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Education policy and inequality: A political economy approach

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ABSTRACT

Regression results show that more unequal societies tend to spend comparatively more on higher levels of education. In a two-period model with heterogeneous agents, this paper investigates the political determinants of this bias. In the first period, public education is financed by the incumbent government by issuing bonds. Investments in basic and higher education have conflicting effects on future labour income distribution and net returns to these investments depend on the tax and transfers system being selected in the following period through the democratic process. Our idea is that public investment in basic education, by decreasing future labour income inequality, may induce future policy-makers to redistribute resources through financial rents taxation, thus making unfeasible the issuing of debt to finance basic education. This will be the more probable the greater wealth inequality is.

1. Introduction

Public provision of education is usually justified as a (politically acceptable) means of redistributing income.[1] However, access to education is not homogeneously distributed across social groups. World Bank reports that children from poor households have much lower enrolment rates, at increasingly higher levels of education, than children from richer families.[2] Thus, the redistributive effects of education expenditure strongly depend on which level of education is funded.

The following table documents how total public expenditure on education, as percentage of GDP, as well as the share of spending at tertiary level in total public education spending vary considerably, even among developed countries (Table 1).

Recent empirical works, by disaggregating spending over educational levels, provide evidence that the composition of public education spending depends on the distribution of income. More specifically, regression results show that more unequal societies tend to spend comparatively more on higher levels of education and thus have a less redistributive way of spending on education (Zhang, 2008; Fink, 2005). Analogous results are found for developing countries (Birdsall, 1996; Gradstein, 2003).

This paper aims at developing a political economy framework capable of accounting for the stylized facts above described. We want to explain why more unequal societies tend to spend proportionately more on high levels of education than on basic education.

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[1] Cross-country analyses show that public spending on education accounts, on average, for more than 4.5% of GNP and more than 14% of total government expenditure (data source: various issues of UNESCO Statistical Yearbook).

[2] World Development Report, 2003. See also De Fraja (2004) for a discussion of this point.

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Table 1
Total public expenditure on education as % of GDP and share of tertiary education expenditure (year 2000).

Country	Total public expenditure on education as % of GDP	Tertiary education expenditure as a share of total expenditure on education
Australia	4.7	0.229
Austria	5.5	0.249
Belgium	6.1	0.246
Denmark	8.5	0.300
Finland	6.5	0.340
France	5.9	0.176
Germany	4.6	0.242
Greece	4.3	0.240
Ireland	4.8	0.303
Italy	4.7	0.178
Japan	3.6	0.152
Korea, South	4.6	0.154
Netherlands	5.4	0.270
New Zealand	6.5	0.247
Norway	7.7	0.254
Portugal	5.7	0.181
Spain	4.3	0.218
Sweden	7.4	0.272
Switzerland	6	0.223
United Kingdom	5.4	0.175
USA	5.6	0.225
Czech Republic	4.4	0.190
Hungary	5.5	0.210
Mexico	5.4	0.180
Poland	5.4	0.146
Slovakia	4.3	0.184
Turkey	3.7	0.309

Data source: OECD, Education and Training Database.

The topic is relevant since the allocation of public education spending might be responsible for persistent inequality. With regard to this point Bowels (1978), for example, argues that public education might contribute to economic inequality if resources are allocated disproportionately to the rich. Along the same lines, Walde (2000) shows that the degree of elitism (measured by public spending per student in tertiary education compared to primary and secondary ones) provides an incentive to develop technologies that allow skilled labour to replace unskilled labour and, hence, generate higher income inequality. More recently, without appealing to elitism, Glomm and Ravikumar (2003) illustrate the possibility of adverse distributional consequences of public education due to a sufficiently high elasticity of parental human capital in the learning technology. On the empirical side, cross-country evidence, collected by Zhang (2008), reveals that countries spending more on higher education today tend to experience more unequal income distribution in the future. Thus, the allocation of public spending on education might be responsible for persistent inequality.

The main idea of this paper is to regard public spending on different levels of education as alternative public investments, which have conflicting effects on future labour income distribution. Net returns to these investments depend on the tax and transfers system being selected in the following period through the democratic process. In our framework, education policy, by changing future income distribution, might trigger a political equilibrium in which compensation for past public investments cannot be paid. This will deter first period incumbent governments from undertaking such investments. Specifically, our idea is that an investment in basic education might not be politically viable since a more egalitarian future income distribution would trigger a political equilibrium in which compensation wouldn't be paid.

To formalise these ideas we develop a model with two time periods, with an election occurring between the two. In the first period, agents differ in their initial wealth and abilities; in the second period, differences in wealth are combined with differences in labour income determined by abilities.

In the first period, the incumbent government decides on education policy. Namely, it has to decide to what level of education a fixed amount of financial resources should be allocated. Such resources are collected through the issue of government bonds.[3]

First period education policy affects second period labour income distribution: agents with higher ability derive greater benefit from higher education, whereas individuals with lower ability benefit more from investment in basic education. Therefore, if education policy is biased in favour of higher (basic) education, future labour income distribution will be more (less) unequal.

At the beginning of the second period, a two-party electoral competition is held and probabilistic voting decides the winner. The elected policymaker sets taxes on labour and capital income to finance a lump-sum transfer and repay public debt. Labour income taxation redistributes resources between the low and high-income individuals; capital income taxation redistributes resources from wealthier bond-holders to the remaining part of the population.

[3] Note that qualitative results would not change by adopting a different and more complex structure where public expenditure in education is financed by taxes in the first period, and the second period labour productivities are determined not only by public investment in education, but also by private investment in physical capital (see Section 6 below).

Since policy is bi-dimensional, citizens, when voting, must compare gains from the different policies to determine which the salient issue is and then vote accordingly.

The point we make is that since first period education policy affects future labour income distribution, it might also affect the taxation policy chosen in the second period political equilibrium. Here is a very rough intuition for why it might happen. Suppose that the majority of the population favour capital taxation, but there exists an "intense" minority who oppose such policy. Moreover, suppose that labour income taxation is the salient issue for all individuals but for the "intense" minority. In this context, parties might be willing to sacrifice the majoritarian stance on capital income taxation to avoid giving the other party the electoral advantage of the minority support. Thus, it may well be that public bonds will not be taxed even if the majority of population favour capital income taxation. The minority position on capital taxation prevails if and only if parties' expected electoral gain on labour income taxation more than offsets the loss associated to the other policy dimension.

If investing in basic education reduces future income differences, the electoral gain from labour income taxation might not be large enough to make up for the loss due to the adoption of the minoritarian stance on capital taxation; in this case, the equilibrium will feature bonds taxation with probability one. On the contrary, since investing in higher education increases future income inequality, this might guarantee the exemption of capital from paying taxes in the second period.

In the first period, if agents anticipate that bond-holdings will be taxed they would be discouraged from buying bonds in favour of investing in an alternative option (a storage technology) that we assume to be exempt from taxation. Thus, our model predicts that, public financing of education is only feasible if agents anticipate a favourable fiscal regime for bonds; this, in turn, might require the adoption of an education policy biased towards higher education.

The main testable prediction of our analysis, is that the higher the extent of wealth inequality compared to initial income inequality, the less egalitarian the incidence of public education expenditure will be. Namely, when capital ownership is concentrated, the credibility of a future regime favourable to capital income requires the anticipation of a large electoral gain in the other policy dimension. In turn, this calls for (intensification or persistence of) income inequality: indeed, only in this case parties will be willing to adopt the minoritarian stance on capital income taxation. Therefore, this argument might explain why more unequal societies appear to favour an allocation of public education spending responsible for persistent inequality.

The rest of the paper is organised as follows. A brief survey of the literature is presented in Section 2; the model is illustrated in Section 3; in Section 4 the political process is presented and in Section 5 the political equilibrium is characterised; Section 6 discusses robustness of results and empirical evidence and finally, Section 7 concludes.

2. Related literature

Our contribution is related to the literature which attempts to explain the limits to redistribution in democracies.[4]

The standard political–economy theory, based on the median voter approach, predicts a positive association between inequality and redistribution. The proposed explanation is that greater inequality, by reducing the income of the median voter relatively to the country's mean income, translates, under majority voting, into the adoption of more redistributive policies (Alesina and Rodrik, 1994; Persson and Tabellini, 1994). Cross-country data, however, do not seem to support such prediction. Perotti (1996) and the other studies surveyed in Benabou (1996) do not find any significant relationship between inequality and the share of transfers or public expenditure over GDP.

Recently, a strand of the literature on income distribution and redistributive policies, departing from the majority voting model, has focused on asymmetries in political influence to demonstrate the existence of a negative link between income inequality and redistribution. Benabou (2000) shows that, when the pivotal voter is richer than the median and redistributive policy generates gains in ex-ante efficiency, political support for the policy initially declines with inequality. Rodriguez (2004), in a model of lobbying, shows that greater inequality can be associated to more regressive tax systems; his result depends on having ruled out the possibility of lobbying by the poor. As for papers dealing directly with the political economy of education, both Gradstein (2003) and Zhang (2008) refer to asymmetric political influence to explain why more unequal societies empirically appear biased towards higher education expenditure.

The novelty of our contribution lies on the fact that we explain the bias in education expenditure without referring to the hypothesis of asymmetric political influence.[5] In fact, we maintain the hypothesis of symmetric political influence, as in the standard voting models, but, unlike the above reviewed literature, we introduce a multidimensional policy space in the spirit of Besley and Coate (2000, 2003).[6] This relates our contribution to the literature which analyses the trade-off between redistribution and other policy dimensions. Specifically, Roemer (1998) proposes an explanation for the limited redistribution puzzle based upon the assumption of party competition on a policy space with two dimensions, the first being taxation to finance redistributive transfers and the second being some non-economic issue. Differently from his contribution, our policy space only consists of economic dimensions. In this, our model is closer to Levy (2005) and Fernandez and Levy (2008). In their models, the existence of specific economic interests due to agents' diversity might destroy class solidarity affecting the level of general redistribution. In our model, solidarity between low-income (high-income) individuals, with respect to the preferred level of labour income taxation is broken by wealth heterogeneity. Specifically, agents who earn a labour income below the average, but have inherited a large wealth

[4] For a survey see Harms and Zink (2003).

[5] We neither refer to incentive or trickle-down arguments, which have often been used to explain the limited redistribution puzzle.

[6] We certainly do not believe that political influence is unrelated to wealth, but we use this assumption as a device to focus on a different channel through which wealth inequality affects public resource allocation.

endowment, are ready to sell their votes to the party which favours high-income earners to obtain support for policies which protect interests targeted to the wealthier. This might induce both parties to adopt the policy most favoured by "wealthier" individuals.

Our contribution is also strictly related to the argument, raised and formalised by Besley and Coate (1998), that an investment, by altering individuals' future productive abilities (future labour income distribution), might affect the desired redistribution policy of future policymakers, making such investment politically unfeasible. Specifically, in our model, if in the second period parties do not adopt the policy favoured by wealthier individuals, the first period public investment in education will not be feasible. Only if the conflict over the level of labour income taxation is strong, so as to make this policy issue salient for all but a minority of individuals, the low and high-income individuals will be ready to accept the minoritarian stance over capital income taxation. Indeed, education policy affects future labour income distribution and, through such distribution, it also determines future return from investing in public bonds. The more favourable the capital income fiscal regime will be, the more agents will be willing to buy bonds to finance education in the first period. Thus, education policy might be biased towards higher education precisely because this will guarantee that the future political conflict will be focused on labour income redistribution, leaving capital income taxation to be decided by the wealthier minority. Thus, in our approach, education policy is driven by the interplay between current inequality in wealth distribution and future inequality in income distribution.

Finally, to the best of our knowledge, this paper represents the first attempt to identify a theoretical relationship between education policy and the level of wealth concentration comparatively to the level of income concentration. Other papers, dealing with the political economy of education (or in general with the political economy of redistribution), have only considered the relationship between redistributive spending and the level of income inequality.

3. The model

3.1. Model overview

We consider a two-period dynamic model of representative democracy *à la* Besley and Coate (1998), which incorporates public investment in education and redistribution. In the first period, the incumbent government issues debt to finance a public investment in education and decides how to allocate the expenditure between different education levels. In the second period, differences in the agents' bond-holdings (wealth inequality) are combined with differences in labour income deriving from different levels of productivity (labour income inequality). Productivity is determined by the innate ability and by the first period public spending on education. Investment in basic education benefits only low talented individuals, thus reducing labour income inequality; investment in higher education benefits only high talented individuals, thus increasing inequality. This is a simplification meant to capture the idea that the marginal effect of education depends on innate abilities. Thus, only the high innate abilities allow to pursue higher education, while, for basic education, a marginal increase in public expenditure (for example, in the form of more tutorial hours, better learning devices etc.) benefits more those who encounter difficulties in learning (the low talented). At the beginning of the second period, an electoral competition with probabilistic voting takes place. The elected policymaker sets taxes on labour and capital income to finance a lump-sum transfer and to repay public debt. It is important to note that in our setting capital income taxation can also be interpreted as an inflation tax, which reduces the real value of the government's bonds.[7]

3.2. The economic environment

Consider a two-period economy with a continuum of individuals of measure one, indexed by i.[8] In the first period, agents receive an exogenous initial endowment a^i, which is distributed in the population according to a known distribution Φ, with mean a and support $[0, A]$, where A is a parameter. An individual's endowment a^i is private information. Let γ^P be the fraction of poor citizens, that is those with $a^i < a$, and $\gamma^R = 1 - \gamma^P$ the fraction of rich citizens, that is those with $a^i \geq a$. In line with empirical evidence, we assume that the majority of the population are poor, that is $\gamma^P > \gamma^R$. Furthermore, according to their ability, individuals can be distinguished into two types — high talented (H) and low talented (L) — of measure $0 < \gamma_k < 1$ with $k = H,L$ and $\gamma_L + \gamma_H = 1$. In the second period, each individual provides one unit of physical labour and talent affects labour productivity. Individuals of type k are characterized by labour productivity e^k, with $e^H > e^L$; thus, average productivity is $e = \gamma_L e^L + \gamma_H e^H$.

Individuals only care about second period consumption; thus, in the first period, they save the whole of their initial endowment. In addition, we assume that they are risk-neutral and, for analytical tractability, we posit $U(c) = c$.

In the economy, there are two saving instruments: a sure-return linear storage technology which earns a gross return $1 + r$, for each unit of initial endowment invested, and interest-bearing public bonds. We posit that individuals, when facing the same expected yield, have a bias in favour of government bonds.[9] We also assume that the government issues bonds so as to satisfy demand. These assumptions have the following implications: first, whenever public bonds are issued their (expected) interest rate has to be greater or equal to the interest rate paid by the storage technology; second, public debt b is identically equal to aggregate savings a and $a^i \equiv b^i$, where b^i stands for debt holdings of the individual.

[7] We thank the journal's editor for having suggested such interpretation. Indeed, using US data, Doepke and Schneider (2006) find that even moderate inflation leads to substantial redistribution from major bondholders in the economy (rich, old households) to young, middle-class families.

[8] This implies that aggregate and average values coincide.

[9] This assumption can be justified by introducing an arbitrarily small search cost for the storage technology.

The first period incumbent government issues public bonds to finance public expenditure in education.[10] We assume that it is constitutionally obliged to spend the bonds' proceeds on education, but it is free to choose whether to invest in basic (E_1) or higher education (E_2). The two investments are mutually exclusive.[11] Public spending on education affects productivity: specifically, basic education (E_1) raises the productivity of low talented individuals, but has no effect on high talented, that is $e^L(E_1)>e^L$, and $e^H(E_1)=e^H$, with $e^L(E_1)<e^H$; on the contrary, higher education (E_2) raises the productivity of high ability individuals, that is $e^H(E_2)>e^H$, and has no effect on low talented, i.e. $e^L(E_2)=e^L$. Labour is paid according to its productivity.

Let $e(E_l)$ denote average productivity when public investment in education is E_l, for $l=1,2$. In the following, we assume that investment in education is potentially Pareto improving (given available redistributive instruments), that is:

Assumption 1. *$e(E_l)-e>(1+r)a$ for $l=1,2$.*

At the beginning of the second period, an election takes place. The winner sets the combination of labour and capital income tax to finance a lump-sum transfer $g\in[\Re]$ and to repay public debt. We assume that the storage technology is exempt from taxation so that only the public bonds' returns can be taxed. This assumption can be justified by referring to prohibitive costs for the fiscal authority to trace back returns from investment whose amount is private information. If we interpret capital income taxation as an inflation tax, the storage technology can be taken as a real technology whose return is invariant to inflation.

We indicate capital income tax rate by $\pi\in[0,1]$, and labour income tax rate by $\tau\in[0,1]$. Thus, with the tax system (τ,π) an individual with pre-tax income $e^k(E_l)+(1+q)b^i$ will have a disposable income equal to $(1-\tau)e^k(E_l)+(1+q(1-\pi))b^i$, where q is the gross interest rate promised by the issuing government on bonds.

Substituting for the government budget constraint,

$$(1+q)b+g=\tau e(E_l)+\pi qb$$

the indirect utility function (consumption) of an individual of productivity type k with bonds' holding b^i is given by:[12]

$$c^{ik}(\tau,\pi)=(1-\tau)\cdot e^k(E_l)+\tau\cdot e(E_l)+(1+q(1-\pi))\left(b^i-b\right) \tag{1}$$

4. The political process

At the beginning of the second period, an electoral competition takes place. The election triggers a game whose players are parties and voters.

4.1. Voters' political preferences

In the second period, the investment in education E_l and the gross interest rate on bonds q are given. The individuals' policy preferences over π, g and τ can be derived from the individuals' indirect utility function (1). However, given the government's budget constraint, only two policies, say π and τ, can be freely set. Thus, to determine the voters' preferences for labour and capital income tax rates, we look at the marginal impact of these policies on the individuals' consumption:

$$\frac{\partial c^{ik}}{\partial\tau}=e(E_l)-e^k(E_l)\quad\text{and}\quad\frac{\partial c^{ik}}{\partial\pi}=q\left(b-b^i\right) \tag{2}$$

From (2) it is immediate to verify that if low talented, the i-th individual prefers $\tau^L=1$, associated to a lump-sum transfer $g=e(E_l)-(1+q(1-\pi))b$, while, if high talented, he prefers $\tau^H=0$ associated to a lump-sum tax (negative transfer) $g=-(1+q(1-\pi))b$. Moreover, (2) shows that the individuals' preferences for capital income taxation depend on the amount of bond-holdings. Those with $b^i\geq b$ (rich citizens) prefer $\pi=0$, while those with $b^i<b$ (poor citizens) prefer the maximum tax rate, i.e. $\pi=1$. On the basis of preferences over the two policy instruments, four groups of individuals can be distinguished:

$$\begin{aligned}&\mathrm{LP}=\left\{i,k\middle|e^k=e^L;b^i<b\right\},\quad\mathrm{HP}=\left\{i,k\middle|e^k=e^H;b^i<b\right\},\\&\mathrm{LR}=\left\{i,k\middle|e^k=e^L;b^i\geq b\right\},\quad\mathrm{HR}=\left\{i,k\middle|e^k=e^H;b^i\geq b\right\}\end{aligned}$$

For the ik-th citizen, the gains from the preferred labour and capital income tax rates are given, respectively, by:

$$\left|c^{ik}\left(\tau^L,\pi\right)-c^{ik}\left(\tau^H,\pi\right)\right|=\left|e(E_l)-e^k(E_l)\right|\quad\text{and}\quad\left|c^{ik}(\tau,0)-c^{ik}(\tau,1)\right|=q\left|b^i-b\right|$$

[10] Education expenditure cannot be financed by taxing initial endowments since they are private information.
[11] For the sake of simplicity, we focus on this extreme case. Qualitative results would not change by allowing the government to invest the proceeds of the bonds' sale in basic and higher education in different proportions.
[12] Recall that $U(c^{ik})=c^{ik}$.

We say that for the *ik*-th citizen labour income taxation is *salient* if benefits deriving from the preferred labour income tax exceed benefits deriving from the preferred capital income tax, that is:

$$\left|e(E_l) - e^k(E_l)\right| > q\left|b - b_i\right| \tag{3}$$

4.2. Parties

There are four groups of individuals who share the same preferences over the second period policies: LP, HP, LR, and HR. Thus, four parties could potentially be formed. In what follows, we assume that candidates in the election are put forward by only two parties, denoted *A* and *B*.[13] Each party is comprised of citizens who share preferences on labour income tax policy: specifically, all members of Party *A* prefer $\tau = 1$ and a positive government transfer, while all members of Party *B* prefer $\tau = 0$ and a lump-sum tax. Both parties contain a mix of rich and poor individuals.

Following Besley and Coate's (1997) and Osborne and Slivinsky's (1996) citizen–candidate models, we assume that no ex-ante commitment is possible: once elected, citizen *i* chooses either the tax rate $\tau^L = 1$ if low talented, or the tax rate $\tau^H = 0$ if high talented, and chooses either $\pi = 1$ if poor, or $\pi = 0$ if rich. Thus, each party's strategy entails the choice of a candidate. Parties select candidates by majority voting;[14] furthermore, we assume that the majority of each party members are poor, that is $b_A^m < b$ and $b_B^m < b$, where b_Z^m stands for public debt holdings of the median member of Party *Z*, with $Z = A,B$.

4.3. Voters[15]

There are two types of voters. A fraction μ are *rational voters*: they vote the candidate whose proposed policy maximises their pay-off function. The remaining fraction is represented by *noise voters*. A fraction η of the noise vote goes to Party *A*, where η is a random variable distributed in the interval [0,1] according to the cumulative distribution function $H(\eta)$. We assume that *H* is symmetric so that for all η, $H(\eta) = 1 - H(1 - \eta)$. This means that the probability that a fraction less then η vote for Party *A*'s candidate is equal to the probability that a fraction less than η vote for Party *B* candidate. Let ω represent the difference between the fraction of voters obtaining a higher utility from the policy chosen by Party *A* and the fraction of voters who benefit more from Party *B*'s policy. Given ω, we define $\Psi(\omega)$ as the probability that Party *A* wins.[16] In the following lemma, we assume that noise voters in the population are sufficiently numerous so that, if the choice of a labour income tax were the only policy issue, both parties would have a positive probability of winning the election.

Lemma 1. *If* $|\gamma_L - \gamma_H| < \frac{1-\mu}{\mu}$ *then* $\Psi(\omega) = \Psi(\gamma_L - \gamma_H) \in (0,1)$.

Proof. See Appendix A. □

4.4. Voting game

An election triggers a game between the two parties in which each party's strategy has two dimensions and can be represented by a policy vector $h_Z = (\tau_Z, \pi_Z)$ with $Z \in \{A,B\}$. A Nash equilibrium of the voting game is a couple of policy vectors, $h_Z^* = (\tau_Z^*, \pi_Z^*)$, one for each party, which are mutual best responses. Party members know the election probabilities associated with different candidate pairs and take them into account when voting. Thus, Party $Z \in \{A,B\}$ chooses a citizen–candidate whose preferences about labour and capital income tax rates maximise the expected median member's pay-off.

5. Political equilibrium

This section provides a description of political decision making in both periods. We begin with the second period, taking public investment in education as given. Then, we analyse the first period education policy choice, recognising that the incumbent government and individuals anticipate the dependence of the second period policy choices on the allocation of education expenditure decided in the first period.

As for the second period, we show that, even if the majority of the two parties' members prefer to tax capital income, if this issue is *salient* (i.e. benefits deriving from the preferred capital income tax policy exceed benefits deriving from the preferred labour income tax policy) only for a minority of individuals who oppose bonds taxation, then the political equilibrium might feature no taxes on capital income. Namely, under certain conditions, parties in equilibrium renounce to their stance on the bonds'

[13] One of the most widely cited facts, is that under the systems of plurality rule there are two main parties (this is the so-called Duverger's Law, after Duverger, 1954). One possible explanation of this stylised fact is that if there are three or more parties at least one can withdraw giving its vote to the "closest" party and cause it to win outright (see Osborne, 1995, for an account of ideas that explain Duverger's Law).

[14] Alternatively, we could have assumed that party members select candidates via some type of bargaining process. In this case the candidate chosen would maximize the expected pay-off of a pivotal party member. Under majority voting the pivotal party member is the median. For a discussion of inter and intra party competition in general elections see Roemer (2004) and Levy (2004).

[15] The description of the noise vote is based on Besley and Coate (2000, 2003).

[16] In the Appendix, $\Psi(\omega)$ is derived from the model's parameters.

taxation to gain the support of the minority who oppose this policy. This support, in turn, allows obtaining an electoral gain on the dimension which is salient for the majority of the individuals (labour income taxation).

Before solving for period two policy choices, we prove the following:

Lemma 2. *If, in the second period, parties adopt the same platform as for capital income taxation, then whenever public bonds are issued in the first period, the promised gross rate of return will be equal to r, whatever party is in power.*

Proof. Since the storage technology provides an interest rate equal to r and individuals are risk-neutral, bonds must pay, in expected terms, at least r. If parties adopt the same electoral platform as for asset taxation, either they both choose $\pi = 0$, or $\pi = 1$.[17] Therefore, in the first period, public bonds can be issued only if $\pi = 0$, that is when no bonds' taxation is anticipated. Conversely, if individuals anticipated $\pi = 1$, they would not buy bonds because the expected net rate of return would be lower than what was paid by the storage technology. Moreover, since party median members are, by hypothesis, poor, in period 1 both parties are interested in promising an interest on bonds as little as possible, then it follows that q will be exactly equal to r.

Note that, under Assumption 1, $q = r$ guarantees the sustainability of government debt, that is $e(E_l) > (1+q)b$ $l = 1,2$. □

5.1. Period two policy choices

Since citizens have only one vote, but each party's strategy is bi-dimensional, when voting individuals have to compare the gain from the preferred capital income tax with the gain from the preferred labour income tax.

Let us suppose that labour income taxation is the *salient* issue for poor individuals (i.e. those with $b^i < b$). It follows that this will be also true for individuals with $b < b^i \leq 2b$, since the distance between b and $2b$ is exactly b. Conversely, let us suppose that capital income taxation is *salient* for those individuals with $b^i > 2b$, who we define as very rich individuals.[18] This, recalling the definition of salience in (3), leads to the conditions embodied in the following:

Assumption 2.

$$\text{(i)} \quad r\,|b^i - b| > \max_k |e(E_l) - e^k(E_l)| \quad \forall l \quad \text{when} \quad b^i > 2b$$

$$\text{(ii)} \quad \frac{\min_k |e(E_l) - e^k(E_l)|}{b} > r \quad \forall l$$

Assumption 2 implies that the very rich minority cast their vote looking at a candidate attitude towards the bonds' taxation. Namely (i) requires that for the very rich minority the gains from the preferred capital income tax are greater than the gains from the preferred labour income tax. Conversely, the majority of the population vote looking at a candidate's attitude towards labour income tax policy.[19] In other words, the labour income tax policy gains are greater than the capital income tax policy ones for all individuals, but for a minority of very rich voters.

Moreover, we assume that parties gain more by following their labour income redistribution preferences than by compromising on such dimension to choose their preferred capital income policy, when the opposing party is running a candidate with conflicting preferences. Namely, neither party wishes to put forward a candidate with the opposing party's labour income taxation preference and the majoritarian stance on capital income taxation. The following assumption embodies the condition under which this will be true.

Assumption 3.

$$\text{For } Z \in \{A,B\},\ k = \begin{cases} L & when \quad Z = A \\ H & when \quad Z = B \end{cases} \text{ and } -k = \begin{cases} L & \text{when} \quad Z = B \\ H & \text{when} \quad Z = A \end{cases}$$

$$\Psi(\gamma_k - \gamma_{-k})|e(E_1) - e^k(E_1)| > \Psi(\gamma^P - \gamma^R) r (b - b_Z^m).$$

Assumption 3 states that for the median member of Party Z the expected loss from compromising on labour income taxation (adopting the policy preferred by the opposing party) (LHS) is greater than the expected gain from choosing the majoritarian stance on capital income taxation, while the opposing party chooses the policy preferred by the wealthier bond-holders (RHS).[20]

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17 We will prove below that this is the equilibrium result.

18 This definition of very rich individuals is meant to capture the idea that the "intensity" of preferences for bonds' taxation (measured by the distance of the individual's debt holdings from the means) of the very rich is higher than for the very poor. In fact, while there is a lower bound on wealth, there is no upper bound and the difference $b^i - b$ for the very rich can be arbitrarily large.

19 If labour income tax policy were *salient* for the whole population, the equilibrium of the policy game would be straightforward: rational voters would vote for the candidate who shares their preferences on labour income taxation and the equilibrium outcome would depend on the proportion of low and high talented individuals (see Besley and Coate, 2000).

20 Note that if parties compromise on labour income taxation , then capital income becomes the only issue at the stake. Therefore, each party's winning probability is determined by the difference between the share of "poor" and "rich" individuals.

Thus, neither party wishes to compromise on labour income taxation. Conversely, both parties might find rational pandering to the rich minority by running a candidate who shares the minority stance on asset taxation, to avoid giving the other party the electoral advantage of the minority support. The next proposition gives conditions under which an equilibrium involves both parties selecting candidates who share the labour income tax preferences of their members, but who have non majoritarian stance on the bonds' taxation.

Proposition 1. *If Assumptions 2 and 3 hold, then $h_A^* = (\tau^L, 0)$ and $h_B^* = (\tau^H, 0)$ is the unique Nash equilibrium of the electoral game if and only if the conditions given below are satisfied.*

$$\forall l, \quad \text{for} \quad Z \in \{A, B\} k = \begin{cases} L & \text{when } Z = A \\ H & \text{when } Z = B \end{cases} \quad \text{and} \quad -k = \begin{cases} L & \text{when } Z = B \\ H & \text{when } Z = A \end{cases}$$

$$\text{(i)} \quad \left[\Psi(\gamma_k - \gamma_{-k}) - \Psi\left((\gamma_k - \gamma_k^{VR}) - (\gamma_{-k} + \gamma_k^{VR})\right)\right] \cdot |(e(E_l) - e^k(E_l))| > \Psi\left((\gamma_k - \gamma_k^{VR}) - (\gamma_{-k} + \gamma_k^{VR})\right) r(b - b_Z^m)$$

$$\text{(ii)} \quad \left[\Psi\left((\gamma_k + \gamma_{-k}^{VR}) - (\gamma_{-k} - \gamma_{-k}^{VR})\right) - \Psi(\gamma_k - \gamma_{-k})\right] \cdot |(e(E_l) - e^k(E_l))| > \Psi\left((\gamma_k + \gamma_{-k}^{VR}) - (\gamma_{-k} - \gamma_{-k}^{VR})\right) r(b - b_Z^m)$$

where γ_k^{VR} is the fraction of very rich individuals, for whom capital income tax policy is the salient issue, and whose productivity is of type k.

Proof. See Appendix A. □

Condition (i) ensures that when both parties are pleasing the minority of rich individuals, the gain that could be obtained by switching to the preferred capital income tax rate ((i) RHS) would be offset by the loss due to the decreased probability of winning the election ((i) LHS). Condition (ii) ensures that both parties selecting rich candidates is the unique equilibrium. It states that when the two parties field candidates with different preferences about labour income taxation but with the same majoritarian stance on capital income taxation, the electoral gain associated with attracting the other party's very rich constituency, by substituting the poor candidate with one who opposes capital income taxation, is sufficiently large.

Intuitively, if Party B is choosing a rich candidate, who opposes capital income taxation, then, under the condition (i) stated above, the best-reply for Party A is to make the same choice. Indeed, if Party A were to choose a poor candidate it would increase the party median member's pay-off in case of success, but it would reduce the probability of winning the election by losing the very rich low talented voters, for whom capital income taxation is *salient*. A symmetric argument ensures that Party B will choose a rich candidate. Moreover condition (ii) guarantees that if the opponent party runs a candidate with majority preferences as for capital income taxation, both parties wish to deviate to a rich candidate.

Proposition 1 gives a theoretical support to the idea that "intense" minorities may exercise a strong political influence on the issue they care about. Indeed, we argue that parties in equilibrium renounce their stance on capital income taxation to gain the support of the minority who opposes such policy. This support, in turn, allows obtaining an electoral gain on the dimension which is salient for the majority of the individuals (labour income taxation).

It is important to note that Proposition 1 crucially relies on the assumption that parties run candidates with different preferences about labour income taxation.[21] Therefore, it is essential that labour income taxation is sufficiently important, compared to capital income taxation, for the majority of individuals.

An immediate implication of Proposition 1 is given by the following:

Corollary 1. *If the conditions in Proposition 1 are not satisfied then $h_A^* = (\tau^L, 1)$ and $h_B^* = (\tau^H, 1)$ is the unique Nash equilibrium of the game.*

Proof. See Appendix A. □

If the conditions in Proposition 1 are violated then the unique Nash equilibrium of the second period political game features a capital income tax rate equal to 1. In other words, both parties will adopt the majoritarian stance as for capital income taxation.

From the above analysis we can conclude that public investment in education will be feasible if and only if conditions (i) and (ii) in Proposition 1 hold. Indeed, if this were not the case, the anticipation of an equilibrium featuring a capital income tax rate equal to 1 would prevent individuals from buying bonds in the first period: the government's bonds' expected return would be lower than the storage technology's returns and therefore no public debt could be issued and investing in public education would not be viable.

Conditions (1.i) and (1.ii) are more likely to hold the larger is the gain from labour income redistribution $|e(E_l) - e^k(E_l))|$ compared to the (median) gain from redistribution through capital income taxation $r(b - b_Z^m)$, and the larger is the electoral gain that each party can obtain from getting a few more voters. This would be true, for example, if the fractions supporting the two parties were close together and the fraction of very rich individuals in each party were non-negligible.

These results can help to explain why the incidence of public expenditure on education appears to be skewed in favour of the middle and upper classes. According to our model investing in basic education reduces future labour income inequality and this, in

[21] If this were not true, then the bonds' taxation would be the only issue at stake. Rational voters would vote for the candidate who shared their preferences on capital income taxation and the equilibrium outcome would depend on the proportion of poor and rich individuals.

turn, decreases the future electoral gain on the labour income tax policy dimension. Thus, parties might not find rational sacrificing the majoritarian stance on the financial rents' taxation to gain the support of the rich minority. The anticipation of an equilibrium featuring a capital income tax rate equal to 1 would prevent individuals from buying bonds in the first period, making the public investment in basic education unfeasible. In the next section we formally develop such intuition.

5.2. Period one policy choices

In the first period, the party in power (either Party *A* or Party *B*) has to decide whether or not to issue public bonds to finance public investment in education and which education policy to adopt, knowing that economic agents are forward looking. On the other side, individuals have to decide whether to buy public bonds or to invest in the storage technology.

Our next proposition relates individuals' preferences about education policy to second period labour income tax policy. We maintain the hypothesis that $\pi = 0$, otherwise no public debt could be issued and public investment in education would not be viable.

Proposition 2. *Assume $\pi = 0$. If in the second period political equilibrium $\tau = \tau^L$(Party A wins the election) then high talented and low talented individuals have homogeneous preferences on education policy. On the contrary, if $\tau = \tau^H$ (Party B wins the election), low talented individuals strictly prefer investing in basic education, while high talented ones strictly prefer higher education.*

Proof. See Appendix A. □

Intuitively, when future labour income tax rate is equal to 1, an individual's preference about education policy is independent of his type. What is important is the aggregate impact of education policy. If different education policies have the same effect on aggregate production, low talented and high talented individuals will be indifferent to the allocation of public spending. If the aggregate impact on future production depends on which education level is financed, then again, the two groups will have homogeneous preferences: they will both prefer investing in the most efficient type of education.

Conversely, when $\tau = \tau^H$, i.e. future labour income tax rate is equal to 0, the individuals' preferences about education policy depend on individuals' type, since aggregate resources will not be redistributed. Thus, low talented individuals will strictly prefer basic education, whereas high talented individuals will strictly prefer higher education, whatever the aggregate impact on production is.

In the following proposition, we relate the incumbent government's education policy choice to the political equilibrium prevailing in the second period.

Proposition 3. *Under the conditions stated in Proposition 1, if $e(E_1) = e(E_2)$ then public spending will finance basic (higher) education if Party A (Party B) is in power; if $e(E_1) \neq e(E_2)$ then the parties' preferences will converge on the level of education which maximizes social welfare only if the probability attached to the event that Party A wins the election is above the following threshold level*:

$$\Psi(\gamma_L - \gamma_H) > \frac{1}{1+x}$$

where

$$x = \begin{cases} \dfrac{|e(E_2) - e(E_1)|}{e^H(E_2) - e^H} & \text{if } e(E_1) - e(E_2) > 0 \\[2ex] \dfrac{|e(E_1) - e(E_2)|}{e^L(E_1) - e^L} & \text{if } e(E_2) - e(E_1) > 0 \end{cases}$$

Otherwise Party A will always choose basic education and Party B higher education.[22]

Proof. See Appendix A. □

Intuitively, when the conditions stated in Proposition 1 hold, the individuals anticipate that future policymakers will never tax capital income. Thus, they won't be deterred from buying bonds whatever the level of education funded by public expenditure is. This implies that the party in power will choose to allocate public funds on its preferred education level. Moreover, Proposition 3 clarifies that the parties' preferences will converge on the level of education which maximizes social welfare when the probability attached to the event that Party *A* wins the election is sufficiently high. The reason is that if Party *A* wins then $\tau = \tau^L = 1$ and individuals' level of consumption will not depend on talent but only on aggregate output.

Now we posit the following:

Assumption 4. *Investing in basic education reduces the conflict over labour income taxation policy up to the point in which the conditions stated in Proposition 1 do not hold.*

[22] Note that x compares aggregate losses to groups' gains. Indeed, when investing in basic education is suboptimal, aggregate losses can be measured by $e(E_2) - e(E_1)$. However, basic education has a positive effect on low talented productivity which can be measured by $e^L(E_1) - e^L$. A symmetric argument holds when investing in higher education is not social welfare maximizing.

From Assumption 4 it is immediate to demonstrate the following proposition:

Proposition 4. *Under Assumption 4, whatever the aggregate impact of different education policies is, Party A will finance higher education if $\Psi(\gamma_L - \gamma_H)(e(E_2) - e) \geq (1 + r)b$, otherwise it will not invest in public education at all. Conversely, if Party B is in power, it will always finance higher education.*

Proof. See Appendix A. □

Given Assumption 4, it immediately follows from Corollary 1 that financing basic education is politically unfeasible. Indeed, the anticipation of an equilibrium featuring a capital income tax rate equal to 1 would prevent individuals from buying bonds in the first period. Only spending on higher education guarantees that future conflict over labour income taxation policy will be intense enough to deflect the attention of "poor" individuals from capital income taxation policy; at the same time, the existence of a very rich minority guarantees that bonds will not be taxed, thus making the financing of higher education in the first period politically feasible. Furthermore, the condition $\Psi(\gamma_L - \gamma_H)(e(E_2) - e) \geq (1 + r)b$ guarantees the satisfaction of Party A's participation constraint (in expected value).

An immediate implication of Proposition 4 is that if $e(E_1) > e(E_2)$, the economy will be stuck in a suboptimal equilibrium. In this case, the socially optimal education policy (financing basic education) can not be adopted for fear that debt obligations, issued to cover public investment current costs, will be taxed in the future, where first period political control does not apply. This result holds even when both parties ex-ante would prefer to invest in basic education. Indeed, in our model, what is crucial to invest in public education is the political feasibility of an equilibrium featuring $\pi = 0$, that is, an equilibrium in which future policymakers choose not to tax inherited public bonds. If future policymakers are expected to tax bonds' return, individuals would be deterred from buying bonds, making public investment in education unfeasible. Since the political feasibility of an equilibrium featuring $\pi = 0$ might depend on which education level is funded in the first period, there is no assurance that the investment will be directed to the level of education which maximizes social surplus. This is an example of the so called "political failures in democracies", as described in Besley and Coate (1998).

6. Discussion

The above analysis is based on a very simplified model. In the following, we discuss the empirical implications that can be derived even from this simplified framework and we provide some preliminary evidence supporting the main result of the model. Beside, we discuss the robustness of our results to changes in the assumption that public education is financed by issuing public bonds.

6.1. Main testable implications

From the model's main results it is possible to derive the following corollary:

Corollary 2. *Public spending in higher education is more likely to be observed, the higher is the wealth inequality compared to the first period income inequality.*

Proof. For public spending on education to be financed, Proposition 1 requires $\frac{(|e(E_l) - e^k(E_l)|)}{r(b - b_Z^m)}$ to be "sufficiently high". Suppose that basic education has been financed in the first period, then we can write labour income inequality as:

$$\left|\left(e(E_1) - e^k(E_1)\right)\right| = (1 - \gamma_k)\left[e^H - e^L(E_1)\right] = (1 - \gamma_k)\left[\left(e^H - e^L\right) - \left(e^L(E_1) - e^L\right)\right]$$

which depends on the initial distribution of talent (income) and on the effects of education. The more egalitarian is the initial distribution of income (talents) relative to wealth inequality, small $(e^H - e^L)$ and high $(b - b_Z^m)$, the more likely is that Assumption 4 holds, i.e. investment in basic education is not politically viable (cfr. Proposition 4). □

Corollary 2 suggests that more unequal societies, that is countries in which wealth inequality is reasonably high as compared to income inequality tend to spend comparatively more on higher education. Below, we report, for the year 2000, the share of spending at tertiary level in total public education spending and a measure of inequality calculated as the ratio of the Gini index for wealth and the Gini index for gross income.[23] Data come from OECD (Education Expenditure and Gross Income) and UNU-Wider (wealth). Table 2 below reports the Gini index for wealth and gross income, as well as the ratio of the two variables, for 15 (mainly OECD) countries for which gross income data are available. The data exhibit enough variability in the "Gini ratio". Moreover, as shown in Fig. 1 below, there seems to be a positive relationship, between the "Gini ratio" and the share of tertiary education spending, in line with our results. Given the limited availability of data on gross income and on wealth, even a simple partial-correlation analysis has to be interpreted cautiously. Nevertheless, we have run a cross-country regression controlling for real GDP per-capita and demographic factors, namely the fraction of population aged 20–24. The estimated coefficient for the "Gini ratio" is 0.122 and it is significant at the 5% level.[24] Further empirical investigation with a more accurate econometric analysis leaves scope for future research.

[23] Working with gross income is essential if one wants to measure the demand for redistribution.

[24] Interestingly, for our dataset, using as independent variable in the regression the gross-income Gini or the wealth Gini, instead of the "Gini ratio", the coefficient, although not significant, is negative (−0.50) for the gross-income Gini and positive (+0.83) for the wealth Gini.

Table 2
Wealth and income inequality (year 2000).

Country	Wealth Gini	Gross_income Gini	Gini ratio
Australia	0.62	0.48	1.296
Austria	0.64	0.46	1.400
Belgium	0.66	0.42	1.571
Denmark	0.77	0.39	1.962
France	0.73	0.48	1.521
Italy	0.61	0.52	1.171
Japan	0.55	0.43	1.272
Netherlands	0.65	0.42	1.545
New Zealand	0.65	0.48	1.356
Norway	0.63	0.41	1.544
Portugal	0.67	0.48	1.388
Sweden	0.78	0.45	1.724
United Kingdom	0.70	0.48	1.452
USA	0.80	0.45	1.780
Czech Republic	0.62	0.41	1.522

Data source: OECD (Social and Welfare Statistics) and UNU-Wider.

6.2. Education with capital accumulation

Qualitative results would not change by adopting a different and more complex structure where public expenditure on education is financed by taxes in the first period, and the second period labour productivities are not only determined by public investment in education, but also by private investment in physical capital.

Consider a two-period economy with a continuum of individuals of measure one. There are two goods: a capital good and a consumption good. The capital good can be produced employing as inputs an investment technology and the consumption good (without the use of labour). Differently, the production of the consumption good can be implemented through two alternative technologies: an advanced technology which requires capital and labour as inputs and a traditional technology which only requires labour. Capital produced in the first period can be used in the production of the consumption good only in the second period. The advanced technology is more productive than the traditional one.

Agents in the economy are either lenders or entrepreneurs. Entrepreneurs and lenders differ in two fundamental aspects: only entrepreneurs have access to the investment technology, while only lenders receive a positive amount of the consumption good in the first period. In the second period, each lender supplies one unit of physical labour. According to their talent, lenders can be distinguished into two types, high talented and low talented. Differently from lenders, entrepreneurs have no labour endowment

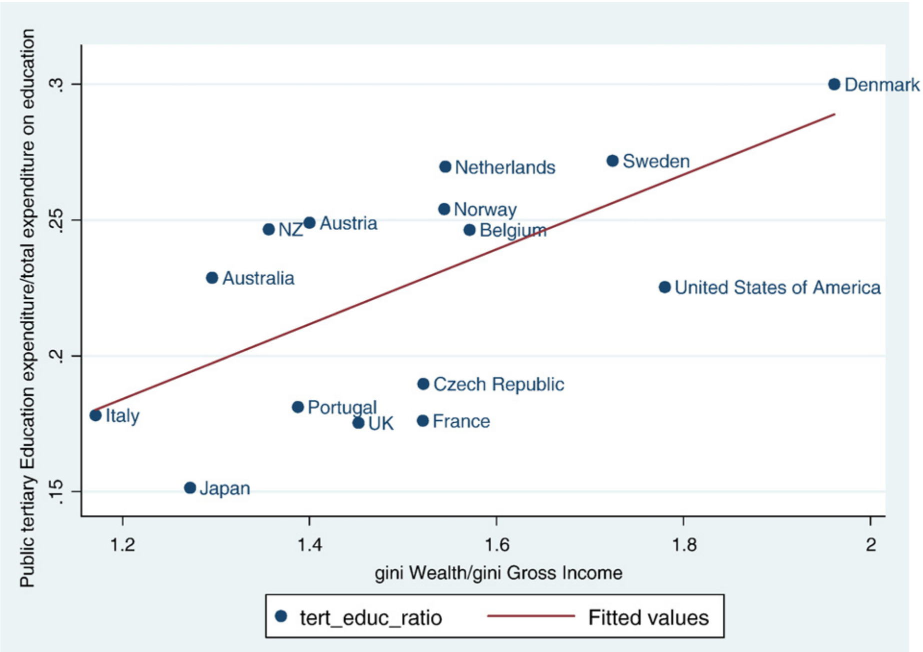

Fig. 1. Inequality and education (year 2000). Data Source: OECD (Education and Training Database, Social and Welfare Statistics) and UNU-Wider.

in the second period, but they might earn a capital income provided they borrowed consumption good from lenders in the first period, in order to initiate the investment project. We suppose that they issue bonds to finance the investment.

Individuals are risk-neutral and care only about the second period consumption, thus, in the first period, lenders save all their endowment. There are two savings instruments: a sure-return storage technology which earns a gross return $1+r$ for each unit of initial endowment invested and interest-bearing bonds issued by entrepreneurs. We posit the following assumptions: future policymakers can only tax bonds and labour income, thus the bonds' net return depends on future policy choices; lenders, when facing the same expected yield, have a bias in favour of the entrepreneurs' bonds; the economy-wide saving always exceeds the amount required by the entrepreneurs to finance their investment projects. In the first period, the incumbent government taxes initial endowments to finance a public investment in education, whose amount is supposed to be exogenously fixed, and decides how to allocate the tax revenue between different education levels. In the second period, labour productivity is affected by the first period public spending on education, as well as by the technology. Specifically, it is assumed that basic education only benefits low talented individuals, thus reducing income inequality, whereas higher education only benefits high talented individuals, thus increasing income inequality.

At the beginning of the second period, a two-party electoral competition is held. Each party chooses a citizen–candidate by majority voting whereas probabilistic voting decides the winner. In the second period, the elected policymaker redistributes resources through a linear income tax, which redistributes resources between low and high-income individuals and a tax on bond-holdings (financial rents taxation), which redistributes resources from bond-holders to labour income tax payers. Education funding, by affecting future income distribution, might affect the policy chosen by future policymakers. Specifically, investment in basic education might reduce future income inequality up to the point in which compromising on financial rents taxation, to gain the support of the minority who oppose rents' taxation, does not allow to obtain a sufficient gain on the labour income tax policy so as to offset the expected loss of such minoritarian choice. In this case, the political outcome on financial rents taxation will be the one preferred by the majority of voters, which is taxation of financial rents (the majority of the population, as well as the majority of the members of each party, are assumed to be poor). On the contrary, investment in higher education, by increasing future income inequality, deflects attention from the financial rents' taxation. Labour income tax policy catalyses the political conflict and, provided the existence of a minority of wealthy bond-holders who oppose financial rents' taxation, the equilibrium will feature no financial rents' taxation with probability one. Working backwards, the anticipation of an equilibrium featuring financial rents' taxation will prevent lenders from buying the bonds issued by the entrepreneurs. Investment in physical capital will be prevented as well, and, in turn, only the traditional technology will be available in the second period. Thus, even if in the first period the party in power preferred basic education, it would not finance it, since this would discourage capital accumulation.

7. Concluding remarks

The incidence of public spending on education, far from being uniform, appears to be biased towards higher education. This paper has presented a model in which this bias is politically determined. The main result is that an equilibrium with investment in higher education might be observed even if the constituency of the incumbent government consisted of individuals who would benefit more from the investment in basic education, and even if basic education were more growth-enhancing than higher education. This result is based on the recognition that an investment, by altering individuals' productive abilities, might lead to changes in preferences for future redistribution, which make the investment politically unfeasible. Intuitively, if investing in basic education reduces labour income inequality, redistribution through public bonds (wealth) taxation might become a politically more relevant issue than redistribution through labour income taxation. In this case, a majority of poor individuals should be expected to implement a large degree of redistribution through bonds' taxation. Ultimately, this would destroy the credibility of public bonds repayment whose proceeds, in our model, finance public investment in education. This result helps to explain why the bias in the incidence of public spending on education is stronger in some countries than in others. According to the model, in fact, countries with more unequal distribution of wealth compared to income inequality, should have a less redistributive way of spending on education. Preliminary empirical evidence supports such theoretical result.

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Appendix A

Proof of Lemma 1.

Party A wins if $\mu\omega+(1-\mu)\eta>(1-\mu)(1-\eta)$ that is, $\eta>\frac{1}{2}-\frac{\mu\omega}{2(1-\mu)}$. Consequently, given ω, the probability that Party A wins is $\Psi(\omega)=1-H\left[\frac{1}{2}-\frac{\mu\omega}{2(1-\mu)}\right]$. For $\omega=\gamma_L-\gamma_H$, $\Psi(\gamma_L-\gamma_H)\in(0,1)$ requires $H\left[\frac{1}{2}-\frac{\mu|\gamma_L-\gamma_H|}{2(1-\mu)}\right]>0$ that is $\frac{1}{2}-\frac{\mu|\gamma_L-\gamma_H|}{2(1-\mu)}>0$ or $|\gamma_L-\gamma_H|<\frac{1-\mu}{\mu}$. □

Proof of Proposition 1.

We have to show that, under Assumptions 2 and 3, $h_A^* = (\tau^L, 0)$ and $h_B^* = (\tau^H, 0)$ represent Nash equilibrium strategies of the policy game. We concentrate on the choice of the Party A; a similar reasoning applies when analysing the opponent party. The specified strategies bring about the following expected pay-off for party A's median member:

$$E_\eta\left[c_A^m \mid h_A = \left(\tau^L, 0\right), h_B = \left(\tau^H, 0\right)\right] = (1+r)(b_A^m - b) + \Psi(\gamma_L - \gamma_H)e(E_l) + [1 - \Psi(\gamma_L - \gamma_H)]e^L(E_l) \tag{A1}$$

In order to show that $h_A = (\tau^L, 0)$ is the best response to Party B's strategy, we have to compare the previous expected pay-off with the pay-off obtainable by choosing the alternative strategies: $(\tau^H,0)(\tau^H,0)(\tau^L,1)$.

Since $\Psi(\gamma_L - \gamma_H) > 0$, $(\tau^L,0)$ is certainly preferred to $(\tau^H,0)$.

If Party A were to choose $(\tau^H,1)$, then debt policy would be the unique policy at stake. Therefore, the expected pay-off for Party A's median member would be:

$$E_\eta\left[c_A^m \mid h_A = \left(\tau^H, 1\right), h_B = \left(\tau^H, 0\right)\right] = \Psi\left(\gamma^P - \gamma^R\right)\left[e^L(E_l) + b_A^m - b\right] + \left(1 - \Psi\left(\gamma^P - \gamma^R\right)\right)\left[e^L(E_l) + (1+r)(b_A^m - b)\right]$$

which has to be compared with (A1).

The difference between the two expected pay-offs is equal to:

$$\begin{aligned} &E_\eta\left[c_A^m \middle| h_A = \left(\tau^L, 0\right), h_B = \left(\tau^H, 0\right)\right] - E_\eta\left[c_A^m \mid h_A = \left(\tau^H, 1\right), h_B = \left(\tau^H, 0\right)\right] = \\ &= \Psi(\gamma_L - \gamma_H)\left[e(E_l) - e^L(E_l)\right] - \Psi\left(\gamma^P - \gamma^R\right) r(b - b_A^m). \end{aligned}$$

Assumption 3 guarantees that the above expression is positive, thus Party A prefers $(\tau^L,0)$ to $(\tau^H,1)$.

Finally, by choosing $(\tau^L,1)$ Party A would lose the votes of rational, low talented and very rich voters (which we indicate with γ_L^{VR}):

$$\begin{aligned} &E_\eta\left[c_A^m \middle| h_A = \left(\tau^L, 1\right), h_B = \left(\tau^H, 0\right)\right] = \Psi\left(\left(\gamma_L - \gamma_L^{VR}\right) - \left(\gamma_H + \gamma_L^{VR}\right)\right) \cdot \left[e(E_l) + b_A^m - b\right] + \\ &+ \left\{1 - \Psi\left(\left(\gamma_L - \gamma_L^{VR}\right) - \left(\gamma_H + \gamma_L^{VR}\right)\right)\right\} \cdot \left[(1+r)(b_A^m - b) + e^L(E_l)\right]. \end{aligned}$$

which, again, has to be compared with (A1).

The difference between the two expected pay-offs is equal to:

$$\begin{aligned} &E_\eta\left[c_A^m \middle| h_A = \left(\tau^L, 0\right), h_B = \left(\tau^H, 0\right)\right] - E_\eta\left[c_A^m \middle| h_A = \left(\tau^L, 1\right), h_B = \left(\tau^H, 0\right)\right] = \\ &= \left\{\Psi(\gamma_L - \gamma_H) - \Psi\left(\left(\gamma_L - \gamma_L^{VR}\right) - \left(\gamma_H + \gamma_L^{VR}\right)\right)\right\} \cdot \left[e(E_l) - e^L(E_l)\right] - \Psi\left(\left(\gamma_L - \gamma_L^{VR}\right) - \left(\gamma_H + \gamma_L^{VR}\right)\right) r(b - b_A^m). \end{aligned}$$

Condition (1.i) guarantees that the above difference between pay-offs is positive and Party A prefers $(\tau^L,0)$ to $(\tau^L,1)$. This shows that $h_A^* = (\tau^L,0)$ is the best response to $h_B^* = (\tau^H,0)$.

We now seek conditions for uniqueness of the equilibrium. In order to do so, we have to show that each party choosing its preferred labour and capital income tax rates is not a Nash equilibrium. Suppose that Party B is choosing its preferred strategy, namely $h_B = (\tau^H,1)$; then, if Party A chooses its preferred strategy $h_A = (\tau^L,1)$ the party's median member pay-off is:

$$E_\eta\left[c_A^m \middle| h_A = \left(\tau^L, 1\right), h_B = \left(\tau^H, 1\right)\right] = \Psi(\gamma_L - \gamma_H)\left[e(E_l) + (b_A^m - b)\right] + \{1 - \Psi(\gamma_L - \gamma_H)\}\left[e^L(E_l) + (b_A^m - b)\right]$$

The above pay-off has to be compared with the party's median member pay-off if $h_A = (\tau^L,0)$ which is:

$$\begin{aligned} &E_\eta\left[c_A^m \middle| h_A = \left(\tau^L, 0\right), h_B = \left(\tau^H, 1\right)\right] = \Psi\left(\left(\gamma_L + \gamma_H^{VR}\right) - \left(\gamma_H - \gamma_H^{VR}\right)\right) \cdot \left[e(E_l) + (1+r)(b_A^m - b)\right] + \\ &+ \left\{1 - \Psi\left(\left(\gamma_L + \gamma_H^{VR}\right) - \left(\gamma_H - \gamma_H^{VR}\right)\right)\right\} \cdot \left[e^L(E_l) + (b_A^m - b)\right]. \end{aligned}$$

The difference between the two expected pay-off is equal to:

$$\begin{aligned} &E_\eta\left[c_A^m \middle| h_A = \left(\tau^L, 0\right), h_B = \left(\tau^H, 1\right)\right] - E_\eta\left[c_A^m \middle| h_A = \left(\tau^L, 1\right), h_B = \left(\tau^H, 1\right)\right] = \\ &= \Psi\left(\left(\gamma_L + \gamma_H^{VR}\right) - \left(\gamma_H - \gamma_H^{VR}\right)\right) - [\Psi(\gamma_L - \gamma_H)] \cdot \left|e(E_l) - e^k(E_l)\right| - \Psi\left(\left(\gamma_L + \gamma_H^{VR}\right) - \left(\gamma_H - \gamma_H^{VR}\right)\right) r(b - b_Z^m) \end{aligned}$$

By condition (1.ii), the above expression is positive; therefore, Party A prefers $(\tau^L,0)$ to $(\tau^L,1)$ also when Party B is choosing $h_B = (\tau^H,1)$.[25] This means that $h_A^* = (\tau^L,1)$ and $h_B^* = (\tau^H,1)$ is not a Nash equilibrium. □

[25] Thus, $(\tau^L,0)$ is a dominant strategy.

Proof of Corollary 1.

Now we show that if condition (1.ii) is violated then $h_A^* = (\tau^L, 1)$ and $h_B^* = (\tau^H, 1)$ represent Nash equilibrium strategies of the policy game. We concentrate on the choice of Party A. A similar argument applies in the case of the opponent party. The specified strategies bring about the following expected pay-off for Party A's median member:

$$E_\eta\left[c_A^m \middle| h_A = \left(\tau^L, 1\right), h_B = \left(\tau^H, 1\right)\right] = \Psi(\gamma_L - \gamma_H)e(E_l) + [1 - \Psi(\gamma_L - \gamma_H)]e^L(E_l) + (b_A^m - b) \tag{A2}$$

In order to show that $h_A = (\tau^L, 1)$ is the best response to Party B's strategy, we have to compare the previous expected pay-off with the pay-off obtainable by choosing the alternative strategies: $(\tau^H, 1)(\tau^H, 0)(\tau^L, 0)$.

Since $\Psi(\gamma_L - \gamma_H) > 0$, $(\tau^L, 1)$ is certainly preferred to $(\tau^H, 1)$.

Next, suppose that Party A were to choose $(\tau^H, 0)$; then, debt policy would be the unique policy at stake. Therefore, the expected pay-off for Party A's median member would be:

$$E_\eta\left[c_A^m \middle| h_A = \left(\tau^H, 0\right), h_B = \left(\tau^H, 1\right)\right] = \left(1 - \Psi\left(\gamma^P - \gamma^R\right)\right)\left[e^L(E_l) + (1 + r)(b_A^m - b)\right] + \Psi\left(\gamma^P - \gamma^R\right)\left[e^L(E_l) + (b_A^m - b)\right]$$

which has to be compared with (A2).

The difference between the two expected pay-offs is equal to:

$$\begin{aligned} &E_\eta\left[c_A^m \middle| h_A = \left(\tau^L, 1\right), h_B = \left(\tau^H, 1\right)\right] - E_\eta\left[c_A^m | h_A = \left(\tau^H, 0\right), h_B = \left(\tau^H, 1\right)\right] = \\ &= \Psi(\gamma_L - \gamma_H)\left[e(E_l) - e^L(E_l)\right] - \left(1 - \Psi\left(\gamma^P - \gamma^R\right)\right)r(b - b_A^m). \end{aligned}$$

Assumption 3 guarantees that the above expression is positive, thus Party A prefers the strategy $(\tau^L, 1)$ to $(\tau^L, 0)$.

Finally, by choosing $(\tau^L, 0)$ Party A would gain the votes of rational, high talented and very rich voters (γ_H^{VR}):

$$\begin{aligned} &E_\eta\left[c_A^m \middle| h_A = \left(\tau^L, 0\right), h_B = \left(\tau^H, 1\right)\right] = \Psi\left(\left(\gamma_L + \gamma_H^{VR}\right) - \left(\gamma_H - \gamma_H^{VR}\right)\right) \cdot \left[e(E_l) + (1 + r)(b_A^m - b)\right] + \\ &+ \left\{1 - \Psi\left(\left(\gamma_L + \gamma_H^{VR}\right) - \left(\gamma_H - \gamma_H^{VR}\right)\right)\right\} \cdot \left[e^L(E_l) + (b_A^m - b)\right]. \end{aligned}$$

which, again, has to be compared with (A2).

The difference between the two expected pay-offs is equal to:

$$\begin{aligned} &E_\eta\left[c_A^m \middle| h_A = \left(\tau^L, 0\right), h_B = \left(\tau^H, 1\right)\right] - E_\eta\left[c_A^m | h_A = \left(\tau^L, 1\right), h_B = \left(\tau^H, 1\right)\right] = \\ &= \left\{\Psi\left(\left(\gamma_L + \gamma_H^{VR}\right) - \left(\gamma_H - \gamma_H^{VR}\right)\right) - \Psi(\gamma_L - \gamma_H)\right\} \cdot \left[e(E_l) - e^L(E_l)\right] + \Psi\left(\left(\gamma_L + \gamma_H^{VR}\right) - \left(\gamma_H - \gamma_H^{VR}\right)\right)r(b_A^m - b) \end{aligned}$$

If condition (1.ii) is violated the above expression is negative and, when $h_B = (\tau^H, 1)$ Party A prefers $(\tau^L, 1)$ to $(\tau^L, 0)$.

Analogous reasoning ensures that $h_B = (\tau^H, 1)$ is the best response to $h_A = (\tau^L, 1)$.

Thus we have shown that *$h_A^* = (\tau^L, 1)$ and $h_B^* = (\tau^H, 1)$ is a Nash equilibrium.*

It is easy to check that uniqueness, requires violation of (1.i). □

Proof of Proposition 2. Consider first $\tau = \tau^L = 1$; substituting $\pi = 0$ and $\tau = 1$ in (1) we obtain

$$c^{ik}(1, 0) = e(E_l) + (1 + r) \cdot \left(b^i - b\right)$$

which does not depend on type k. Next consider $\tau = \tau^H = 0$; substituting $\pi = 0$ and $\tau = 0$ in (1) we obtain

$$c^{iL}(\tau, \pi) = e^L(E_1) + (1 + r) \cdot \left(b^i - b\right) > e^L(E_2) + (1 + r) \cdot \left(b^i - b\right)$$

$$c^{iH}(\tau, \pi) = e^H(E_1) + (1 + r) \cdot \left(b^i - b\right) < e^H(E_2) + (1 + r) \cdot \left(b^i - b\right)$$

which show that, if $\tau = \tau^H = 0$, low talented individuals prefer basic education and high talented individuals prefer higher education. Finally, it is easy to check that Assumption 1 guarantees the satisfaction of participation constraint for all individuals (i.e. public investment is preferred to the no investment alternative). □

Proof of Proposition 3. According to Proposition 1, both parties will be running rich candidates, who will not tax bonds, independently from the education level funded in the first period. As a result, in the first period, the party in power decides which level of education to finance, according to its own preferences. Thus, if the aggregate impact on production is the same whatever the investment in education is, by Proposition 1, Party A will finance basic education, while Party B will endorse higher education.

Indeed, if Party *A* wins the second period election, Party *A* and Party *B* will be indifferent to the education policy choice (aggregate output will be fully redistributed); but if Party *B* wins the election, low talented individuals (Party *A*'s constituency) strictly prefer basic education and high talented individuals (Party *B*'s constituency) strictly prefer higher education. If the aggregate impact is different, we have to distinguish between two cases: either $e(E_1)>e(E_2)$, or $e(E_1)<e(E_2)$. If $e(E_1)>e(E_2)$ and Party *A* is in power, it will obviously invest in basic education. If Party *B* is in power the decision will depend on the probability attributed to the event that in the second period labour income tax rate will be equal to 1. Namely, Party *B* will choose to invest in basic education only if

$$\Psi(\gamma_L-\gamma_H)\left[e(E_1)+(1+r)\cdot\left(b^i-b\right)\right]+(1-\Psi(\gamma_L-\gamma_H))\left[e^H+(1+r)\cdot\left(b^i-b\right)\right]>$$
$$\Psi(\gamma_L-\gamma_H)\left[e(E_2)+(1+r)\cdot\left(b^i-b\right)\right]+(1-\Psi(\gamma_L-\gamma_H))\left[e^H(E_2)+(1+r)\cdot\left(b^i-b\right)\right]$$

Solving for $\Psi(\gamma_L-\gamma_H)$, the above inequality requires that

$$\Psi(\gamma_L-\gamma_H)>\frac{1}{1+\frac{e(E_1)-e(E_2)}{e^H(E_2)-e^H}}$$

If $e(E_1)<e(E_2)$ and Party *B* is in power, it will obviously invest in higher education. If Party *A* is in power, following the previous argument, it is possible to show that it will choose to invest in higher education only if

$$\Psi(\gamma_L-\gamma_H)>\frac{1}{1+\frac{e(E_2)-e(E_1)}{e^L(E_1)-e^L}} \qquad \square$$

Proof of proposition 4. We have to show that if for $l=1$ condition (1.ii) is violated, so that the investment in basic education is unfeasible, then Party *A*, if in power in the first period, will prefer to invest in higher education rather than spending nothing. If Party *A* invests in higher education, its median member's expected consumption in the second period is given by:

$$\Psi(\gamma_L-\gamma_H)\left\{e(E_2)+(1+r)\left(b_A^m-b\right)\right\}+(1-\Psi(\gamma_L-\gamma_H))\left\{e^L+(1+r)\left(b_A^m-b\right)\right\}=$$
$$=\Psi(\gamma_L-\gamma_H)e(E_2)+(1-\Psi(\gamma_L-\gamma_H))e^L+(1+r)\left(b_A^m-b\right)$$

If Party *A* does not invest in education, no public debt is issued and individuals save by acquiring the sure-return storage technology. In this case, Party *A*'s median member's expected consumption in the second period is given by:

$$\Psi(\gamma_L-\gamma_H)e+(1-\Psi(\gamma_L-\gamma_H))e^L+(1+r)b_A^m$$

Straightforward computation shows that Party *A* prefers to invest in higher education rather than spending nothing if and only if:

$$\Psi(\gamma_L-\gamma_H)(e(E_2)-e)\geq(1+r)b. \qquad \square$$

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