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Why education expenditures differ across countries? The role of income inequality, human capital, and the inclusiveness of the education system.

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Abstract: This paper provides a simple model of hierarchical education to study the political determination of the public education budget and its allocation between different stages of education (basic education and advanced education). The model integrates private education decisions by allowing parents, who are differentiated according to income and human capital, to opt out from the public system and to enrol their offspring at private universities. Majority voting decides the size of the budget allocated to education and the expenditure composition. We find that the presence of a large private education sector depends positively on income inequality. On the contrary, income inequality negatively affects the level of public education expenditure. The allocation between different stages of education depends on the adult population's human capital and on the inclusiveness of the education system. The main predictions of the theory are broadly consistent with cross-country evidence collected for OECD countries. Our comparative analysis identifies four clusters of countries whose education regimes might be explained by our model's results. In addition, the theory helps explain why some OECD countries, like Italy, seem to remain stuck in a "low education" trap.

Keywords: Education Funding, Political Economy, Majority Voting, Opting Out, Income Inequality, Redistribution.
JEL codes: H23, H26, H42, H52, I28.

1. Introduction

Why education expenditures differ so much even among developed countries? Not only the share of GDP devoted to education is different, but also the type of financing (*e.g.* public vs private), and the allocation of education expenditures across hierarchical stages (primary/secondary vs. tertiary).
The aim of this paper is to provide a positive theory of education spending which integrates the political determination of public education funding and its allocation between different stages of education with private education decisions. We adopt a political economy approach by recognising that public education funding and the allocation of the public budget across different education stages is the result of the interaction of market forces and political decisions involving groups with conflicting preferences.
Against this background, our research questions are the following: what is the majority-preferred level of funding for public education when private options for advanced education are available? What is the majority-preferred allocation of public funds across educational tiers? How do income inequality and household heterogeneity in human capital affect the political equilibrium? How do the features of the education system, such as its inclusiveness, influence the political equilibrium?

Public provision of education is usually justified as a means of redistributing income (redistribution in kind). Accordingly, the position on the income ladder should determine conflicting preferences about public investment in education and, in majority voting settings, large income inequality should create strong support for public education.[1] However, these predictions are not fully supported by empirical evidence. Benabou (1997) and Soares (1998) find that more unequal and more heterogeneous societies spend less on public goods. De la Croix and Doepke (2009), focusing on education expenditures for primary and secondary schools, find that in countries with higher income inequality average public funding is lower. In addition, regression results show that societies that are more unequal tend to spend comparatively more on higher levels of education and thus have a less redistributive way of spending (Zhang, 2008). Analogous results are found for developing countries (Birdsall, 1996; Gradstein, 2003).

The point we make in this paper is that to address the political economy of public education funding, the hierarchical nature of the education process must be explicitly recognised. Tertiary education is very different from K-12 education: first, it is not mandatory but optional, and more importantly, it is not universally accessible. The level of educational attainment during the first-stage rations participation in the second stage, generating an endogenous participation constraint that is stricter for children from lower social background. Indeed, the social and cultural environment at home directly influences children's educational attainments in the first stage (Glomm and Ravikumar, 1992 and 2003): children from highly educated families enjoy a comparative advantage in the learning activity, and this advantage gives them a higher chance of benefitting longer from public spending in education.[2] Thus, not only the size but also the composition of public spending across educational tiers becomes a critical policy issue.

This paper provides a simple model of hierarchical education to study the political determination of the size and the composition of public education budget. The model integrates private education

[1] See for example Saint-Paul and Verdier (1993), Gradstein and Justman (1997), Epple and Romano (1996a).
[2] Empirical evidence has demonstrated that even when education fully relies on public funding, children from families with a lower socioeconomic status have lower enrolment rates at increasing levels of education. See De Fraja (2004) and Cunha and Heckman (2007).

decisions allowing parents to opt out from the public system and to enrol their offspring at private universities. Households consist of one parent and one child and are differentiated according to parent's income and human capital. Children get educated in a hierarchical schooling system that features two levels of education: the lower level (K-12) is mandatory and funded exclusively by the government; the higher level (tertiary education) is not universally accessible and can be funded either privately or publicly. Access to tertiary education depends on the level of human capital accumulated in the first education stage and, in turn, basic education attainment depends on resource allocation from the government and parental human capital. Inclusive school systems, featuring a relatively even standard of education and few possibilities for schools to select their pupils, dampen the relative importance of inherited human capital. [3] Ultimately, the share of children entering tertiary education is determined by the initial distribution of human capital in the adult population and by the education system design. Majority voting decides the size of the budget allocated to education and the expenditure composition. Affluent parents may find public funding of tertiary education insufficient; in this case, they enrol their children at a private university. This endogenously separates public and private university students according to household's income. Finally, we assume that private education expenditures are tax-deductible. This assumption is a feature observed in many OECD countries and drives some of the results.

Our results suggest that: (i) income inequality increases private education spending and reduces public spending; (ii) the inclusiveness of the education system rises the size of the public education budget as well as the share allocated to tertiary education; (iii) the share of graduates in the adult population has a positive effect on total spending on education and an ambiguous effect on public spending.

The contribution of this paper is relevant for political and theoretical reasons. On the political side, given the important involvement of governments in the education sector, understanding the political economy constraints of public education policy is crucial. Theoretically, our paper helps explain the documented differences in education expenditures across OECD countries and why some countries, like Italy, seem to remain stuck in a "low education" trap.

The paper is organised as follows. Section 2 briefly discusses the related literature. Section 3 presents some descriptive evidence on education expenditures in OECD countries. Section 4 illustrates the theoretical model. Section 5 shows that the model's results are broadly consistent with cross-country evidence collected for OECD countries. Section 6 concludes and highlights some policy implications.

Related literature

This paper broadly relates to the theoretical literature on the political economy of education funding (Glomm et al., 2011). Much of this literature assumes a single type of education,[4] or focuses on the political economy of spending in a particular stage, such as higher education.[5] However, some recent works have begun to model the hierarchical nature of education through an explicit two-stage

[3] Features of an inclusive education system are a high degree of comprehensiveness of programs, a relatively even standard of education, a low percentage of private schools, and few possibilities for schools to select their pupils. By contrast, low inclusiveness features include formal differentiation (students are separated by ability through early tracking) and/or informal differentiation (socioeconomic segregation among schools).

4 See, for example, Levy (2005), De la Croix and Doepke (2009), Arcalean and Schiopu (2016).

5 See for example Fernandez and Rogerson (1995); Beviá, and Iturbe-Ormaetxe, I. (2002); Di Gioacchino and Sabani (2009), Gradstein and Justman (2004), Haupt (2012).

technology, where the skills acquired during the first stage of education are used as inputs in the production of higher education. In this framework, optimal decisions on tertiary education participation depend on the level of human capital acquired in the first stage. [6] Following a political economy approach, Blankenau et al. (2007) and Viane and Zilcha (2013) have emphasised the role of pupils' innate abilities and parental skill profile in shaping preferences over the allocation of public funds between different tiers of education. In the specific, Viane and Zilcha (2013) show that in a society with a majority of low-skilled workers, the median voter may oppose public funding of high education, because low-skilled workers' offspring have a lower probability to enter university than high-skilled ones. In the same line, Naito and Nishida (2017) argue that in a democracy a tax increase to finance higher education cannot be politically feasible until the majority accumulates sufficient human capital. An unbiased budget allocation across different education tiers can be observed only if the median voter has a level of human capital above a given threshold level. Differently, Su (2006) analyses policy preferences of the top class in a model with public education in both stages. She argues that in less developed countries, where rich elites hold the political power, higher spending on advanced education may come at the expense of basic education funding.

In all these models, individuals accumulate human capital solely through public education, funded by tax revenues. On the contrary, in our contribution we do consider private alternatives and thus the possibility of opting out from the public system. We model the opting out option as in the voting models of De la Croix and Doepke (2009) and Arcalean and Schiopu (2016), in which an endogenous income threshold separates public from private school users. However, differently from their contributions, we assume that human capital accumulates in a hierarchical education system. This allows us to analyse not only the political determination of the public education budget, but also its allocation across different stages of education. This aspect relates our paper to Romero (2009), although we consider the possibility of opting out from public education only for tertiary education.[7]

An important point that differentiates our contribution from Romero - and from the bulk of the literature on the political economy of public education spending - is that we analyse a two dimensional political economy model. Specifically, we assume that income and human capital are two different dimensions of heterogeneity.[8] It follows that conflicting interests are not only between public and private school users (rich and poor), but also between highly educated families who enrol their children at university and those who do not. Finally, we do not adopt a probabilistic voting model as in De la Croix and Doepke (2009) and Arcalean and Schiopu (2016), but we rely on the median voter approach as in Romero (2009) and Naito and Nishida (2017).

Our paper also relates to Busemeyer and Iversen (2014), who provide a game-theoretic analysis of opting out decisions, by focusing on the role that electoral institutions play in explaining the large variation in the share of private financing in education in OECD countries. Differently, we want to investigate the role that income inequality, human capital distribution and the inclusiveness of the

[6] Taking into account the hierarchical nature of the education process, Su (2004), Restuccia and Urria (2004), Arcalean and Schiopu (2010), Sarid (2017) study how exogenous policy changes for different education sectors affects economic growth and aggregate welfare.

[7] We justify this assumption by referring to the empirical observation showing that in OECD countries, in 2016, basic education is mainly public in most countries (94% on average), while private financing of tertiary education is on average 32%.

[8] We justify this assumption by referring to empirical evidence. By working on OECD survey data, Di Gioacchino et al. (2019) find that the correlation between individual income and human capital is positive but below 0.5.

education system play in determining not only the size of the public education budget but also its composition.

This paper is meant to follow up Di Gioacchino et al. (2020). In their contribution, private investments in education are added to public investments, but only rich households top up. In contrast, we focus on a more realistic setting where the rich can opt out of the public system.

2. Stylized facts

In this section, we provide evidence on the variation across OECD countries of education expenditures (levels and composition) and source of financing (private vs. public).[9] Figure 1 reports education expenditures as a share of GDP and its composition between private and public funding. It shows that the share of GDP devoted to education is on average equal to 5% ranging from the low values of Czech Republic (3.4%), Italy (3.6%) and Greece (3.8%) up to 6.5% in Norway and Denmark. In terms of composition, on average 17% of education expenditure comes from private funding, with the highest value in Chile (37%), US (32%), United Kingdom (30%), Australia (32%), Japan (29%) and Korea (30%); at the other extreme, in Nordic countries education expenditures are almost entirely financed with public funds.[10]

Figure 1. Education expenditures, % of GDP, public and private.

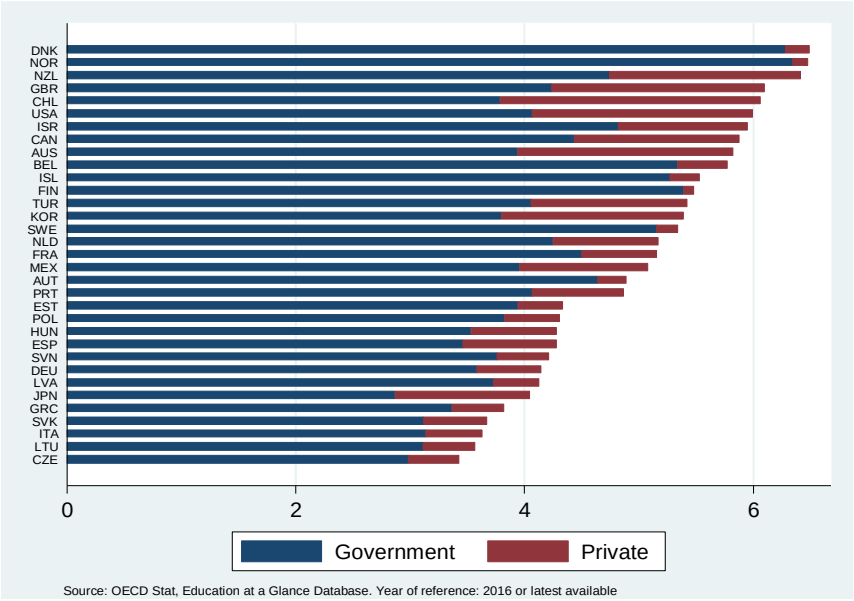


Figure 2 compares education expenditures, both private and public, as a share of GDP (panel a) with education spending per student as a share of GDP per capita (panel b). Compared to panel a, panel b has the advantage to take into account the numerosity of the student population and thus, indirectly, the demographic structure and the length of compulsory education period; furthermore spending per student is sometimes considered a proxy for the quality of education.[11] It is an open question which

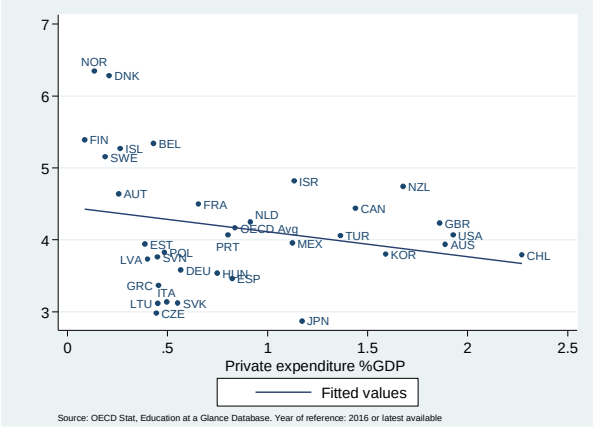
[9]Unless otherwise stated, data are taken from OECD (2019) and from http://stats.oecd.org/. Summary tables, at the end of the paper, summarise the original variables used in the descriptive analyses.

[10] We do not consider Luxembourg and Ireland because they are outliers in terms of GDP. In the case of Ireland, GDP is not a satisfactory measure of the country's income, due to the large income out-flow (in 2015, Irish GDP was over 150% of Irish GNI).

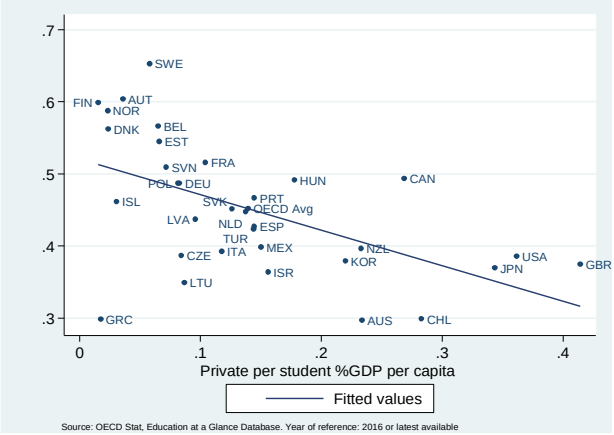
[11] See for example De la Croix and Doepke (2009).

variable should be considered when discussing political preferences for education spending. In the following to have a more precise picture of a country's education policy we look at both.[12]

Figure 2. Public and private spending in education



panel a



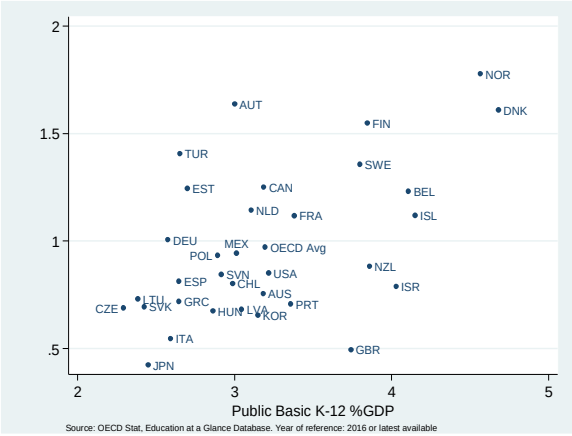
panel b

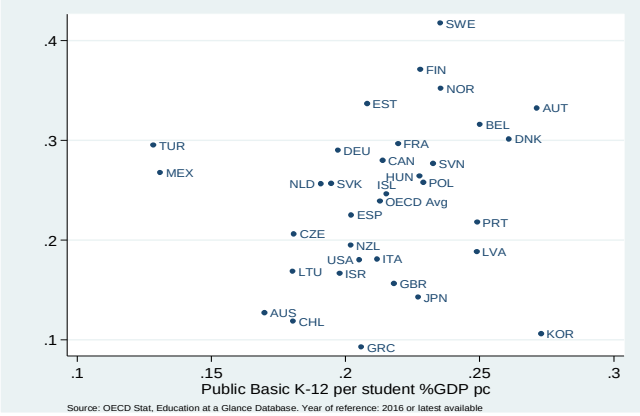
Summing up, figures 1 and 2 document great variability in education expenditures among OECD countries; they also show that among high spending countries there are important differences in terms of source of funding. All Nordic and some continental European countries (Austria, Belgium and France) are high spenders, mostly from public funds.[13] Anglo-Saxon countries (Australia, United Kingdom, USA and New Zealand), plus Chile, Korea and Japan, if we look at spending per student, are high spenders, but with a relevant share of private funding (above 29% of total spending).[14] Lastly, countries such as Czech Republic, Greece, Italy, Lithuania and Slovakia are low spenders from both funding sources.[15]

Next, figure 3 shows the allocation of public expenditure between basic and tertiary education. We consider public expenditure as share of GDP and public expenditure per student as share of GDP per capita (panel a and b, respectively). A positive relationship between public spending in the two tiers of education emerges; countries spending more on basic education tend to spend more also on tertiary education. Moreover, high private spenders tend to concentrate public spending on basic education (e.g. United Kingdom), which is somehow expected since private spending is concentrated on tertiary education. On the other side, high public spenders (e.g. Nordic countries, France Belgium, Austria) tend to either have a balanced composition or tend to be slightly biased towards tertiary education. Low spenders, and in particular low public spenders, are biased towards basic education; exceptions are Turkey and Mexico clearly biased towards tertiary education.

[12] For example, in Japan education spending appears to be extremely low if considered as a share of GDP, but less so if one looks at per capita values, particularly from private funding. Another example is Israel where education expenditure as a share of GDP is high (almost 6%), but public spending per student as a share of GDP per capita is relatively low.
[13] For these countries public spending is 9 to 10 times private spending (panel a) and about 5 times if one looks at spending per student (panel b).
[14] For these countries, the share of private to public spending is higher than 0.5 (panel a and b).
[15] They spend less than 4% of GDP in education (figure 1).

Figure 3. Public spending, basic Vs. tertiary education

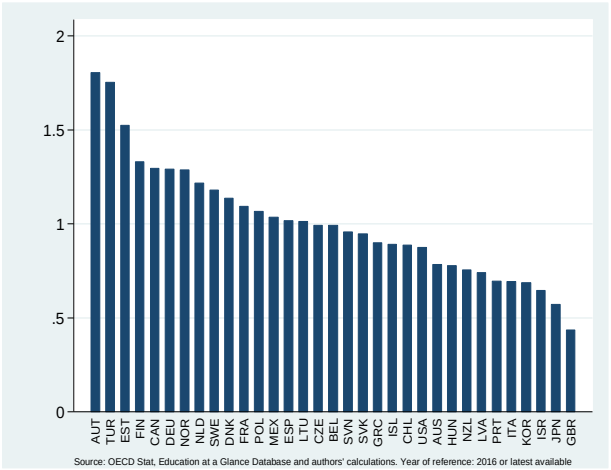


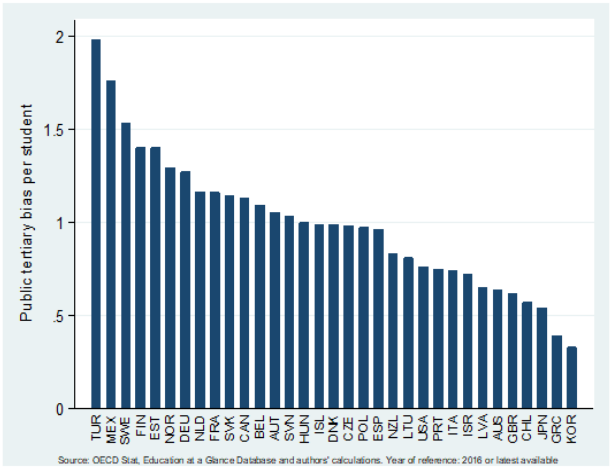


panel a ***panel b***

Going deeper on the composition of public spending, in table A1 and A2 in Appendix 2, we have computed for each country a "tertiary bias" index, by comparing the ratio of tertiary to basic public spending with the OECD average ratio. A value of the index greater (smaller) than one suggests that the country is biased towards tertiary (basic) education. The values in figure 4 confirm the above analysis.[16]

Figure 4. Tertiary bias





Panel a: expenditure as % of GDP. ***Panel b: expenditure per student as % of GDP per capita***

Summing up, the evidence in this section seems to suggest the existence of four education models. In the first, education spending is high, almost entirely financed by public funds, and the budget is balanced between the two tiers of education. In the second model, education spending is high but a large part, mostly at the tertiary level, is financed by private funds. In the third model, spending is low from both funding sources and it is biased towards basic education. Lastly, in the fourth model

[16] Panel a considers public expenditures as % of GDP. Considering expenditures per student as % of GDP per capita does not significantly change the ranking (panel b).

spending is relatively low and biased towards tertiary education. The first group includes Nordic countries and some continental countries. The second group includes Anglo-Saxon countries together with Chile, Japan and Korea. The third group includes, as more significant examples, Italy, Greece, Czech Republic and Lithuania. The last group contains Turkey and Mexico.

4. The model

Consider a two-period economy with a continuum of households of mass one. Each household consists of one parent and one child. [17] Parents live only in the first period and children live both periods. Parents are differentiated according to an exogenously given human capital h_p and income x. Human capital comes in two levels: it is high ($h_p = 1$) if the parent has graduated from university, and it is low ($h_p = h < 1$) if the parent has not obtained a university degree. We assume a uniform distribution of income over the interval [1 – δ, 1 + δ]. The parameter δ can be thought of as a measure of income inequality. [18]

Parents care about household's consumption, c, and their children's human capital, h_c, according to the following utility function:

$$U(c, h_c) = ln(c) + \gamma\,[ln(h_c)] \qquad \textbf{(1)}$$

The parameter γ ∈ R+ is the weight attached to children's human capital.

4.1 Children's human capital formation

This section describes children's human capital formation emphasising its dependence on parental education and the potential role of the education system in mitigating this dependence. Human capital formation is modelled as a two-stage process. The first stage (basic education), which corresponds to primary and secondary education, is mandatory and depends on government's expenditure in basic education, G_B, with no direct costs to the parents. If the education system is non-inclusive, the human capital accumulated in the first stage depends also on parental human capital h_p. [19]This dependence is mitigated by the inclusivity of the school system and in a perfectly inclusive system all children can fully exploit returns from public education, independently of their parent's education. We denote by h_B the human capital accumulated during the first stage and assume the following production function:

$$h_B = \begin{cases} h_p {G_B}^{\alpha} & if\ the\ system\ is\ non-inclusive \\ {G_B}^{\alpha} & if\ the\ system\ is\ inclusive \end{cases}$$

where α, the elasticity of human capital wrt spending in basic education, is an efficiency parameter.

The access to the second education stage (tertiary education) is not universal. To enter university children must pass an exam to verify they reached minimum educational pre-requisites.[20] In a non-inclusive system, the probability to pass the exam, and thus to enter advanced education, depends on parental human capital. We assume that children whose parents have a university degree always pass

[17] We are aware of the trade-off between quantity and quality of children, but in this model we do not address fertility decisions.

[18] We choose a uniform distribution of income for analytical tractability. We are aware that in this case, under majority voting, the standard Metzler and Richard (1981) redistribution issue disappears. As we will discuss later, in our model the effect of income inequality on public education budget does not depend on the distance between median and average income.

[19] We do not consider the role of children's innate abitity. Although this is obviously an important factor of the learning process, it is natural to immagine that they are equally distributed among children with different social background.

[20] The exam "story" is not meant to portray any particular education system. It is just a way to model in a simple way the fact that access to tertiary education is not universal.

the exam and enter university. By contrast, children with a non-graduate parent have a probability η to enter university and we assume $0 \leq \eta \leq 1$. [21] Thus, η is a measure of the inclusiveness of the education system. In an ideal perfectly inclusive system, the probability to enter university should not depend on parental education, in this case η would be equal to one.[22] At the other extreme, in a non-inclusive system, children, whose parent has not graduated from university, never attend tertiary education, that is $\eta = 0$.

We assume that parents can choose to opt out from public university. In this case, they can freely choose the education quantity *e*, but they must pay for it. We assume that private education expenditure is tax-deductible; deductibility simplifies the analysis, and, in addition, it is a feature observed in many OECD countries. On the contrary, if parents opt for the public system (*e=0*), their children receive an education level G_T , the same for every student. [23]

If a child enters university, the capital accumulated at the second stage- h_T - is given by

$$h_T = h_B \max(e;\ G_T)^{\beta}$$

where *e* denotes private expenditure in tertiary education, G_T public expenditure, and β (elasticity of human capital wrt spending in tertiary education) is an efficiency parameter, the same for private and public university.

Total public education expenditure is financed by a proportional income tax τ. The tax rate τ and the allocation of tax revenues between basic and tertiary education are determined through voting, to be described in more detail later.

Summing up, a child's human capital builds up as follows:

$$h_c = \begin{cases} h_B \max(e;\ G_T)^{\beta} & if\ tertiary\ education\ is\ completed \\ h_B & otherwise \end{cases} \qquad \textbf{(2)}$$

4.2 Timing of events.

At stage 1, before voting decides τ and the allocation of tax revenues between G_B and G_T, parents decide whether to enroll the child at public or private universities. In making these choices, they have perfect foresight regarding the outcome of the voting process.[24] At stage 2, majority voting decides the budget τ and the allocation of tax revenues between G_B and G_T . In the following, we assume that in a non-inclusive system non-graduate parents always opt for public universities. This assumption simplifies the analysis, but we think it also reflects the fact that for children from low educated families the probability to enter highly selective universities (often private) is even lower than the probability to enter public universities.[25] Moreover, if the family has to pay for the child's education

[21] The lower probability to pass the final exam, relative to children whose parent has graduated, is justified by the lower level of human capital accumulated in the first stage. It is however important to underline that, beside accumulated education, other (non-modelled) inherited cultural and economic factors might affect the decision to enrol at university.

[22] This assumption simplifies the presentation without affecting qualitative results.

[23] In contrast to basic education, not all individuals take tertiary education. However, we overlook the congestion effect in higher education, and we assume that individual capital accumulation depends on public expenditure G_T and not on public expenditure per student. We justify such assumption by referring to the empirical evidence showing that class size does not matter for educational outcomes in undergraduate classes. See on this point Naito and Nishida (2017) and references cited therein.

[24] As in De la Croix and Doepke (2009), we motivate such timing by the observation that public education spending can be adjusted more frequently than the choice between public versus private education, which might entail substantial switching costs.

[25] Moreover, as the legacy student controversy has drawn attention to, the probability to be admitted to a prestigious university is much higher for students whose parent are alumni of the same institution, as compared to the differential odds at public universities.

and if the probability to enter university is low, the family is less willing to forgo current consumption to save and invest in the child's education.

4.3 Private education choice.

Graduate parents, who decide to opt out from the public system, choose *e* to maximise utility given by (1) under the budget constraint

$$c = (1 - \tau)(x - e) \quad \textbf{(3)}$$

Substituting (2) and (3) in (1) we obtain

$$ln[(1 - \tau)(x - e)] + \gamma\,[ln(h_B) + ln(e)] \quad \textbf{(4)}$$

Straightforward computation shows that the optimal choice of *e* is equal to

$$e^* = \frac{\beta\gamma}{1 + \beta\gamma}x \quad \textbf{(5)}$$

High-income parents are more able to afford the resource cost of private education, thus private spending on education depends positively on income *x*. To compute the threshold income level $\hat{x}$ such that a parent with income $x=\hat{x}$ is indifferent between public and private university, we compare the household indirect utility if choosing private tertiary education $V(e^*)$ with the one obtained if choosing public tertiary education $V(E(G_T))$, where $E(G_T)$ is the expected level of public tertiary education expenditure to be decided at stage 2.

Substituting (5) in (4), find

$$V(e^*) = ln\big((1 - \tau)(x - e)\big) + \gamma\,\left[ln(h_B) + \beta\ ln\left(\frac{\beta\gamma}{1 + \beta\gamma}x\right)\right] \quad \textbf{(6)}$$

Substituting $E(G_T)$ in (1) when *e=0*, gives

$$V(E(G_T)) = ln\big((1 - \tau)x\big) + \gamma\,[ln(h_B) + \beta\, ln\, E(G_T)] \quad \textbf{(7)}$$

Imposing

$$V(e^*) = V\big(E(G_T)\big)$$

and solving for *x*, we find the threshold income level $\hat{x}$ to be an (increasing) function of $E(G_T)$

$$\hat{x}\big(E(G_T)\big) = DE(G_T) \quad \textbf{(8)}$$

where $D = \frac{(1+\beta\gamma)^{\frac{1+\beta\gamma}{\beta\gamma}}}{\beta\gamma}$.

Parents with income $x > \hat{x}(E(G_T))$ opt out from the public system. Therefore, the lower is the expected public spending in tertiary education, the higher is the share of households opting out from the public system.

4.4 Participation rate at public university and public education budget

To compute the participation rate at public universities we must distinguish between graduate and non-graduate parents. The participation rate Ψ for children from graduate parents depends on income and it is given by the following function:

$$\Psi = \begin{cases} 0 & \hat{x}(E(G_T)) \le 1 - \delta \\ \dfrac{\hat{x}(E(G_T)) - (1 - \delta)}{2\delta} & 1 - \delta < \hat{x}(E(G_T)) \le 1 + \delta \\ 1 & \hat{x}(E(G_T)) > 1 + \delta \end{cases} \quad \textbf{(9)}$$

Non-graduate parents, whose measure is *(1-K)*, are not expected to enrol their children at a private university but may attend a public university with probability η. Thus, overall, the participation rate at public universities is $\mathrm{K}\Psi + (1 - \mathrm{K})\,\eta$.

Let $\tilde{x} = 2\delta\Psi + (1 - \delta)$ be the threshold income value as a function of the participation rate; the government education budget is then given by:

$$F(\tau, \Psi) = (1 - K)\int_{1-\delta}^{1+\delta} \tau x \frac{1}{2\delta} dx + K\int_{1-\delta}^{\tilde{x}} \tau x \frac{1}{2\delta} dx + K\int_{\tilde{x}}^{1+\delta} \tau\left(x - \frac{\beta\gamma x}{1+\beta\gamma}\right)\frac{1}{2\delta} dx$$

By solving the integral, we obtain:

$$F(\tau, \Psi) = \tau\left[1 - \frac{K\beta\gamma}{1+\beta\gamma}\left[1 - \Psi\left(\delta\Psi + (1 - \Psi)\right)\right]\right] \qquad \textbf{(10)}$$

The budget increases with the participation rate ($\frac{\partial F}{\partial \Psi} > 0$) and the tax rate ($\frac{\partial F}{\partial \tau} > 0$) and decreases with income inequality ($\frac{\partial F}{\partial \delta} < 0$). Note that, income inequality negatively affects the budget because of private expenditures' tax deductibility.

Given the budget $F(\tau, \Psi)$, the share of basic spending is $G_B = \phi\, F(\tau, \Psi)$ and the share of tertiary spending is $G_T = (1 - \phi)F(\tau, \Psi)$. Voting decides τ and ϕ.

4.5 Preferences

We can distinguish three groups. The first group (A) consists of non-graduate parents ***(h_p =h<1)***. Their share in the population is (*1-K).* Given our hypotheses, they do not enrol their children at a private university but may attend a public university. The second group (B) consists of graduate parents ***(h_p =1)*** whose income is below $\hat{x}(E(G_T))$ and enrol their children at a public university. Their measure is K Ψ. Finally, the third group (C) consists of graduate parents whose income is above $\hat{x}(E(G_T))$. They opt out from the public system and enrol their children at a private university; their measure is $\mathrm{K}(1 - \Psi)$.

Group A's preferences (h_p =h)

Taking Ψ as given, for group A the preferred tax rate and the preferred allocation, τ^A *and* ϕ^A, are given by:

$$\tau^A = arg\max_{0\le\tau\le1} \ln(1-\tau)x + \gamma(\alpha \ln h\phi\, F(\tau, \Psi) + \eta\beta\ln(1-\phi)\, F(\tau, \Psi)) = \frac{\gamma(\alpha+\eta\beta)}{1+\gamma(\alpha+\eta\beta)}$$

$$\phi^A = arg\max_{0\le\phi\le1} \ln(1-\tau)x + \gamma(\alpha \ln h\phi\, F(\tau, \Psi) + \eta\beta\ln(1-\phi)\, F(\tau, \Psi)) = \frac{\alpha}{\alpha+\eta\beta}$$

This means that $G_T = (1 - \phi^A)F(\tau^A, \Psi)$, where $F(\tau^A, \Psi)$ is given by (10) substituting $\tau = \tau^A$.

Group B's preferences (h_p=1 and $x \le \hat{x}(E(G^T))$

Taking Ψ as given, for group B the preferred tax rate and the preferred allocation, τ^B and ϕ^B, are given by:

$$\tau^B = arg\max_{0\le\tau\le1} \ln(1-\tau)x + \gamma(\alpha \ln \phi\, F(\tau, \Psi) + \beta\ln(1-\phi)\, F(\tau, \Psi)) = \frac{\gamma(\alpha+\beta)}{1+\gamma(\alpha+\beta)}$$

$$\phi^B = arg\max_{0\le\phi\le1} \ln(1-\tau)x + \gamma(\alpha \ln \phi\, F(\tau, \Psi) + \beta\ln(1-\phi)\, F(\tau, \Psi)) = \frac{\alpha}{\alpha+\beta}$$

This means that their preferred level of public university funding is $G_T = (1-\phi^B)F(\tau^B, \Psi)$, where $F(\tau^B, \Psi)$ is given by (10) substituting $\tau = \tau^B$.

Group C's preferences (h_p=1 and $x > \hat{x}(E(G^T))$)

Taking Ψ as given, for group C the preferred tax rate τ^C and the preferred allocation, τ^C and ϕ^C, are given by:

$$\tau^C = arg \max_{0\le\tau\le1} \ln(1-\tau)x + \gamma(\alpha \ln \phi\, F(\tau,\Psi)\, \beta \ln \frac{\beta\gamma}{1+\beta\gamma}x) = \frac{\gamma\alpha}{1+\gamma\alpha}$$

$$\phi^C = arg \max_{0\le\phi\le1} \ln(1-\tau)x + \gamma(\alpha \ln \phi\, F(\tau,\Psi)\ + \beta \ln \frac{\beta\gamma}{1+\beta\gamma}x)\ = 1$$

This means that their preferred level of public university funding is $G_T = (1-\phi^C)F(\tau^C, \Psi)$=0 for each Ψ.

Preferences ranking.

We can order the preferences of the three groups as follows:

$$\begin{matrix}\tau^B \ge \tau^A \ge \tau^C \\ \phi^B \le \phi^A \le \phi^C = 1\end{matrix} \qquad \textbf{(11)}$$

Note that group A's preferences coincide with group C's if $\eta = 0$. By contrast, in a perfectly inclusive system there would be only two groups, B and C. In the intermediate case $0 < \eta < 1$, if no group has an absolute majority, then the median voter belongs to group A, namely the group of non-graduate parents.

4.6 Political Equilibrium.

So far, we have taken the participation rate Ψ as given, and solved for the preferred pair (τ, ϕ) associated to each of the three groups. The voting outcome (τ, ϕ) is decided by the median voter. In equilibrium, the choice whether to attend a public university must be optimal and the expectations must be rational. This leads to the following definition of an equilibrium:

Definition 1 (Equilibrium)

An equilibrium consists of an income threshold $\hat{x}$ satisfying (8), a private education decision e = 0 *for $x \le \hat{x}$ and $e = \frac{\beta\gamma}{1+\beta\gamma}x$ for $x > \hat{x}$, and aggregate variables (τ^*, ϕ^*, Ψ)*, where Ψ *is given by (9), and τ^*, ϕ^* are decided by the median voter, such that the perfect foresight condition holds:*

$$G_T = (1-\phi^*)F(\tau^*, \Psi) = E(G_T) \qquad \textbf{(12)}$$

Given the preferences ranking (11) and assuming $0 < \eta < 1$, the median voter belongs to group A. Thus, in the second stage, majority voting establishes $\tau^* = \frac{\gamma(\alpha+\eta\beta)}{1+\gamma(\alpha+\eta\beta)}$ and the equilibrium allocation rule is $\phi^* = \frac{\alpha}{\alpha+\eta\beta}$. Given the expected value of tertiary public education expenditure $E(G_T)$, the realised tertiary public education expenditure can be found by solving for the fixed point of the following equation:

$$G_T = \frac{\eta\beta}{\alpha+\eta\beta}F(\tau^*, \Psi(G_T)) = \frac{\gamma\eta\beta}{1+\gamma(\alpha+\eta\beta)}\left[1 - \frac{K\beta\gamma}{1+\beta\gamma}(1-\Psi(G_T)(\delta\Psi(G_T) + (1-\delta))\right]$$

Proposition 1

If

(i) $\frac{\gamma\eta\beta}{1+(\alpha+\eta\beta)\gamma}\left(1-\frac{K\beta\gamma}{1+\beta\gamma}\right)>\frac{1-\delta}{D}$ or

(ii) $\frac{\gamma\eta\beta}{1+(\alpha+\eta\beta)\gamma}>\frac{1+\delta}{D}$

then there exists a unique fixed point ${G_T}^*$.[26]

$$ {G_T}^*=\frac{\gamma\eta\beta}{1+\gamma(\alpha+\eta\beta)}\left[1-\frac{K\beta\gamma}{1+\beta\gamma}(1-\Psi({G_T}^*)(\delta\Psi({G_T}^*)+(1-\delta))\right] $$

with $0<\frac{\gamma\eta\beta}{1+(\alpha+\eta\beta)\gamma}\left(1-\frac{K\beta\gamma}{1+\beta\gamma}\right)\leq {G_T}^*\leq\frac{\gamma\eta\beta}{1+(\alpha+\eta\beta)\gamma}$ and $\frac{\partial {G_T}^*}{\partial\eta}>0$.

Proof. *See appendix.*

Discussion.

In the political equilibrium, the budget is increasing with the inclusiveness of the education system, as measured by η. The allocation between the two stages of education depends on the elasticity parameters α, β and on the inclusiveness of the education system. The higher is η the greater is the share of public spending in tertiary education. As for private spending in education, the overall amount increases with income inequality (δ) and decreases with the inclusiveness of the education system (η). Note that, since in our model private spending in education is tax deductible, income inequality has the opposite effect on public spending in education.[27]

In the extreme case - $\eta=0$ -, the result recalls Epple and Romano (1996b)'s "ends-against-the-middle" type of equilibrium. The preferences of low social status households (group A) coincide with those of the rich educated élite (group C). The public budget would be at its minimum and there would be no spending in public tertiary education.

In an ideal perfectly inclusive system, where $\eta=1$, there would be just two groups, B and C. By reasonably assuming that group B were majoritarian, in the political equilibrium, the public budget would be at its maximum and the allocation of public expenditure between basic and tertiary education would depend only on the technical efficiency parameters α, β.

So far, we have considered an economic system in which a private alternative to public advanced education exists. However, in some developing and emerging countries, private alternatives are not viable since, it would not be remunerative for private entrepreneurs to set up private institutions if the demand were too low. In this case, group C's preferences would be clearly biased towards advanced education, since a political choice of free public university would clearly redistribute from the poor to the rich. A political equilibrium featuring high public spending in tertiary education is thus consistent with a situation in which the private university system is absent, and the pivotal voter belongs to the high social status élite, which is more likely in unequal societies.

In the next section, to support our arguments, we bring our results to the data and try to assess the following hypotheses:

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[26] The two conditions impose restrictions on the minimum *(i)* and on the maximum *(ii)* level of G_T .

[27] In our model, income inequality reduces the public budget through tax deductibility of private education expenses. However, adopting a non-majoritarian political setting in which income inequality increases the political power of the rich educated elite, the increase in income inequality would reduce public budget even without tax deductibility of private education expenses. See for example the probabilistic voting model of De la Croix and Doepke (2009).

i. Private spending in education is positively correlated with income inequality.

ii. Public spending in education is negatively correlated with income inequality and positively correlated with the inclusiveness of the education system.

iii. The allocation of public spending between basic and tertiary education depends on the inclusiveness of the education system; namely, the share of spending in basic education decreases with the inclusiveness of the system.

iv. The share of graduate parents in the population (K) has two conflicting effects. On one side, a higher K indicates that a higher share of households opt out the public system and, because they deduct private education expenditures from their tax burden, this reduces the overall budget (see eq. 10). On the other hand, if a higher share of the population has a university degree, then the size of group A shrinks and it is possible that group B becomes majoritarian, which implies higher public education expenditure as compared to the equilibrium in which group A is pivotal.

5. Empirical evidence

In section 3, we have identified four education models. In the first, education spending is high, financed almost entirely by public funds and the budget is balanced between the two tiers of education. In the second model, education spending is high but a large part, mostly at the tertiary level, is financed by private funds. In the third model, spending is low from both funding sources and it is biased towards basic education. In the fourth model, as in the third one, spending is low from both funding sources, but public spending is biased towards higher education. The first group includes Nordic countries and some continental countries. The second group comprises Anglo-Saxon countries plus Chile, Japan and Korea. The third group includes, among others, Italy, Greece, Czech Republic and Lithuania. The last group contains Turkey and Mexico.

Building on our theoretical model's results, we try to relate these clusters to differences in countries' features such as income inequality, the inclusiveness of the education system, and the share of graduates in the adult population. The variations of these variables across countries are shown in the figures below. Income inequality is measured by the variable GINI, which is the Gini index of disposable income for the year 2010.[28] To assess inclusiveness, we take the variable COR which measures the correlation between the years spent in education by parents and the years spent by the child. We use data from the 2018 Global Database on Intergenerational Mobility of the World Bank (GDIM, 2018) for the 1980's cohort. [29] Higher COR indicates higher intergenerational persistence, lower relative mobility and lower inclusiveness. Finally, the variable SHARE, that is the share of graduates in the adult population, refers to the year 2010.[30]

[28] As discussed in the previous section, in our model income inequality affects the public budget only through tax deductibility of private expenses, which are decided on the basis of perfectly foresighted public expenses. Therefore, private expenditures are decided taking into account redistribution. For this reason, in the correlations we use the Gini index computed for disposable income.

[29] COR measures intergenerational persistence in education using Pearson's correlation coefficient between the years of education of parents and children. We use data from GDIM (2018), where data are available for different cohorts. The 1980 cohort refers to the generation born between 1980 and 1989 and their parents. For parents' educational attainment, we take the subpopulation "max", which represents the greatest available values among parents. For children's educational attainment, we consider "all" the respondents who belong to the cohort. Further information is available on the Description of Global Database on Intergenerational Mobility (GDIM, 2018).

[30] One concern here is a reverse causality link whereby low public expenditure in education leads to more inequality, lower inclusiveness and lower share of graduates. To try to address this problem and to strengthen our interpretation of

Figure 5 suggests that the group of high public spenders (Nordic Countries plus France, Belgium, Austria) have a Gini index of disposable income lower, and in the case of Nordic countries much lower, than the OECD average (0.32). By contrast, for the group of countries characterized by high private spending, the Gini index is above the OECD average, with Chile standing out with 0.51. The evidence is mixed for the group of low spenders; countries like Turkey and Mexico stand out for a strong inequality in the income distribution, while the others are below or around the average.

As for the variable COR, figure 6 suggests that the group of high public spenders have education systems characterized by high inclusiveness, while almost all low public spenders present values of COR above the OECD average. Finally, figure 7 suggests that high spenders in education (from both funding sources) feature a high share of graduates in the adult population.

Figure 5: Gini Index, Disposable Income.

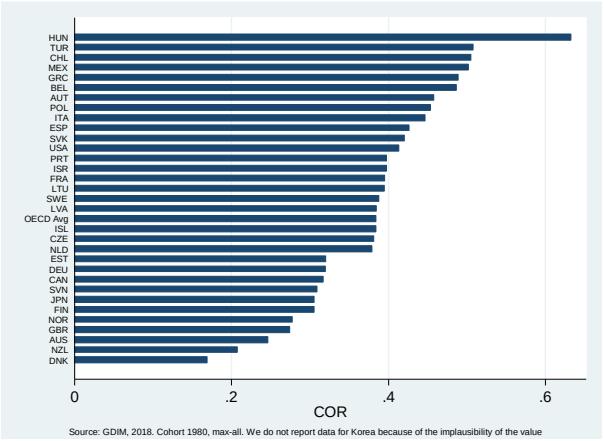


Figure: 6 Correlation between parents' and children's education

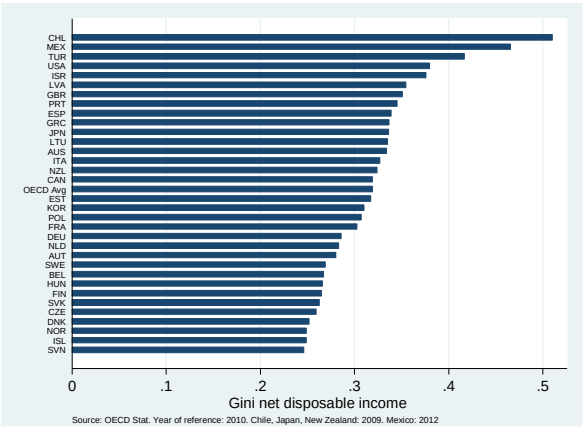
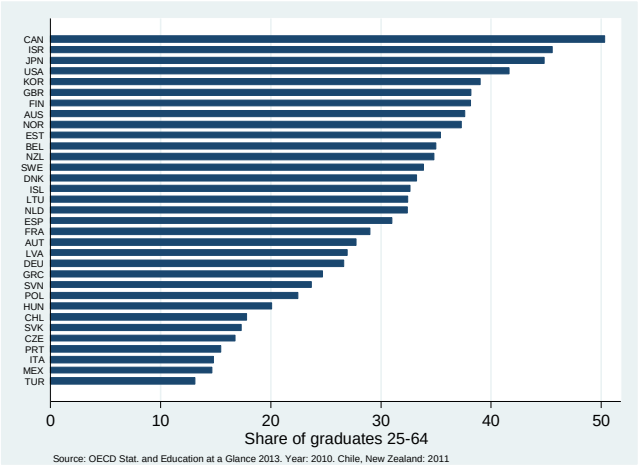


Figure 7: Share of graduates in the adult population 25-64



To support our arguments, we look at correlations between education expenditures and the variables that in our model explain the level and the composition of these expenditures, namely GINI, COR and SHARE**.** Table 1 reports the outcome of a linear regression between three spending variables (Public Basic, Public Tertiary and Total Private) plus the share of public basic (Public Basic/Total Public) - all computed as averages over seven years (from 2010 to 2016) - and our two main variables

the results in terms of the effects of COR, GINI and SHARE on the demand for education, we consider values of GINI, COR and SHARE that precede the observed values of education expenditures.

of interest (COR and GINI). To strengthen our interpretation of the results in terms of the effects of COR and GINI on the demand for education, we take GINI for the year 2010 and COR evaluated for the 1980's cohort.[31] Consistently with model's results, public expenditure in education (as % of GDP) is negatively correlated with COR and GINI: higher persistence in education and higher income inequality are associated with lower public education expenditure. COR appears to be significant in the relationship with basic education (column 1) while GINI seems to be more relevant on tertiary education (column 3). In columns 2 and 4, we add a dummy for high private spending countries.[32] The dummy is not significant in the regression for basic education, while it is significant for tertiary education. This suggests that while for basic education all countries share the same spending pattern, for tertiary education they adopt different models. This is confirmed by looking at private spending (columns 5 and 6). Note that the coefficient of income inequality remains significant also when we add the dummy, suggesting that the positive relationship between income inequality and private spending is not restricted to the group of private-spending countries. As a further evidence, in the last two columns, we look at the share of public spending devoted to basic education. As we have seen, spending on both education levels increases if the system is more inclusive (a negative sign in the COR coefficient). However, our model suggests that spending on tertiary education increases more, so that the share of basic education decreases. Table 1 corroborates this conclusion, when we add the dummy for high private spending countries (column 8).

Table 1

VARIABLES	*Public Basic*		*Public Tertiary*		*Total Private*		*Public Basic/Total Public*	
COR	-2.950***	-3.198**	-0.341	-1.139*	-1.869**	-0.081	-0.117	0.028
	(1.071)	*(1.248)*	*(0.591)*	*(0.618)*	*(0.814)*	*(0.655)*	*(0.098)*	*(0.099)*
GINI	-1.542	-1.093	-1.868*	-0.419	7.540***	4.295***	0.239	-0.022
	(1.665)	*(2.022)*	*(0.919)*	*(1.001)*	*(1.265)*	*(1.061)*	*(0.152)*	*(0.162)*
Dummy		-0.127		0.410**		0.919***		0.074***
		(0.315)		*(0.156)*		*(0.165)*		(0.025)
Constant	4.895***	4.867***	1.758***	1.677***	-0.890**	-0.709**	0.731***	0.745***
	(0.561)	*(0.572)*	*(0.309)*	*(0.284)*	*(0.426)*	*(0.300)*	*(0.051)*	*(0.046)*
Observations	32	32	32	32	32	32	32	32

Standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1
Source: own elaborations on OECD and GDIM 2018 data.

Next, to consider the role of the share of graduates in the adult population, we have added SHARE for the year 2010 as a third variable in the regressions. Not surprisingly, given the high correlation between SHARE and COR (-0.55) most coefficients are not significant.[33] Table 2 reports the coefficients of the linear regressions using SHARE instead of COR. The results suggest a positive and significant relationship between the share of graduates in the adult population and spending in education. According to our model, this result suggests that where the education level of the population is higher, the median voter is more educated and demand for education is higher.

Table 2

[31] A similar approach is followed by De la Croix and Doepke (2009).
[32] It takes value one for countries where the share of private to public spending is higher than 0.5, namely Australia, United Kingdom, USA, New Zealand, Chile, Japan and Korea. We excluded the last country because the COR value, reported in the dataset, is inconsistent with the regression coefficient between the years of education of parents and children reported in the same dataset.
[33] Results not shown, available from authors.

VARIABLES	*Public Basic*		*Public Tertiary*		*Total Private*		*Public Basic/Total Public*	
GINI	-2.207	-2.000	-1.878**	-0.652	7.135***	4.480***	0.1999	-0.032
	(1.593)	*(1.859)*	*(0.873)*	*(0.904)*	*(1.205)*	*(0.969)*	*(0.148)*	*(0.148)*
Share of graduates	0.028***	0.029**	0.005	0.012**	0.018**	0.004	0.0007	-0.0005
	(0.010)	*(0.011)*	*(0.006)*	*(0.006)*	*(0.008)*	*(0.006)*	*(0.001)*	*(0.001)*
Dummy		-0.069		-0.407***		0.881***		0.077***
		(0.303)		*(0.147)*		*(0.158)*		*(0.024)*
Constant	3.141***	3.055***	1.470***	0.960**	-2.020***	-0.916**	0.678***	0.774***
	(0.648)	*(0.760)*	*(0.355)*	*(0.370)*	*(0.490)*	*(0.396)*	*(0.060)*	*(0.061)*
Observations	32	32	32	32	32	32	32	32

Standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1
Source: own elaborations on OECD data.

The above discussion suggests that the empirical evidence presented is consistent with the results of our model as summarised by the hypotheses laid down at the end of the previous section. Furthermore, the four clusters of countries agree with model's results. Countries whose public expenditure is remarkably high and where private expenditure is almost non-existent have an education system very inclusive (low COR), a high share of graduates in the population and a low level of inequality. High private spenders have instead a Gini index and a COR value above the OECD average. Moreover, the high share of graduates boosts private spending. In low spending countries, with the exception of Turkey and Mexico, income inequality is around the average or slightly above, the inclusiveness of the education system is generally low and they have a level of graduates around or below the average. In line with our model, these features translate in a low demand for education, particularly at the tertiary level. On the contrary, Turkey and Mexico are biased towards tertiary education. We interpret Turkey's and Mexico's situation, where income inequality is remarkably high, as the equilibrium outcome obtained when the political power is in the hands of a rich and well educated élite and private alternatives in the tertiary sector are not fully developed.

Summing up, our theoretical and empirical analysis highlights that in countries where the share of population with tertiary education is low and the specific design of the education system is not of an inclusive type, the median voter's demand for public education is low, above all at the tertiary level. The political equilibrium will thus feature a low level of public education expenditures. Since this policy choice is self-reinforcing, it can explain why some countries, like Italy, seem to remain stuck in a "low education" trap.

Section 6. Concluding remarks and policy implications

This paper documents differences in education systems across OECD and stresses that ultimately the education system observed in a country is the result of a complex interaction between preferences for education and political competition, both of which depend on the characteristics of the underlying conflict of interest. To analyse this issue, we put forward a model that emphasises households' income and education heterogeneity. We also relate households' preferences to country-level characteristics such as income inequality and inclusiveness of the education system. Based on our model's results, on the empirical evidence presented in section 3 and on the correlations presented in section 5, the main policy message of our analysis is that the call for an increase of public expenditures on education to favour equality of opportunities might not be politically sustainable. From a political economy perspective, our theoretical analysis highlights that although less affluent households are the segment of population that should strive more to increase equality of opportunities, they could accept a coalition with the richer segment of population to reduce the overall level of education expenditures. The likelihood of this event is greater in countries where the share of population with tertiary education is low and the specific design of the education system is not of an inclusive type. Since these choices are self-reinforcing, they can lock countries into "low education" traps. Indeed, the empirical evidence seems to confirm that the amount of resources devoted to both levels of education is low in poorly educated societies, which is precisely where more investment in education is needed.

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Appendix 1.

PROOF Proposition 1.
Tertiary education public expenditure G_T lies in the interval

$$G_T \in \left\{\frac{\gamma\eta\beta}{1+(\alpha+\eta\beta)\gamma}\left(1-\frac{K\beta\gamma}{1+\beta\gamma}\right), \frac{\gamma\eta\beta}{1+(\alpha+\eta\beta)\gamma}\right\}$$

The lower bound is obtained when no child with a graduate parent attends public university ($\Psi = 0$), the upper bound when all children with a graduate parent attend public university ($\Psi = 1$).

Given the expected tertiary education expenditure $E(G_T)$, the fraction of parents enrolling their children into public university, is $K\Psi + (1 - K)\,\eta$ where, from equations (8) and (9), Ψ is given by

$$\Psi = \begin{cases} 0 & DE(G_T) < 1-\delta \\ \dfrac{DE(G_T)-(1-\delta)}{2\delta} & 1-\delta \le DE(G_T) \le 1+\delta \\ 1 & DE(G_T) > 1+\delta \end{cases} \qquad (A.1)$$

This function is (weakly) increasing in $E(G_T)$ in the interval $(0, \infty)$; the higher $E(G_T)$ the more parents enrol their chidren at public university.
We can now use (A.1) to map the expected tertiary education expenditure $E(G_T)$ into the actual tertiary education expenditure G_T that would result from the political system if the fraction $K\Psi$ ($E(G_T)$) of children with graduate parents participated in the public system.
In a majoritarian political equilibrium in which group A is the median, tertiary education expenditure is given by

$$G_T = E(G_T) = (1-\Phi^A)F\left(\tau^A, \Psi(E(G_T)\right) = \frac{\eta\beta}{\alpha+\eta\beta}F\left(\tau^A, \Psi(E(G_T)\right) = \Delta(E(G_T) \qquad (A.2)$$

with

$$\tau^A = \frac{\gamma(\alpha+\eta\beta)}{1+\gamma(\alpha+\eta\beta)}.$$

An equilibrium is characterized by a fixed point of $\Delta(E(G_T)$. Given (A.1), Δ is a continuous, weakly increasing function of $E(G_T)$.

To prove that on the plane $[E(G_T), G_T]$ the mapping Δ crosses the 45-degree line exactly once, first consider the interval $E(G_T) \le \frac{1-\delta}{D}$. In this case, expected expenditure in tertiary education are too low, which implies $\Psi = 0$. It follows that $\Delta(E(G_T) = \frac{\gamma\eta\beta}{1+(\alpha+\eta\beta)\gamma}\left(1-\frac{K\beta\gamma}{1+\beta\gamma}\right) > \frac{1-\delta}{D}$. The last inequality follows from assumption (i) in proposition 1. Next consider the interval $E(G_T) \ge \frac{1+\delta}{D}$. In this case, expected expenditures in tertiary education are so high that $\Psi = 1$. It follows that $\Delta(E(G_T) = \frac{\gamma\eta\beta}{1+(\alpha+\eta\beta)\gamma}$. If $\frac{\gamma\eta\beta}{1+(\alpha+\eta\beta)\gamma} < \frac{1+\delta}{D}$, the mapping Δ is above the 45-degree line for low values of $E(G_T)$ and below the 45-degree line for high values of $E(G_T)$. Being continuous, it crosses the 45-degree line only once. If instead $\frac{\gamma\eta\beta}{1+(\alpha+\eta\beta)\gamma} > \frac{1+\delta}{D}$, the mapping Δ is above the 45-degree line for any value of $E(G_T) \le \frac{1+\delta}{D}$. At $E(G_T) = \frac{1+\delta}{D}$ the mapping Δ becomes flat and it crosses the 45-degree line at $G_T = E(G_T) = \frac{\gamma\eta\beta}{1+(\alpha+\eta\beta)\gamma}$.
Finally, if $\frac{\gamma\eta\beta}{1+(\alpha+\eta\beta)\gamma}\left(1-\frac{K\beta\gamma}{1+\beta\gamma}\right) < \frac{1-\delta}{D}$ that is if Δ is below the 45-degree line for low values of $E(G_T)$, a sufficient condition for a unique equilibrium to exists is $\frac{\gamma\eta\beta}{1+(\alpha+\eta\beta)\gamma} > \frac{1+\delta}{D}$ (condition (ii) in proposition 1).

APPENDIX 2[34]

TABLE A1 (a)

Country	Year	Total education expenditure %GDP	Public Education expenditure %GDP K-12	Public expenditure % GDP	Public Education expenditure % GDP Tertiary	Bias Public Tertiary/Public K-12	Gini net disposable income 2010	Gini market income 2010	COR	Share of graduates 25-64 years old
Australia	2016	5.83	3.18	3.94	0.75	0.78	0.334	0.469	0.25	43.7
Austria	2016	4.89	3.00	4.64	1.64	1.80	0.28	0.496	0.46	31.4
Belgium	2016	5.77	4.11	5.34	1.23	0.99	0.267	0.483	0.49	37.5
Canada	2016	5.88	3.19	4.44	1.25	1.30	0.319	0.447	0.32	56.3
Chile	2016	6.06	2.99	3.79	0.80	0.89	0.51	0.536	0.51	22.5[35]
Czech Republic	2016	3.42	2.29	2.98	0.69	0.99	0.259	0.450	0.38	23.0
Denmark	2014	6.49	4.68	6.28	1.61	1.14	0.252	0.429	0.17	38.2
Estonia	2016	4.33	2.70	3.94	1.24	1.52	0.317	0.488	0.32	38.8
Finland	2016	5.48	3.85	5.39	1.55	1.33	0.265	0.487	0.30	43.6
France	2016	5.15	3.38	4.50	1.12	1.09	0.303	0.505	0.39	34.6
Germany	2016	4.15	2.57	3.58	1.01	1.29	0.286	0.492	0.32	28.3
Greece	2015	3.82	2.65	3.37	0.72	0.90	0.337	0.528	0.49	30.2
Hungary	2016	4.28	2.86	3.54	0.67	0.78	0.266	0.508	0.63	23.7
Iceland	2016	5.53	4.15	5.27	1.12	0.89	0.249	0.400	0.38	40.5
Israel	2016	5.95	4.03	4.82	0.79	0.65	0.376	0.501	0.40	49.9
Italy	2016	3.63	2.59	3.14	0.54	0.69	0.327	0.512	0.45	17.7
Japan	2016	4.04	2.45	2.87	0.42	0.57	0.336	0.488	0.31	50.5
Korea	2016	5.39	3.15	3.80	0.65	0.69	0.31	0.341	-0.02	46.6
Latvia	2016	4.13	3.05	3.73	0.68	0.74	0.355	0.52	0.38	33.4
Lithuania	2016	3.57	2.38	3.11	0.73	1.01	0.335	0.542	0.39	39.7
Mexico	2016	5.08	3.01	3.96	0.94	1.04	0.466	0.473	0.50	16.8
Netherlands	2016	5.16	3.11	4.25	1.14	1.22	0.283	0.421	0.38	36.0
New Zealand	2016	6.42	3.86	4.74	0.88	0.76	0.324	0.454	0.21	36.3
Norway	2016	6.48	4.57	6.34	1.78	1.29	0.249	0.409	0.28	43.0
Poland	2016	4.31	2.89	3.83	0.93	1.07	0.307	0.473	0.45	28.7
Portugal	2016	4.87	3.36	4.07	0.71	0.70	0.345	0.525	0.40	23.8
Slovak Republic	2016	3.67	2.42	3.12	0.69	0.95	0.263	0.434	0.42	22.0
Slovenia	2016	4.21	2.91	3.76	0.84	0.96	0.246	0.456	0.31	30.7
Spain	2016	4.28	2.65	3.46	0.81	1.02	0.339	0.505	0.43	35.7
Sweden	2016	5.34	3.80	5.16	1.36	1.18	0.269	0.441	0.39	41.1
Turkey	2016	5.42	2.65	4.06	1.41	1.75	0.417	0.477	0.51	19.4
United Kingdom	2016	6.10	3.74	4.24	0.49	0.44	0.351	0.523	0.27	45.8
United States	2016	5.99	3.22	4.07	0.85	0.88	0.38	0.499	0.41	45.7
OECD average		5.00	3.19	4.17	0.97	1.01	0.32	0.48	0.38	35.0

[34] We took indicators C2.1 and C2.2 for spending on education as a percentage of GDP and C3.1 (Relative share of Public, Private and International expenditure on educational institutions, final source of funds; unit of measure: USD PPP; indicator: total expenditure on educational institutions per full-time equivalent student) for expenditure on education per student.

[35] The value refers to 2014.

Table A1 (b)

Country	Year	Total education expenditure per student %GDP per capita	Public Education expenditure per student %GDP per capita K-12	Public per student % GDP per capita	Public Education expenditure per student % GDP Tertiary	Bias Public Tertiary/Public K-12	Gini net disposable income 2010*	Gini market income 2010**	COR	Share of graduates 25-64 years old***
Australia	2016	0.53	0.17	0.30	0.13	0.64	0.334	0.469	0.25	43.7
Austria	2016	0.64	0.27	0.60	0.33	1.05	0.28	0.496	0.46	31.4
Belgium	2016	0.63	0.25	0.57	0.32	1.09	0.267	0.483	0.49	37.5
Canada	2016	0.76	0.21	0.49	0.28	1.13	0.319	0.447	0.32	56.3
Chile	2016	0.58	0.18	0.30	0.12	0.57	0.51	0.536	0.51	22.5
Czech Republic	2016	0.47	0.18	0.39	0.21	0.98	0.259	0.450	0.38	23.0
Denmark	2014	0.59	0.26	0.56	0.30	0.99	0.252	0.429	0.17	38.2
Estonia	2016	0.61	0.21	0.54	0.34	1.40	0.317	0.488	0.32	38.8
Finland	2016	0.61	0.23	0.60	0.37	1.40	0.265	0.487	0.30	43.6
France	2016	0.62	0.22	0.52	0.30	1.16	0.303	0.505	0.39	34.6
Germany	2016	0.57	0.20	0.49	0.29	1.27	0.286	0.492	0.32	28.3
Greece	2016	0.32	0.21	0.30	0.09	0.39	0.337	0.528	0.49	30.2
Hungary	2016	0.67	0.23	0.49	0.26	1.00	0.266	0.508	0.63	23.7
Iceland	2016	0.49	0.22	0.46	0.25	0.99	0.249	0.400	0.38	40.5
Israel	2016	0.52	0.20	0.36	0.17	0.72	0.376	0.501	0.40	49.9
Italy	2016	0.51	0.21	0.39	0.18	0.74	0.327	0.512	0.45	17.7
Japan	2016	0.71	0.23	0.37	0.14	0.54	0.336	0.488	0.31	50.5
Korea	2016	0.60	0.27	0.38	0.11	0.33	0.31	0.341	-0.002	46.6
Latvia	2016	0.53	0.25	0.44	0.19	0.65	0.355	0.52	0.38	33.4
Lithuania	2016	0.44	0.18	0.35	0.17	0.81	0.335	0.542	0.39	39.7
Mexico	2016	0.55	0.13	0.40	0.27	1.76	0.466	0.473	0.50	16.8
Netherlands	2016	0.58	0.19	0.45	0.26	1.16	0.283	0.421	0.38	36.0
New Zealand	2016	0.63	0.20	0.40	0.19	0.83	0.324	0.454	0.21	36.3
Norway	2016	0.61	0.24	0.59	0.35	1.29	0.249	0.409	0.28	43.0
Poland	2016	0.57	0.23	0.49	0.26	0.97	0.307	0.473	0.45	28.7
Portugal	2016	0.61	0.25	0.47	0.22	0.75	0.345	0.525	0.40	23.8
Slovak Republic	2016	0.58	0.19	0.45	0.26	1.14	0.263	0.434	0.42	22.0
Slovenia	2016	0.58	0.23	0.51	0.28	1.03	0.246	0.456	0.31	30.7
Spain	2016	0.57	0.20	0.43	0.23	0.96	0.339	0.505	0.43	35.7
Sweden	2016	0.71	0.24	0.65	0.42	1.53	0.269	0.441	0.39	41.1
Turkey	2016	0.57	0.13	0.42	0.29	1.98	0.417	0.477	0.51	19.4
United Kingdom	2016	0.79	0.22	0.37	0.16	0.62	0.351	0.523	0.27	45.8
United States	2016	0.75	0.21	0.39	0.18	0.76	0.38	0.499	0.41	45.7
OECD average		0.59	0.21	0.45	0.24	0.99	0.32	0.48	0.38[36]	35.0

Source: OECD Statistics and Education at a Glance Database (http://stats.oecd.org/). *Data for Chile, Japan and New Zealand refer to 2009. **Data for Chile, Japan and New Zealand refer to 2009; Mexico to 2012.***Data for Chile refer to 2014. Data for Ireland and Denmark refer to 2015.

[36] The average of COR does not include Korea's value .