlinearities in intergenerational earnings mobility: Consequences for cross-country comparisons. Economic Journal 117, C72–C92.

Busemeyer, M.R., Iversen, T., 2014. The politics of opting out: explaining educational financing and popular support for public spending. Socio-Economic Review 12, 299–328.

Card, D., 2001. Estimating the return to schooling: Progress on some persistent econometric problems. Econometrica 69, 1127–60.

Casamatta, G., Cremer, H., Pestieau, P., 2000. Political sustainability and the design of social insurance. Journal of Public Economics 75, 341–364.

Cattaneo, M.A., Wolter, S.C., 2009. Are the elderly a threat to educational expenditures? European Journal of Political Economy 25, 225–236.

Chen, Z., West, E.G., 2000. Selective versus Universal Vouchers: Modeling Median Voter Preferences in Education. American Economic Review 90, 1520–1534.

Cohen-Zada, D., Justman, M., 2003. The political economy of school choice: linking theory and evidence. Journal of Urban Economics 54, 277–308.

Cremer, H., De Donder, P., Gahvari, F., 2004. Taxes, budgetary rule and majority voting. Public Choice 119, 335–358.

Croix, D.D.L., Doepke, M., 2009. To segregate or to integrate: Education politics and democracy. The Review of Economic Studies 76, 597–628.

Dur, R., Teulings, C., van Rens, T., 2004. Should higher education subsidies depend on parental income? Oxford Review of Economic Policy 20, 284–297.

Echevarría, C.A., 2004. Life Expectancy, Schooling Time, Retirement, and Growth. Economic Inquiry 42, 602–617.

Epple, D., Romano, R., 1996a. Ends against the middle: Determining public service provision when there are private alternatives. Journal of Public Economics 62, 297–325.

Epple, D., Romano, R., 1996b. Public provision of private goods. Journal of Political Economy 104, 57–84.

Epple, D., Romano, R., 1998. Competition between Private and Public Schools, Vouchers, and Peer-Group Effects. American Economic Review 88, 33–62.

Epple, D., Romano, R., Sarpça, S., 2018. Majority choice of an income-targeted educational voucher. American Economic Journal: Microeconomics 10, 289–325.

Goldstein, H., 2011. Multilevel Statistical Models. Chichester: John Wiley & Sons.

Gonzalez-Eiras, M., Niepelt, D., 2012. Ageing, government budgets, retirement, and growth. European Economic Review 56, 97–115.

Gradstein, M., 2000. An economic rationale for public education: the value of commitment. Journal of monetary economics 45, 463–474.

Gradstein, M., Justman, M., 1997. Democratic choice of an education regime. Journal of economic growth 2, 169–183.

Gradstein, M., Justman, M., 2005. The melting pot and school choice. Journal of Public Economics 89, 871–896.

Griliches, Z., Mason, W.M., 1972. Education, income, and ability. Journal of Political Economy 80, pp. S74–S103.

Kaganovich, M., Zilcha, I., 1999. Education, social security, and growth. Journal of Public Economics 71, 289–309.

Krieger, T., Traub, S., 2011. Wie hat sich die intragenerationale umverteilung in der staatlichen saeule des rentensystems veraendert? Journal of Economics and Statistics (Jahrbuecher fuer Nationaloekonomie und Statistik) 231, 266–287.

Krieger, T., Traub, S., 2013. The Bismarckian factor: a measure of intra-generational redistribution in international pension systems. CESifo DICE Report 1, 64–66.

Kritzer, B., Jankowski, J., 2010. Social Security Programs Throughout the World: Europe, 2010. Technical Report. SSA Publication No. 13-11801.

Lancia, F., Russo, A., 2016. Public Education and Pensions in Democracy: A Political Economy Theory. Journal of the European Economic Association 14, 1038–1073.

Lee, C.I., Solon, G., 2009. Trends in intergenerational income mobility. The Review of Economics and Statistics 91, 766–772.

Lefgren, L., Lindquist, M.J., Sims, D., 2012. Rich dad, smart dad: Decomposing the intergenerational transmission of income. Journal of Political Economy 120, 268 – 303.

Lemieux, T., 2006. Postsecondary education and increasing wage inequality. American Economic Review 96, 195–199.

Luxembourg Income Study, 2008. Harmonisation of original surveys conducted by the Luxembourg Income Study asbl. Luxembourg, periodic updating. (multiple countries; July 2007 to April 2008). Available at http://www.lisproject.org/techdoc.htm.

Mazumder, B., 2005. Fortunate sons: New estimates of intergenerational mobility in the united states using social security earnings data. The Review of Economics and Statistics 87, 235–255.

Montolio, D., Piolatto, A., Salvadori, L., 2022. Financing public education when altruistic agents have retirement concerns. IEB Working Paper 2022/01.

Morgan, J., Buice, M., 2013. Latin american attitudes toward women in politics: The influence of elite cues, female advancement, and indivividual characteristics. American Political Science Review 107(4), 644–662.

Pecchenino, R., Pollard, P., 2002. Dependent children and aged parents: funding education and social security in an aging economy. Journal of Macroeconomics 24, 145–169.

Piolatto, A., 2010. Education and selective vouchers. Economics of Education Review 29, 993–1004.

Poterba, J.M., 1998. Demographic change, intergenerational linkages, and public education. American Economic Review 88, 315–20.

Rattsø, J., Sørensen, R.J., 2010. Grey power and public budgets: Family altruism helps children, but not the elderly. European Journal of Political Economy 26, 222–234.

Romer, P., 1986. Increasing returns and long run growth. Journal of Political Economy 94, 1002–1037.

Sanchez-Losada, F., 2000. Growth effects of an unfunded social security system when there is altruism and human capital. Economics letters 69, 95–99.

Sanz, I., Velázquez, F.J., 2007. The role of ageing in the growth of government and social welfare spending in the oecd. European Journal of Political Economy 23, 917 – 931.

Soares, J., 2003. Self-interest and public funding of education. Journal of Public Economics 87, 703–727.

Tolley, G.S., Olson, E., 1971. The interdependence between income and education. Journal of Political Economy 79, 460–480.

Zhang, J., Zhang, J., 2004. How does social security affect economic growth? Evidence from cross-country data. Journal of Population Economics 17, 473–500.

Appendix

A Proofs

Proof of Lemma 1. Using equation (2),

$$\bar{\omega}_y = \int_0^1 (\omega + X^\phi) d\omega \tag{15}$$

$$\bar{\omega}_y = \frac{1}{2} + \tilde{\omega} X_p^\phi + \lambda^\phi \int_{\tilde{\omega}}^1 \omega_0^{\beta\phi} d\omega \tag{16}$$

$$\bar{\omega}_y = \frac{1}{2} + \frac{\lambda^\phi}{\beta\phi + 1} + \left(\frac{e}{\lambda}\right)^{\frac{1-\phi}{\beta+1}} \left(1 - \frac{e^\phi}{\beta\phi + 1}\right) \left(\frac{t}{2}\right)^{\frac{\beta\phi+1}{\beta+1}} \tag{17}$$

□

Proof of Prop. 1. If we derive the previous equations (10), (11) and (12) with respect to t, we obtain the variation of the number of public school students, of the quality of public school and of the average income in the second period, when the equilibrium tax varies.

$$\frac{\partial n}{\partial t} = \frac{1}{\beta + 1} \left(\frac{e}{2\lambda}\right)^{\frac{1}{\beta+1}} t^{\frac{-\beta}{\beta+1}} = \frac{n}{(\beta+1)t} > 0 \tag{18a}$$

$$\frac{\partial X_P}{\partial t} = \frac{\beta}{\beta + 1} \left(\frac{\lambda}{e 2^\beta}\right)^{\frac{1}{\beta+1}} t^{\frac{-1}{\beta+1}} > 0 \tag{18b}$$

$$\frac{\partial \bar{\omega}_y}{\partial t} = \frac{\beta\phi + 1 - e^\phi}{\beta + 1} \left(\frac{e}{\lambda}\right)^{\frac{1-\phi}{\beta+1}} \left(\frac{1}{2}\right)^{\frac{\beta\phi+1}{\beta+1}} t^{-\frac{\beta(1-\phi)}{\beta+1}} \tag{18c}$$

The first two equations are both positive. The sign of equation (18c) is positive if $\beta > \frac{e^\phi - 1}{\phi}$.

To prove the corollary, notice that if $\beta < \frac{e^\phi - 1}{\phi}$ or $\phi > 1$, we have a corner solution for the problem of adults opting for private education and their preferred tax is $t = 0$. If $\beta > \frac{e^\phi - 1}{\phi}$ and $\phi \leq 1$, then both types of agent are in favour of a positive taxation, but then comparing equations (5) and (8) we can see that in the former we have an extra term $\left(\lambda \omega_0^\beta \frac{1}{X_P} \frac{\partial X_P}{\partial t}\right)$, which is always positive by equation (18b). It is sufficient to notice that $\frac{\partial^2 \bar{\omega}_y}{\partial t^2} < 0$, to conclude that for a same income ω_0, the value of t that solves equation (8) must be lower than that for equation (5). By the same reasoning, if we compare two adults opting for private education, a decrease in ω_0 implies that the optimal value for $\frac{\partial \bar{\omega}_y}{\partial t}$ is also lower, hence (from $\frac{\partial^2 \bar{\omega}_y}{\partial t^2}$) it must be that the preferred tax is lower for a wealthier agent. To show that t_R^* is decreasing and convex in income, it is sufficient to derive equation (20) to see that the first derivative is negative and the second is positive. □

Proof of Prop. 2. The proof consists of three steps. The first one consists in rewriting the first order conditions in a convenient way. The second step defines the derivatives that we want to compute. The last one shows that the sign of the derivative is unambiguous.

1. We can first rewrite the first order conditions of both types of agent.
   For agents opting for public education, equation (5) is rewritten using equations (18a) and (18c)

$$(1-\alpha)s\frac{\partial\bar{\omega}_y}{\partial t}+\lambda\omega_0^{\beta}\left(\frac{1}{t}-\frac{1}{n}\frac{\partial n}{\partial t}\right)-\omega_0=0 \tag{19a}$$

$$(1-\alpha)s\left(\frac{\beta\phi+1}{\beta+1}\left(\frac{e}{\lambda}\right)^{\frac{1-\phi}{\beta+1}}\left(1-\frac{e^{\phi}}{\beta\phi+1}\right)\left(\frac{1}{2}\right)^{\frac{\beta\phi+1}{\beta+1}}t^{-\frac{\beta(1-\phi)}{\beta+1}}\right)+\frac{\lambda\omega_0^{\beta}}{t}\frac{\beta}{\beta+1}-\omega_0=0 \tag{19b}$$

$$(1-\alpha)s\left(\frac{e}{\lambda}\right)^{\frac{1-\phi}{\beta+1}}(\beta\phi+1-e^{\phi})\left(\frac{t}{2}\right)^{\frac{\beta\phi+1}{\beta+1}}+\beta\lambda\omega_0^{\beta}-(\beta+1)\omega_0 t=0 \tag{19c}$$

   Differentiating equation (19b) with respect to t, we can see that if a solution to equation (5) exists, then the second derivative is always negative; hence, the stationary point solving equation (5) is a maximum of the problem.

   For agents preferring private education, equation (8) can be rewritten in closed form as

$$t=\omega_0^{-\frac{\beta+1}{\beta(1-\phi)}}(2)^{\frac{\beta\phi+1}{\beta(1-\phi)}}\left(\frac{\lambda}{e}\right)^{\frac{1-\phi}{\beta(1-\phi)}}\left(\frac{\beta+1}{(1-\alpha)s(\beta\phi+1-e^{\phi})}\right)^{-\frac{\beta+1}{\beta(1-\phi)}}. \tag{20}$$

2. Define equations (19c) and (8) respectively as $\Gamma(t_P)=0$ and $\Omega(t_R)=0$. From these equations, we can describe the change in the agent's optimal tax, when the pension system changes:

$$\frac{\partial t_P}{\partial\alpha}=-\frac{\frac{\partial\Gamma(t_P)}{\partial\alpha}}{\frac{\partial\Gamma}{\partial t_P}} \tag{21a}$$

$$\frac{\partial t_R}{\partial\alpha}=-\frac{\frac{\partial\Omega(t_R)}{\partial\alpha}}{\frac{\partial\Omega}{\partial t_P}} \tag{21b}$$

$$\frac{\partial t_P}{\partial s}=-\frac{\frac{\partial\Gamma(t_P)}{\partial s}}{\frac{\partial\Gamma}{\partial t_P}} \tag{22a}$$

$$\frac{\partial t_R}{\partial s}=-\frac{\frac{\partial\Omega(t_R)}{\partial s}}{\frac{\partial\Omega}{\partial t_P}} \tag{22b}$$

   Equations (21a) and (21b) describe the change in the preferred tax resulting from a change in the Bismarckian factor α, while equations (22a) and (22b) consider a change in the tax rate s in order to finance pensions. In both cases, equation (a) refers to the optimal tax of an adult opting for public education, while (b) is for the case of private education.

3. We are interested in the sign of the previous equations, and we know that all the denominators are negative, therefore we have that:

$$sign\left(\frac{\partial t_P}{\partial\alpha}\right)=sign\left(\frac{\partial\Gamma(t_P)}{\partial\alpha}\right)=sign\left(-s\frac{\partial\bar{\omega}_y}{\partial t}\right)<0 \tag{23a}$$

$$sign\left(\frac{\partial t_R}{\partial \alpha}\right) = sign\left(\frac{\partial \Omega(t_R)}{\partial \alpha}\right) = sign\left(-s\frac{\partial \bar{\omega}_y}{\partial t}\right) < 0 \tag{23b}$$

$$sign\left(\frac{\partial t_P}{\partial s}\right) = sign\left(\frac{\partial \Gamma(t_P)}{\partial s}\right) = sign\left((1-\alpha)\frac{\partial \bar{\omega}_y}{\partial t}\right) > 0 \tag{24a}$$

$$sign\left(\frac{\partial t_R}{\partial s}\right) = sign\left(\frac{\partial \Omega(t_R)}{\partial s}\right) = sign\left((1-\alpha)\frac{\partial \bar{\omega}_y}{\partial t}\right) > 0 \tag{24b}$$

From equations (23a), (23b), (24a) and (24b) it can be noted that for all voters the sign of the variation of the preferred tax due to a change in either α or s does not depend on income or on the schooling choice. Therefore, we do not need to identify the pivotal voter at the election in order to confirm that the preferred tax rate of the pivotal voter is decreasing in α and increasing in s. □

Proof of Prop. 3. Prop. 3 characterises the voting equilibrium for the two cases of $t_P^*(\frac{1}{2}) \geq t_P^*(\tilde{\omega})$ and $t_P^*(\frac{1}{2}) < t_P^*(\tilde{\omega})$. The proof is organised as follow: in part A., we derive the optimal tax rate for adults having opted for public education, and show that it is convex, with a minimum at $\omega = \underline{\omega}$. In part B., we show that for $t_P^*(\frac{1}{2}) \geq t_P^*(\tilde{\omega})$, the only possible equilibrium is that the median voter is decisive, with all agents poorer than the median being in favour of a larger tax rate, opposing the remaining agents, who are in favour of a lower tax rate. In part C., we analyse the voting equilibrium when $t_P^*(\frac{1}{2}) < t_P^*(\tilde{\omega})$, showing that the median voter cannot be decisive, and we show the characteristics of the equilibrium.

A. We rewrite equation (19c) as $\Gamma(t_P^*) = 0$. We can describe the change in the agent's optimal tax, when the income changes as:

$$\frac{\partial t_P^*}{\partial \omega_0} = -\frac{\frac{\partial \Gamma(t_P^*)}{\partial \omega_0}}{\frac{\partial \Gamma}{\partial t_P^*}} \tag{25}$$

We know, from the second order condition, that $\frac{\partial \Gamma}{\partial t_P^*} < 0$, hence

$$sign\left(\frac{\partial t_P^*}{\partial \omega_0}\right) = sign\left(\frac{\partial \Gamma(t_P^*)}{\partial \omega_0}\right). \tag{26}$$

Therefore, $\frac{\partial t_P^*}{\partial \omega_0} > 0$ if and only if $\omega_0 > \left(\frac{(1+\beta)t}{\beta^2\lambda}\right)^{\frac{1}{\beta-1}} \equiv \underline{\omega}$. Under the conditions of existence of the model, $\beta > 1$, therefore $\underline{\omega}$ is a minimum and t_P^* is convex in ω_0.

B. From the corollary of Prop. 1, we know that for $\tilde{\omega}$ (as for any level of income), $t_P^*(\tilde{\omega}) > t_R^*(\tilde{\omega})$, furthermore, the t_R^* is decreasing in income. If $t_P^*(\frac{1}{2}) \geq t_P^*(\tilde{\omega})$, then there can be no income $\hat{\omega} \in [\tilde{\omega}, 1]$ such that $t_R^*(\hat{\omega}) \geq t_P^*(\frac{1}{2})$. Finally, if $t_P^*(\frac{1}{2}) \geq t_P^*(\tilde{\omega})$, then $\underline{\omega} > \frac{1}{2}$ and for all $\omega_0' \in \left(\frac{1}{2}, \tilde{\omega}\right)$, it must be that $t_P^*(\frac{1}{2}) \geq t_P^*(\omega_0')$, as represented in Fig. 2. Since the preferred tax is decreasing in income for $\omega_0 < \underline{\omega}$, the preferred one for agents with income $\omega_0 < \frac{1}{2}$ (who represent half of the population) is larger than that of the median voter. Meanwhile, for all agents with income above the median the preferred tax is smaller than that of the median voter. We conclude that the median voter is decisive.

C. If $t_P^*(\frac{1}{2}) < t_P^*(\tilde{\omega})$, then, by continuity, there will be some neighbourhood around $\frac{1}{2}$ ($\omega \in [\overleftarrow{\omega}, \frac{1}{2})$ in Fig. 3) and around $\tilde{\omega}$ ($\omega \in (\overrightarrow{\omega}, \tilde{\omega}]$ in Fig. 3) where the preferred tax rate is larger than $t_P^*(\frac{1}{2})$.

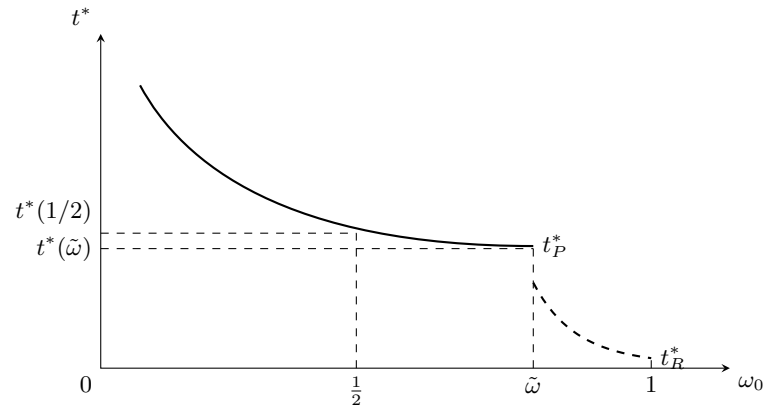

Figure 2: $t_P^*(\frac{1}{2}) \geq t_P^*(\tilde{\omega})$

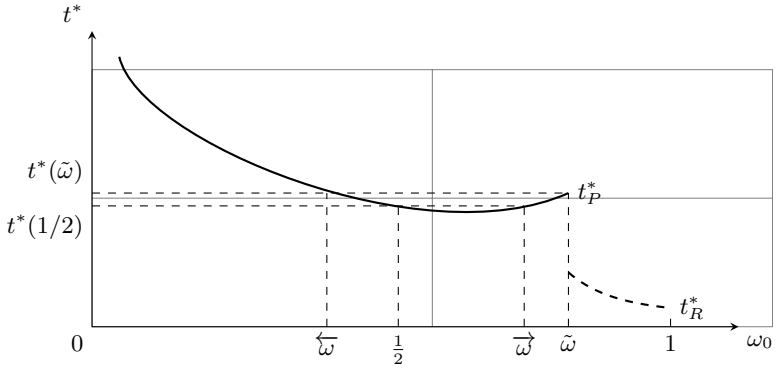

Figure 3: $t_P^*(\frac{1}{2}) < t_P^*(\tilde{\omega})$

Define $\overrightarrow{\omega} \equiv \omega : t_P^*(\frac{1}{2}) = t_P^*(\overrightarrow{\omega})$, and $\overleftarrow{\omega} \equiv \omega : t_P^*(\tilde{\omega}) = t_P^*(\overleftarrow{\omega})$. By the convexity of t and $t_P^*(\frac{1}{2}) < t_P^*(\tilde{\omega})$, it must be that $\overleftarrow{\omega} < \frac{1}{2}$, while $\overrightarrow{\omega} \in [\overleftarrow{\omega}, \tilde{\omega}]$ can be larger or smaller than $\frac{1}{2}$. Since $\overleftarrow{\omega} < \frac{1}{2}$, the group of poorest agents with the highest preferred tax rate (i.e., $\omega < \overleftarrow{\omega}$) is not large enough to form a winning coalition. We must include some more agents, in order to have a coalition of that half of the population with the highest preferred tax rate. Hence, the coalition is formed by all agents with income $\omega < \overleftarrow{\omega}$, together with some agents with income

$$\begin{cases} \omega \in [\overleftarrow{\omega}, \frac{1}{2}) \text{ and } \omega > \overrightarrow{\omega} & \text{if } \overrightarrow{\omega} > \frac{1}{2} \\ \omega \in [\overleftarrow{\omega}, \overrightarrow{\omega}) \text{ and } \omega > \frac{1}{2} & \text{if } \overrightarrow{\omega} \leq \frac{1}{2} \end{cases} \tag{27}$$

so that the coalition's size is $\frac{1}{2}$.[17] □

B Sources used for the motivating evidence

Fig. 1 is constructed using as sources of information: the Bismarckian factor estimated by Krieger and Traub (2013) and public expenditure, as a share of GDP, on education and

[17]Notice that in Fig. 3, we assume that $t_P^*(\frac{1}{2}) > t_R^*(\tilde{\omega})$, but it could be the other way around. In this case, some voters opting for private education and income sufficiently close to $\tilde{\omega}$ may also join the coalition.

on (old-age) pensions. The data used for the Bismarckian factor are reproduced in Table 3. The distribution of the Bismarckian factor across countries and years shows a bimodal distribution with one mode around the value 0.15 and the other mode around 0.42 (the Bismarckian factor has a minimum of -0.086 and a maximum of 0.737). This information has been used to determine the cut-off point that defines above- and below-average countries with respect to the redistributive part of the pensions system.

Table 3: Bismarckian factor

Country	1979-1983	1983-1987	1988-1992	1993-1997	1998-2002	2003-2008
Australia	0.014	-0.086	0.046	0.113	0.010	0.029
Austria				0.501	0.525	
Belgium		0.417	0.463	0.488	0.430	
Canada	0.035	0.046	0.066	0.270	0.307	0.277
Denmark		0.181	0.173	0.056	0.024	-0.004
Finland			0.019	0.594	0.416	0.364
France	0.710	0.701	0.711	0.730	0.737	0.715
Germany	0.579	0.583	0.539	0.564	0.589	0.562
Greece				0.694	0.639	0.638
Ireland		0.121	0.234	0.347	0.327	0.348
Italy		0.379	0.375	0.54	0.549	0.595
Luxemburg		0.445	0.367	0.315	0.351	0.508
Mexico		0.506	0.506	0.522	0.689	0.709
Netherlands	0.156	0.253	0.353	0.289	0.278	
Norway	0.301	0.194	0.226	0.434		
Spain			0.528	0.432	0.470	0.554
Sweden	0.422	0.476	0.571	0.421	0.432	0.214
Swiss	0.190	0.169	0.147	0.123	0.099	0.052
UK	0.198	0.157	0.141	0.168	0.088	0.095
USA	0.342	0.532	0.533	0.545	0.462	0.445

Data on public expenditure on education (as a share of GDP) come from the World Development Indicators (WDI) of the World Bank (http://data.worldbank.org/). Data on public expenditure on pensions (old age) as a share of GDP come from OECD (http://data.worldbank.org/). Table 4 reports them for the selection of OECD countries used in Fig. 1.

Table 4: Public spending as a share of GDP for Public education and Pensions

	Public education						Old-age Pensions					
Country	1980	1985	1990	1995	2000	2005	1980	1985	1990	1995	2000	2005
Australia	5.1	5.1	-	4.9	4.7	4.7	3.0	2.9	2.7	3.4	3.2	3.1
Austria	5.3	5.6	-	6.2	5.8	5.5	8.4	9.0	7.3	8.0	8.1	8.8
Belgium	5.7	5.7	-	-	-	5.9	5.5	6.0	6.0	6.7	6.5	6.7
Canada	6.8	6.5	-	5.6	5.6	4.9	2.8	3.4	3.8	4.2	3.9	3.7
Denmark	6.4	6.6	-	8.3	8.3	8.3	4.6	4.1	4.4	5.4	4.6	5.1
Finland	5.1	-	-	-	5.9	6.3	4.6	-	6.2	7.0	6.1	6.8
France	4.9	5.4	-	5.8	5.7	5.7	7.4	8.3	8.6	10.0	10.0	10.2
Germany	-	-	-	4.6	-	4.4	9.0	8.8	8.5	7.0	7.7	8.4
Greece	1.9	2.3	-	3.1	3.4	4.0	4.4	6.8	6.5	6.6	7.2	7.9
Ireland	5.8	5.4	-	4.4	4.3	4.8	3.5	3.6	3.0	2.4	1.6	1.8
Italy	4.3	4.9	-	4.6	4.5	4.4	7.2	8.9	7.8	8.7	10.6	11.1
Luxembourg	5.6	2.6	-	-	3.7	-	5.7	5.4	7.2	8.0	6.9	3.8
Mexico	-	3.7	-	4.2	4.9	5.0	-	0.1	0.3	0.5	0.5	0.9
Netherlands	7.0	6.0	-	4.9	5.0	5.5	5.6	5.4	5.7	5.0	4.6	4.6
Norway	6.3	5.8	-	7.5	6.6	7.0	4.0	4.3	5.2	5.1	4.4	4.4
Spain	2.1	3.1	-	4.4	4.3	4.2	4.6	5.7	6.4	7.5	5.9	5.4
Sweden	8.5	7.4	-	7.6	7.2	6.9	6.1	6.8	6.9	7.3	6.6	6.8
Swiss	4.9	4.8	-	5.3	5.2	5.7	5.3	5.4	5.2	6.2	6.2	6.3
UK	5.3	5.1	-	4.9	4.5	5.4	3.7	4.0	4.0	4.1	4.0	4.1
USA	6.5	6.4	-	5.0	5.8	5.3	5.0	5.2	5.1	5.3	5.0	5.2

C Sensitivity analyses: Multilevel models

Table 5 presents the results of the multilevel analysis (see Goldstein, 2011)[18] corresponding to both the ordered logit and logit models in Table 2. More precisely, given that individuals responding to the surveys are nested within countries, we perform two-level models. The results of the main analysis still hold for any specification of the multilevel models corroborating and reinforcing the analysis presented in the main text. This analysis is performed to better account for within-groups correlation of the error term at country level although in the main analysis we are already indirectly taking into account this issue and controlling for most of the within-country correlation of the error term by including country-level fixed effect. This is confirmed also by the results of the likelihood-ratio (LR) test reported in Table 5, which indicate that the multilevel version of both the ordered logit and logit models presented here do not represent a significant improvement in fit relative to standard ordered logit and logit models with fixed effects presented in Table 2.

Table 5: Impact of Bismarckian factor and pension system's generosity on voters' support for increasing spending in public education (1985-2006) - Multilevel models (ML)

Model	ML Ordered logit				ML Logit
	(1)	(2)	(3)	(4)	(5)
Bismarckian factor (α)	-1.026***	-1.176***	-1.659***	-1.255**	-1.446**
	(0.331)	(0.335)	(0.373)	(0.541)	(0.642)
Generosity pension system (s)	0.064***	0.075***	0.064**	0.473***	0.230**
	(0.025)	(0.025)	(0.028)	(0.088)	(0.110)
var(_cons[Country])	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	31727	31218	24666	19528	19952
Log-likelihood	-36250.97	-35555.13	-28272.05	-21878.59	-11644.80
Wald chi2 (all variables)	3216.38	3326.06	2234.87	2126.18	1647.41
p-value	0.000	0.000	0.000	0.000	0.000
AIC	72561.95	71184.27	56644.10	43863.19	23387.59
BIC	72812.90	71493.17	57049.76	44280.80	23774.75
LR test (chi2)	0.000	0.000	0.000	0.000	0.000
LR test (p-value)	1.000	1.000	1.000	1.000	1.000
Basic Demographic controls	YES	YES	YES	YES	YES
Labour Market controls	NO	YES	YES	YES	YES
Political and Religious Attitudes	NO	NO	YES	YES	YES
Country-level controls	NO	NO	NO	YES	YES

Note: Each model includes both Time and Country Fixed Effects. AIC is the Akaike's information criterion; BIC is the Bayesian information criterion. Control variables are described in Section 3.1. Robust standard errors in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

[18] This approach is common in the literature. Among others, it has been used in Morgan and Buice (2013).

2018

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