



# Intergenerational Upward (Im)mobility and Political Support of Public Education Spending

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## Abstract

This paper provides a simple model of hierarchical education to study the political determination of public education spending and its allocation between different tiers of education. The model integrates private education decisions by allowing parents, who are differentiated according to income and human capital, to top up public expenditures with private transfers. We identify four groups of households with conflicting preferences over the size of the public education budget and its allocation. In equilibrium, public education budget, private expenditures and expenditure allocation among different tiers of education, depend on which group of households is in power and on country-specific features such as income inequality and intergenerational persistence in education. By running a cluster analysis on 32 OECD countries, we seek to establish if distinctive ‘education regimes’, akin to those identified in the theoretical analysis, could be discerned. Our main finding is that a high intergenerational persistence in education might foster the establishment of education regimes in which the size and the allocation of the public budget among different tiers of education prevent a stable and significant increase of the population graduation rate, thus plunging the country in a ‘low education’ trap.

**Keywords** Education expenditures · Individual preferences · Income inequality · Redistribution · Intergenerational mobility in education · Political economy

**JEL Classification** H23 · H26 · H42 · H52 · I28

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## 1 Introduction

Education expenditures, allocation between tiers of education and source of financing vary considerably over the world, even among OECD countries. These differences have important consequences for the quality and equity of the education system.<sup>1</sup>

Table 2 (in Appendix 1) summarises differences in education expenditures, composition, and funding source by reporting average values over the period 2010–2017 for 32 OECD countries.<sup>2</sup> In the period considered, spending on education as a share of GDP was, on average, slightly above 5%, varying from less than 4% (Czech Republic, Greece, Italy, Hungary and Slovakia) to more than 6% (Canada, Denmark, New Zealand, Norway, UK and USA). There is, however, great variability in the distribution of expenditures between tiers of education; countries such as the US, Chile and Canada allocate around 40% of education spending to the tertiary level while others (Greece, Slovenia and Italy) less than 25%.<sup>3</sup> Regarding the source of financing, non-tertiary education is mainly public in most countries (90% on average), but private financing of tertiary education varies considerably across countries (33% on average, ranging from 4% in Finland to more than 60% in Chile, Japan, UK and USA). Looking at public spending, the greater share is allocated to non-tertiary education, on average, 3.3% of GDP compared to 1% of GDP to tertiary education. To compare the allocation of public spending between tiers of education across countries, we have computed the ratio of a country's public spending on tertiary to basic with the OECD average (see last column of Table 2). A value of the index greater (lower) than one indicates that the country's public education spending is unbalanced towards tertiary (basic) education.

In this paper, we argue that countries' differences in total public spending and its allocation between basic and tertiary education are the result of political decisions involving groups with conflicting preferences. To study these preferences, we provide a simple model of hierarchical education that considers two dimensions of heterogeneity among agents: income and education.

Standard redistributive arguments suggest that the impact of income on preferences for public education spending should be negative.<sup>4</sup> However, children from low socio-economic status have lower enrolment rates at increasing levels of education and thus they benefit less from spending on tertiary education.<sup>5</sup> This evidence has been explained by the role of parental income and education in the children's

<sup>1</sup> Equity in education means that personal or social circumstances such as gender, ethnic origin or family background, are not obstacles to achieving educational potential (fairness) and that all individuals reach at least a basic minimum level of skills (inclusion) (OECD 2012).

<sup>2</sup> We use the average to smooth out short run fluctuations. All the variables are taken from <http://stats.oecd.org/>. We do not consider Luxemburg and Ireland; Luxemburg because it is an outlier in terms of GDP and Ireland because 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).

<sup>3</sup> We refer to primary and secondary education as K-12, non-tertiary, or basic.

<sup>4</sup> Meltzer and Richard (1981).

<sup>5</sup> See, among others, Doyle (2007).

human-capital production function. Parents contribute directly by financing the purchase of ‘inputs’ in the production of children’s human capital, such as books and other education resources, so wealthier parents spend more on their children education. As for parental education, Glomm and Ravikumar (1992, 2003) argue that a sufficiently high elasticity of parental human capital in the learning technology might be responsible for low intergenerational mobility in education. Along the same line, Cohen (1987) and Keane and Wolpin (2001) argue that class differential in education attainment might be due to the fact that more educated parents attribute greater importance to education and as a result children of highly educated parents put more effort during their schooling.<sup>6</sup> In addition, class differential in education attainments might also derive from social status differences in the ‘take-up’ of available opportunities.<sup>7</sup>

Another factor, related to the socioeconomic status of the household, that might affect children’s probability of enrolling in higher education, is the prospect of being allocated into high skill jobs. If children from disadvantaged households anticipate that they have lower chances of being employed into better paying jobs, they perceive lower benefit from higher education (see Bernasconi and Profeta 2012; Gradstein 2019). In countries where education-based meritocracy is low, we therefore expect that parents from lower socioeconomic status tend to attach less importance to education.<sup>8</sup> The same argument applies to the social inclusiveness of the education system.<sup>9</sup> In education systems featuring low inclusiveness, children’s education attainments strongly depend on social background. This means that children from disadvantaged environments do not entirely reap the advantages of public funding of higher education; thus, we expect these households to be less in favour of tertiary education spending.<sup>10</sup>

Aiming to capture the above features, which we believe shape individual preferences for public education budget and for its allocation between different stages of education, we develop a simple model of hierarchical education. The model integrates public expenditure with private education decisions, by allowing parents to top up public expenditure in advanced education with private transfers. Households consist of one parent and one child. Parents, who are differentiated according to an exogenously given level of human capital and income, care about household’s consumption and their children’s human capital. Children get educated in a hierarchical schooling system that features two levels of education: the lower level (K-12)

<sup>6</sup> Kirchsteiger and Sebold (2010) develop an OLG model in which parents’ influence shapes children’s attitudes to education.

<sup>7</sup> In this respect Goldthorpe (2003) writes –citing research in Sweden and Britain—that among children of average ability those from higher salaried class origin are almost twice as likely to opt for academic courses as those from working class origins.

<sup>8</sup> Bowles and Gintis (2000), Bukodi and Goldthorpe (2010).

<sup>9</sup> 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).

<sup>10</sup> See, among others, Busemeyer (2012).

is mandatory and funded exclusively by the government; the higher level (tertiary education), whose access is not universal, is publicly funded, although affluent parents can top up with private transfers. We assume that access to tertiary education depends on parental human capital. The degree of such dependence—to which hereafter we refer as intergenerational persistence in education— is determined by a variety of elements which in part can be country-specific. Finally, we assume that the public budget is entirely allocated to education and it is financed through income tax collection.

We identify four groups of households with conflicting preferences over the size of the public education budget and its allocation. The intensity of the conflict among the groups is related to income inequality and to the degree of intergenerational persistence in education.

In equilibrium, the size of the budget allocated to education (and therefore the income tax) and the expenditure allocation among different tiers of education, depend on which group of households is in power and on country-specific features such as income inequality and the intergenerational persistence in education. We show that if the interests of low-educated households prevail, the equilibrium features a low level of public spending, unbalanced towards basic education, the more so the higher is the intergenerational persistence in education. By contrast, if the interests that predominate are those of highly educated households, whose income is lower than mean income, then, in equilibrium, public spending is relatively high. In both cases, the size of private expenditure in tertiary education is positively related to income inequality. Finally, if the political power is in the hands of rich and well-educated households, the equilibrium is similar to the one associated to the predominance of low-educated agents, and it is characterised by low public spending, unbalanced towards basic education, while advanced education is mainly financed by private sources.<sup>11</sup> If, instead, private options were not available, or not sufficiently developed, rich and well-educated households would support a relatively high public spending, unbalanced towards tertiary education.

After conceptualising different political equilibria, we turn to the data to explore similarities and differences between education systems in 32 OECD countries. Our aim is to establish if distinctive ‘education regimes’, akin to those identified in the theoretical analysis, could be discerned. To this purpose, we run a cluster analysis based on four key dimensions: inequality in the distribution of income; intergenerational persistence in education; share of graduates in the adult population; educational expenditure (private and public) and its composition between tiers. Five clusters emerge from the analysis and narratives of one country exemplifying each cluster are presented. To each of these exemplifying countries, we associate a political equilibrium identified in the theoretical analysis. Our main finding is that a high intergenerational persistence in education might foster the establishment of education regimes in which the size and the allocation of the public budget among different

<sup>11</sup> This is consistent with a well-established result in the literature: when private options for advanced education are available, the interests of low and high social status households might converge and an “ends-against-the-middle” type of equilibrium is likely to be observed (Epple and Romano 1996).

tiers of education prevent a stable and significant increase in educational upward mobility, thus plunging the country in a ‘low education’ trap.

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 explaining 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 illustrates the theoretical model. Section 4 contains the cluster analysis. Section 5 concludes and highlights some policy implications.

## 2 Related Literature

This paper relates to the theoretical literature on the political economy of education funding (Glomm et al. 2011). Investigating the political economy constraints of public education policy is crucial to understand the variation of public education expenditures across countries. The literature on education mainly treats basic and tertiary education symmetrically, or simply assumes a single type of education. More recently, some contributions have considered the hierarchical nature of education through an explicit two-stage technology and have analysed the preferences for the two tiers of education in a political economy perspective (Blankenau et al. 2007; Viaene and Zilcha 2013; Naito and Nishida 2017).<sup>12</sup> Our contribution is related to this strand of the literature. In these models, the level of human capital produced in the last stage of education is either fixed or depends on the amount of government expenditure. In the first case, the government can only choose to subsidize part of the cost of higher education, thus affecting its private cost but not its quality (that in these models is exogenous). By contrast, in our contribution, the human capital produced in the last stage of education depends on privately and publicly provided (monetary) inputs, which justifies our assumption of perfect substitutability.<sup>13</sup> Specifically, we assume that parents can top up public expenditure in advanced education with private transfers. Another important difference between our contribution and the bulk of the literature on the political economy of public education spending is that we analyse a two-dimensional political economy model and consider income and human capital as two different dimensions of heterogeneity.<sup>14</sup> Thus, conflicting

<sup>12</sup> Others have focused on how the allocation of resources in education affects growth (see, among others, Blankenau 2005; Arcalean and Schiopu 2010).

<sup>13</sup> The literature has not reached a consensus regarding the degree of substitutability between private and public inputs in the various stages of education. While arguments for complementarity are quite strong for early stages of education (Nordblom 2003), the same arguments are less compelling for tertiary education, as reviewed by Jacobs and van der Ploeg (2005).

<sup>14</sup> We justify this assumption by referring to empirical evidence. By working with OECD survey data, Di Gioacchino et al. (2019) find that the correlation between individual income and human capital is positive but below 0.5.

interests are not only between rich and poor families over the size of the public education budget, but also between highly educated families who enrol their children in university and those who do not. In this framework, we explicitly model partisan preferences for public spending in basic and tertiary education and investigate the impact of countries' features such as income inequality and the intergenerational persistence in education on these preferences. We are thus able to identify different political equilibria and relate them to different 'education regimes'.

This paper is also broadly related to the literature that, following a comparative approach, studies the typologies of welfare states and the 'varieties of capitalism'. Research in this field has focused on how welfare regimes might be conceptualised, concentrating on social transfer payments as opposed to services. However, the latter, and in particular education, are a fundamental component of the welfare state. This paper adds to this literature by focusing on how different 'education regimes' might be rationalised. Along this line of research, West and Nikolai (2013) have addressed the relationship between 'education regimes' and the welfare state.<sup>15</sup> They have clustered 14 OECD countries (all European apart from US) according to education spending variables and other variables related to the characteristics of the education system. They have identified four clusters or 'education regimes', which roughly overlap with the European welfare regimes identified by Esping-Andersen (1990) and subsequent studies (Nordic, Anglo-Saxon, Continental and Mediterranean).<sup>16</sup> By contrast, we run a cluster analysis over 32 OECD countries considering, in addition to education spending variables, also income inequality, intergenerational education persistence, and the share of graduates in the adult population. We identify five clusters. Two of them—the one including Nordic European countries and that including mostly English-speaking countries—detect 'education regimes' which 'overlap' with the welfare regimes, respectively Social-Democratic and Liberal, identified by Esping-Andersen (1990). However, we are not able to recognise, among European countries, the Continental and Mediterranean clusters. Rather, we clearly single out a cluster of low spending countries (Italy, Hungary, Slovakia, Czech Republic and Greece) whose 'education regimes' recall the political equilibrium in which the interests of low-educated households prevail. This cluster is characterised by high values of intergenerational persistence in education. It is worth noting that this feature is shared with another clear-cut cluster identified by our analysis: the one including three emerging countries (Turkey, Mexico and Chile), though, in this case, the 'education regime' features a higher level of public spending biased towards tertiary education. Given the high intergenerational persistence in education, this last 'education regime' appears to favour the interests of rich and well-educated households, whose offspring are more likely to reap the benefits of

<sup>15</sup> A similar analysis has been carried out by Willemsse and de Beer (2012). They have applied the comparative approach to higher education, aiming at uncovering the original three clusters identified by Esping-Andersen's and concluded that it is not clear that the concepts of decommodification and stratification, proposed by Esping-Andersen's analysis of welfare state, suffice to capture the characteristics of higher education regimes.

<sup>16</sup> See Arts and Gelissen (2002) for a survey. The comparative approach has been also used by Hall and Soskice (2001) and subsequent literature to explain the varieties of capitalism.

public education spending biased towards tertiary education. Our expectation is that in both ‘education regimes’ the size of the public education budget and its allocation between different tiers will prevent a stable and significant increase of educational upward mobility.

### 3 The Model

In the economy, there is a continuum of households of measure one; this implies that per capita values coincide with total values. A household consists of one parent and one child. Parents are heterogeneous along two dimensions: income and human capital. Let indexes  $j$  and  $i$  identify, respectively, parent’s income and education. Income  $y_j$ , is distributed in the parent population according to a given distribution function with mean  $y$ . Parent’s human capital can take two values:  $i = G$ , if the parent has graduated from university, and  $i = NG$  if the parent has not obtained a university degree. Parents maximise an expected utility function defined over household consumption and human capital accumulated by the offspring.

Children’s human capital depends on public and private expenditures on education.<sup>17</sup> Children are educated in a hierarchical schooling system in which basic education might be followed by tertiary education. Basic education is publicly financed, while tertiary education is the result of public spending and parents’ educational transfer.

Human capital formation is modelled as a two-stage process. The first stage (basic education)—corresponding to primary and secondary education—is mandatory. We denote by  $B$  public expenditures in basic education. Access to the second stage (tertiary education) requires the successful completion of basic education. Public tertiary education spending is denoted by  $T$  and it is the same for all children accessing university. Each parent can top up public tertiary expenditure with private expenditure  $T_{ij}$  where the indexes  $i$  and  $j$  identify, respectively, parent’s education and income.<sup>18</sup>

Each child accumulates human capital according to the following production function:

$$h_{ij} = \begin{cases} B^\alpha (T_{ij} + T) & \text{if tertiary education is completed} \\ B^\alpha & \text{otherwise} \end{cases}$$

Note that we allow for the possibility that the effectiveness of the two tiers of education differ and, by taking the elasticity of human capital w.r.t tertiary education spending as numeraire,  $\alpha$  measures the benefits of basic education relative to

<sup>17</sup> Since our focus is on the role of household social status, we assume all children to be alike. Adding children’s heterogeneity in innate abilities or talent would not change preferences, on average, if innate talent were randomly distributed among households.

<sup>18</sup> The idea is that parents might make up for public funding deemed insufficient by adding private expenditures. For example, paying for a private Master degree after a public BA or augmenting ERASMUS public funding.

tertiary. If higher education spending is more effective than basic education spending, then  $0 < \alpha < 1$ .

The probability of entering university is not the same for all children. We assume that children whose parent has a university degree access university with probability  $p_G$ , while, if the parent has not graduated from university, this probability is  $p_{NG}$ , with  $0 < p_{NG} < p_G < 1$ .<sup>19</sup>

The ratio  $\frac{p_G}{p_{NG}}$  can be interpreted as an indicator of the intergenerational persistence in education: the closer this ratio is to one, the less access to tertiary education depends on parents' education.

We assume that human capital acquisition in higher education depends on total public spending regardless of the number of advanced students. Indeed, empirical studies show that class size has little effect on students' achievements in higher education (Naito and Nishida 2017). Moreover, there is a wide consensus that there are considerable economies of scale in the production of teaching and research at tertiary level, even larger in the production of supportive services, like libraries and administrative services.<sup>20</sup>

Total public education expenditures are financed by a proportional income tax ( $\tau$ ), thus the government budget constraint can be written as:

$$B + T = \tau y \quad (1)$$

where  $y$  is the average income in the parents' population.

We assume that the household utility function is logarithmic in consumption and child's human capital, with the parameter  $\gamma$  measuring parent's altruism<sup>21</sup>:

$$U_{ij} = \ln c_{ij} + \gamma \ln h_{ij} \quad (2)$$

Utility is maximised under the household budget constraint and the non-negativity constraints:

$$c_{ij} + T_{ij} = (1 - \tau)y_j \quad (3)$$

$$T_{ij}, c_{ij} \geq 0 \quad (4)$$

In Appendix 2, we find the household optimal choices of consumption and private investment in tertiary education ( $c_{ij}^*, T_{ij}^*$ ). In case of an interior solution ( $T_{ij} > 0$ ),

<sup>19</sup> We are aware that, as shown by the empirical evidence, these probabilities also depend on parent's income. We omit this aspect in the model, but we recognise this dependence in the discussion of our results.

<sup>20</sup> See Brinkman and Leslie (1986), Cohn et al. (1989) and de Groot et al. (1991) for universities cost evaluation in the US and Worthington and Higgs (2011), Johnes and Schwarzenberger (2011) for recent applications to other countries. In a previous version of this paper, we computed political preferences assuming constant return to scale in tertiary education and thus including the participation rate in the budget constraint. Qualitative results do not change.

<sup>21</sup> This is a standard assumption in the literature; see, among others, Viaene and Zilcha (2013) and Bernasconi and Profeta (2012).



$$c_{ij}^* = \frac{(1 - \tau)y_j + T}{1 + \gamma p_i}$$

$$T_{ij}^* = \frac{\gamma p_i(1 - \tau)y_j - T}{1 + \gamma p_i}$$

Two results are worth noting: first, as income increases, private expenditure in (tertiary) education rises; second, graduate parents spend more than non-graduate parents do.

### 3.1 Preferences for Public Education and Political Equilibrium

To derive preferences for public education expenditures, write the household indirect utility as a function of the Government’s choice variables<sup>22</sup>:

$$W_{ij}(\tau, T) = \ln c_{ij}^* + \alpha \gamma \ln(\tau y - T) + \gamma p_{ij} \ln(T_{ij}^* + T) \tag{5}$$

Substituting the optimal choices of consumption and private investment in tertiary education ( $c_{ij}^*, T_{ij}^*$ ), in Appendix 2, we obtain households’ policy preferences, which are shown in the table below.

Table 1 summarises demand for public education spending by households’ socio-economic status. If education policy is interpreted as the (equilibrium) result of an electoral competition then, the policy outcome depends on which group is the most powerful, i.e. on the identity of the pivotal voter. In our framework, there are four possible outcomes, each characterised by the prevalence of one group of households. In what follows, we consider each one of them and discuss the likelihood of its occurrence.

Beforehand, note that the equilibrium share of basic education, which is obtained residually ( $\frac{B^*}{y} = \tau^* - \frac{T^*}{y}$ ), increases with the elasticity of human capital w.r.t to basic education ( $\alpha$ ), which is a measure of the benefits from basic education. Similarly, the equilibrium share of tertiary education, if positive, increases with the probability to enter university ( $p_i$ ). These parameters are, at least partially, country-specific being related to the productive and social structure of the economy.

First, consider the case in which the pivotal voter’s income is below average income; namely, the two outcomes in the first column of Table 1.<sup>23</sup> Comparing these two outcomes, we see that if  $p_G = p_{NG}$  they coincide. Otherwise, total public education spending and the share of tertiary education are higher if households with graduate parents prevail (i.e. if the equilibrium is the one in the second row).<sup>24</sup> This

<sup>22</sup> Given its budget constraints, the Government can choose only two variables.

<sup>23</sup> This would probably be the case in a majority voting with no abstention.

<sup>24</sup> Note also, that the share of tertiary education increases more than total public education when the probability to access higher education increases, i.e.  $\frac{\partial \tau}{\partial p_i} > \frac{\partial T}{\partial p_i} > 0$

is more likely to happen if the share of graduates in the adult population is high. This is summarised in the following results.

**Result 1** *If the pivotal voter's income is lower than mean income, then total public spending and the tertiary share are higher if the pivotal voter is a graduate.*

**Result 2** *If the pivotal voter's income is lower than mean income, then, public education spending is unbalanced towards tertiary (basic) education if  $p_i > \alpha$  (if  $p_i < \alpha$ ).*

Note also that in these equilibria, low-income households (i.e. those with  $y_j < y$ ) do not invest in private education, while high-income households spend an amount  $T_{ij}^* = \frac{p_i(y_j - y)}{(p_i + \alpha + \frac{1}{\gamma})(1 + \gamma p_i)}$  on tertiary education (see Appendix 2).

Next consider a setting in which the pivotal voter's income is above average income. In this case, the outcome would be one of the two equilibria shown in the second column of Table 1. We have the following

**Result 3** *If the pivotal voter is rich, then total public spending is low and unbalanced towards basic education.*

In these equilibria, there is no public tertiary education and each household is willing to invest privately in tertiary education an amount  $T_{ij}^* = \frac{\gamma p_i (1 - \tau) y_j}{1 + \gamma p_i}$  (see Appendix 2).

Comparing the two equilibria in the second column, we see that total public education spending is even lower if households with graduate parents prevail. The reason is that high-income households prefer a low public budget, devoted to basic education, and privately invest in tertiary education, the more so the higher is their probability to enter tertiary education ( $p_i$ ).

In each of the above equilibria, private spending increases with the income share of the rich. Thus, our model predicts a positive relationship between income inequality and private education spending. This is summarised in the following results.

**Result 4** *Private spending in tertiary education increases with income inequality.*

Finally, suppose that there is no possibility to top up public education expenditure with private expenditures. This could happen if, for example, there are too few potential students and, due to high fixed costs, it is not convenient to start a for-profit university. In this case, preferences are as shown in the first column of Table 1 for all households, independently of their income. This suggests that if the rich do not have the opportunity to substitute public education with private education, they would support public spending.

**Table 1** Households' policy preferences for tertiary and total public education, as shares of GDP

	Low-income ( $y_j < y$ )	High-income ( $y_j \geq y$ )
Non-graduated parents ( $i = NG$ )	$\frac{T^*}{y} = \frac{p_{NG}}{p_{NG} + \alpha + \frac{1}{\gamma}}$ $\tau^* = \frac{p_{NG} + \alpha}{p_{NG} + \alpha + 1/\gamma}$	$\frac{T^*}{y} = 0$ $\tau^* = \frac{\alpha}{p_{NG} + \alpha + 1/\gamma}$
Graduated parents ( $i = G$ )	$\frac{T^*}{y} = \frac{p_G}{p_G + \alpha + \frac{1}{\gamma}}$ $\tau^* = \frac{p_G + \alpha}{p_G + \alpha + 1/\gamma}$	$\frac{T^*}{y} = 0$ $\tau^* = \frac{\alpha}{p_G + \alpha + 1/\gamma}$

**Result 5** *If there is no private tertiary education, then (also) the rich support tertiary public education. In this case, if the pivotal voter is rich and well educated and if  $p_G > \alpha$ , spending is unbalanced towards tertiary education.*

To interpret countries' public education spending and its composition as the outcome of a political equilibrium, in the next section, we perform a cluster analysis for OECD countries and use the results of our model to interpret the clusters.

## 4 Cluster Analysis

In this section, we report the result of a cluster analysis performed over 32 OECD countries. To cluster the countries, we use the following education expenditure variables (averaged over the period 2010–2017)<sup>25</sup>: public tertiary (TerPub), public basic (BasPub), total private (TotPriv) and total public (TotPub), all computed as share of GDP. Furthermore, we consider income inequality, an index of the intergenerational persistence in education and the share of graduates in the population. In our model income inequality is positively related to private education spending, while the index of intergenerational persistence in education proxies the gap between the probability of entering university of children from low social status relative to children from high social status. More precisely, a higher intergenerational educational persistence is associated with lower  $p_{NG}$  relative to  $p_G$ . Finally, we consider the share of graduates and we expect that the higher is this share, the higher is the graduates' political weight and therefore the higher the probability that their interest would prevail in equilibrium. To measure income inequality, we use the GINI index of disposable income; to assess the intergenerational persistence in education, we take the variable COR, which measures the correlation between the years spent in education by parents and the years spent by the child; higher COR indicates higher intergenerational persistence in education.<sup>26</sup> The SHARE of graduates in the adult population refers

<sup>25</sup> The original variables used in the analyses are reported in the appendix (see Table 2).

<sup>26</sup> COR measures intergenerational persistence in education using Pearson's correlation coefficient between the years of education of parents and children. We use data from 2018 Global Database on Intergenerational Mobility of the World Bank (GDIM 2018) for the 1980's cohort. 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 chil-

to the population aged 25–64 who have completed tertiary education. To limit the problem of reverse causality and to strengthen our interpretation of the results in terms of the effects of COR, GINI and SHARE on the demand for public and private education, we consider values of GINI, COR and SHARE that precede the observed values of education expenditures (for GINI and SHARE, we take the 2010 values and for COR, we refer to the 1980 cohort).<sup>27</sup>

To perform the cluster analysis, we use the standardised values of the seven variables (see Table 4 in Appendix 3). The standardisation allows each variable to contribute equally to the definition of the clusters by eliminating distortions coming from the fact that variables with a large range are given more weight in defining a cluster solution than those with a small range (Afifi et al. 2019).

We first run a principal component analysis on the standardised variables. As shown in Table 5 in Appendix 3, the first three components explain 85% of the variance. Each component captures a specific dimension of the variability in the data set. The first component (PC1) has a large positive association with TotPub and it is negatively correlated with GINI and COR. We interpret this component as capturing the ‘egalitarian society’ dimension: a country scoring high in this dimension exhibits a low redistributive conflict, a quite mobile society (low intergenerational persistence in education) and high public spending. The second component (PC2) has a large positive association with TotPriv, GINI and SHARE. We interpret this component as capturing the ‘market-based society’ dimension: a country scoring high in this dimension exhibits a strong redistributive conflict, high private education expenditure and low public spending, especially in the tertiary segment. The third component (PC3) is positively correlated with GINI, COR and TerPub. We interpret this component as capturing the ‘élitarian society’ dimension: high values along this dimension indicate high income inequality, high intergenerational persistence in education and a public spending biased towards tertiary education. We call it ‘élitarian’ because a country scoring high in this dimension uses public spending in education mainly to benefit the privileged élite.

The position of each country along the three principal components (Fig. 1)<sup>28</sup> and the hierarchical tree-diagram (Fig. 2), resulting from the cluster analysis based on these principal components, identify five groups of countries at the dissimilarity level shown by the red line.<sup>29,30</sup>

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Footnote 26 (continued)

dren’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).

<sup>27</sup> Table 3, in Appendix 3 reports the value of these variables for each country.

<sup>28</sup> Countries’ scores for the three components are reported in Table 6, in Appendix 3.

<sup>29</sup> A Ward’s linkage clustering with Euclidean distance as a dissimilarity measure is adopted. The vertical axis of the dendrogram represents the distance or dissimilarity between clusters. The horizontal axis represents the countries and clusters. The purpose is to obtain few groups, each containing elements that are similar among themselves and dissimilar to elements belonging to other groups. In practice, the choice on the number of groups is the choice of the vertical level at which to cut the tree.

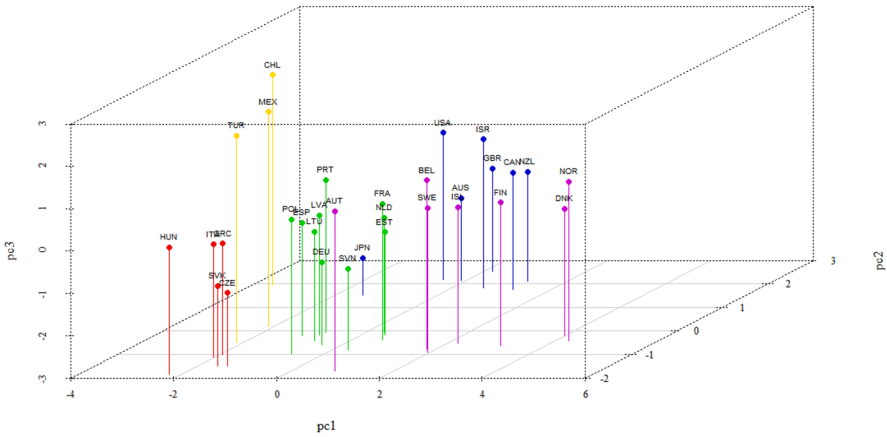
<sup>30</sup> The same dendrogram is obtained by performing a cluster analysis using the seven original standardised variables instead of the three principal components.

Group 1 (Austria, Belgium, Iceland, Sweden, Denmark, Norway, Finland) contains countries that score very high in the first component ('egalitarian society' dimension) and have a negative or very low score in the second and in the third components ('market-based society' and 'elitarian society' dimensions). In these countries, education expenditures are high in both education tiers and almost entirely publicly funded; the correlation between parents and children's years of education is low (apart from Austria and Belgium) and there is a high share of graduates in the population. These societies display a low level of redistributive conflict (low income inequality), and a high degree of social mobility (low intergenerational persistence in education). These facts are consistent with a political equilibrium in which public spending in education is high and education funding from private sources is insignificant. The identity of the pivotal voter is not important given the low level of conflicts, although the high share of graduates in the adult population strengthens the probability that the pivotal voter be highly educated and explains the bias towards public spending in tertiary education. This 'low conflict' equilibrium is well suited to describe the situation observed in Denmark where the GINI index is 0.25, COR is 0.17 and the SHARE of graduates in the adult population is 33% (see Table 4). Public education spending in Denmark is 6.13% of GDP. Private spending is almost insignificant (0.19%) and public expenditure is biased towards tertiary education (our tertiary bias index scores 1.18).<sup>31</sup>

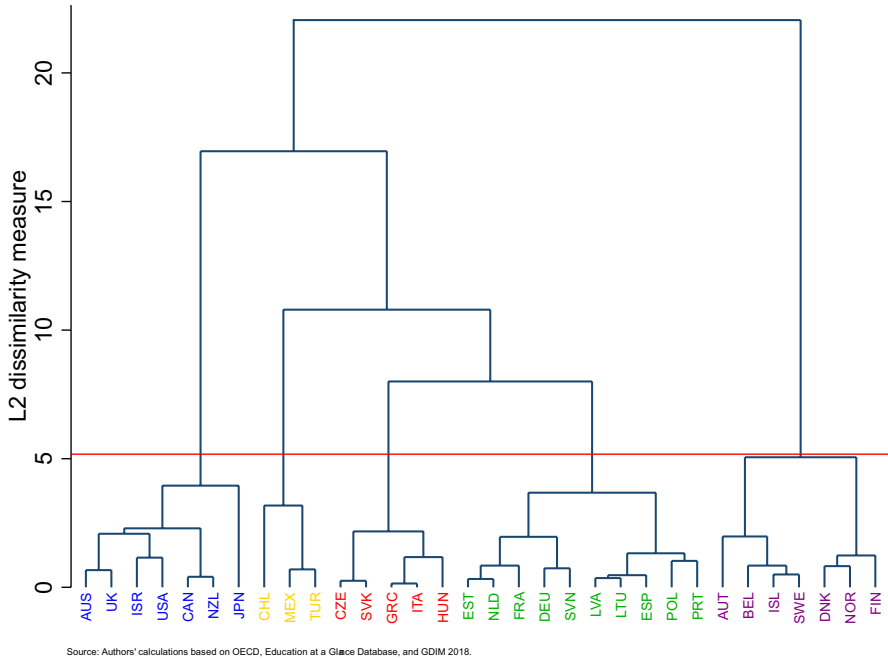
Group 2 (Australia, UK, Israel, USA, Canada, New Zealand, Japan) contains countries characterised by high values of the second component ('market-based society' dimension). In these countries, education expenditures are high, but a relevant share of tertiary education spending is financed by private funds. As an example of this group, consider the US. In the US, a high share of graduates (42%) boosts demand for education and accordingly, total spending is high. Income inequality is relatively high (the GINI index is 0.38) and, in line with our model's results, a relevant share of education is privately funded (1.98% of GDP). This expenditure is concentrated at the tertiary level. Public spending in education is relatively low (4.3% of GDP) and unbalanced towards basic education (our tertiary bias index scores 0.93). This can be taken as an example of an 'ends-against-the-middle' type of equilibrium. When private options for advanced education are available, the interests of low and high social status households might converge. The political equilibrium in this case features low public spending, unbalanced towards basic education, with a high share of advanced education financed by private sources.

Group 3 (Czech Republic, Slovakia, Greece, Italy, Hungary) includes countries with negative scores along all the three dimensions. These countries spend on education a small share of their GDP, mainly concentrated on basic education. They are all characterised by a high COR value indicating a high intergenerational persistence in education. In Italy, for example, the average share of GDP devoted to education in the period 2010–2017 is 3.85% (3.4% from public funding), one of the lowest values among OECD countries; education spending is mainly public, and it is unbalanced towards basic education (our tertiary bias index scores 0.68). According to our

<sup>31</sup> See Table 2 in Appendix 1.



**Fig. 1** Countries' position in the three-dimensional space (PC1, PC2, PC3)



**Fig. 2** Dendrogram

model, low spending on both education tiers should be the outcome if the pivotal voter is non-graduate and if the intergenerational persistence in education is high. Indeed, in Italy, children's access to tertiary education is highly dependent on parents' education (COR=0.45) and the share of graduates in the population in 2010

was the lowest among OECD countries (14.8%), consistent with the hypothesis that the pivotal voter represents the interest of the non-graduated population.

Group 4 (Chile, Mexico, Turkey) contains countries that score high in the third component ‘*élitarian society*’ dimension) and very low in the first component (‘*egalitarian society*’ dimension). As an example of this group, we consider Turkey.<sup>32</sup> In the early 2000s, Turkey was among low spending countries, but, in the last decade, the country seems to have undergone a rapid change; public spending on education as a share of GDP increased by 24% between 2010 and 2017 (mostly concentrated on tertiary education), bringing Turkey, for the first time, above the OECD average (5.4% in Turkey in 2017 compared to the OECD average of 4.9%).<sup>33</sup> Income inequality is high (GINI=0.42) as it is the intergenerational persistence in education (COR=0.51). Public education spending is unbalanced towards tertiary education (our tertiary bias index scores 1.67). In a context of high income inequality and high intergenerational persistence in education, public spending in education is regressive rather than progressive.<sup>34</sup> The interests represented are therefore those of a rich and well-educated *élite*. Thus, we interpret Turkey’s situation as the equilibrium outcome obtained when the political power is in the hands of the rich and well educated, but a private supply of tertiary education is absent or not yet fully developed.

Finally, group 5 contains countries that apparently are quite different: Central European (The Netherlands and Deutschland), Eastern European (Poland, Latvia, Lithuania, Slovenia) and Mediterranean (Portugal, Spain, France). They all present a negative score in the second component, consistent with the observation that in these countries education is mainly public. The absolute value of the score along the two other dimensions is always quite small suggesting that these countries are less egalitarian than countries in group one, although definitely not *élitarian*. Excluding Portugal, the SHARE of graduates in 2010 was similar to countries in group 1, but the GINI index was relatively higher. The COR value was around the OECD average for most of the countries in the group. As exemplifying country, we take France. In terms of average total spending, over the period considered the proportion of French GDP allocated to education was slightly above the OECD average (5.2% versus 5.1%). Public expenditure as a percentage of GDP was above the OECD average (4.6% of GDP versus 4.3%) and balanced between the two education tiers (our tertiary bias index scores 1.06). The share of GDP allocated to private expenditure was instead below the average (0.6% versus 0.8%). The GINI index (0.30%), COR (0.39) and SHARE (29%) are in line with the OECD average. We interpret this outcome as a political equilibrium similar to the one in Denmark, but less extreme. The political

<sup>32</sup> According to the World Bank’s classification – based on Gross National Income per capita—Turkey belongs to the upper-middle income group (<https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups>).

<sup>33</sup> If one looks at spending per student, which also accounts for the demographic structure of the population, Turkey’s education expenditure in 2017 is still below OECD average.

<sup>34</sup> Although in 2012, Turkey has approved a reform, which, among others, has increased compulsory education from 8 to 12 years, and although the number of students in tertiary education has increased substantially, access to higher levels of tertiary education and to prestigious universities is still a privilege (Gok 2016).

conflict along the income and the education dimensions, measured respectively by the GINI index and COR, are higher relative to Denmark. Also, the share of graduates in the French population is lower than in the Danish population. The observed equilibrium is consistent with a low-educated and low-income pivotal voter. The higher public education expenditure observed, especially in the tertiary level, is consistent with a COR index remarkably lower than in countries of Group 3. French society appears more mobile than the Italian, and we argue that this explains the greater demand for education in France.

#### 4.1 Discussion and Policy Implication: Italy

Italy is somehow a puzzle. Notwithstanding its tradition and its level of development, it spends very little on education, particularly at the advanced level. Several reasons can be put forward to explain such situation; here we highlight the role played by the intergenerational persistence in education. In this respect, it is interesting to compare Italy to Portugal. In the last decade, in Portugal the share of young adults (25–34 years old) who have attained a tertiary education has increased by fifty percent reaching 37.4% in 2019.<sup>35</sup> By comparison, in Italy, where the share of graduates in the population was similar to Portugal in 2010 (14.8%), the share of graduates in the young population in 2019 is only 27.7%. Comparing overall education expenditures in the two countries, reveals that average total education expenditure in the period 2010–2017 in Portugal was 5.3% of GDP (4.3% from public funding) while in Italy it amounted to 3.9% of GDP (3.4% from public funding). In the last two decades, the most dynamic component of education expenditures in Portugal has been tertiary education, which was below 1% of GDP in 2000 and it has increased by more than 30% since then, reaching 1.3% of GDP in 2019. In the same period, tertiary spending over GDP in Italy has remained below 1%. To interpret this impressive divarication using a political economy key, firstly, notice that in 2010 the index of intergenerational persistence in education was lower in Portugal than in Italy (0.40 compared to 0.45). To this respect, note that in all countries included in the group of low spenders (group 3), the children's level of education is highly correlated to the parents' education level. In our interpretation, this factor reduces the demand for advanced education from low-educated households. Since the pivotal voter is likely to belong to this majoritarian group, a high education spending equilibrium cannot emerge. In turn, this prevents the share of graduates in the adult population from growing, and this increases the probability to remain stuck in a low education spending equilibrium. Unlike other examples,<sup>36</sup> the 2006 Italian reform

<sup>35</sup> "Population with tertiary education" (indicator), <https://doi.org/10.1787/0b8f90e9-en> (accessed on 26 January 2021).

<sup>36</sup> Garrouste (2010) reports a detailed list of reforms on the duration of compulsory education in 15 European countries plus Israel, during the twentieth century. Although all the countries considered report higher educational attainment levels than the compulsory education duration, the two do not seem to be correlated. For example, Italy and Denmark, have had similar average compulsory years of education (around 5.5 years over the century), but actual duration is 8.2 and 12.3 years, on average, in Italy and Denmark respectively. This suggests that, alongside education reforms, other factors, such as the demand for skilled workers in time of changes of the industry sectoral composition, have contributed to



that has raised mandatory education to 10 years does not seem to have been effective in increasing education expenditures, particularly for tertiary education, nor the number of graduates.<sup>37</sup> In our opinion what is needed is a radical reform of secondary education, which should reduce early tracking and school segregation by neighborhood and by school programs, emphasising comprehensiveness as opposed to vocational orientation.

## 5 Concluding Remarks

This paper documents differences in education systems across OECD arguing that 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 build a model that emphasises the role of households' income and education heterogeneity. It also relates households' preferences to country-level characteristics such as income inequality and intergenerational persistence in education. Based on our model's results and on the empirical evidence presented, the main policy message of our analysis is that the call for an increase of public education expenditures to favour equality of opportunities, might not receive political support. Although low social status households are the segment of population that should strive more to increase equality of opportunities, they might oppose an increase in the level of education expenditure, especially at tertiary level. This position might obtain the political support of the richer segment of population interested in reducing the public budget in favour of private expenditures. The likelihood of this event is greater in countries where the share of population with tertiary education is low and the intergenerational persistence in education is high, like in Italy. The great dependence of the access to tertiary education on parental social status prevents the majority of low-educated agents from supporting an increase in public education spending, especially at tertiary level. In this respect, reforms of the education system, directed at promoting equity and inclusiveness in education and thus at lowering the degree of intergenerational persistence in education, are needed.

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Footnote 36 (continued)

the increase in the number of years of education. For a successful story about the effects of a compulsory education reform on educational attainment and returns to education, see Aakvik et al. (2010) on the 1960s reform in Norway. This reform has contributed to moving the country from the bottom to the high-end of the distribution of education among OECD countries.

<sup>37</sup> Our model does not consider the population age structure, which is likely to be an important factor affecting support for education. In fact, a population with a high share of young is more likely to support education spending as opposed to an old population, which is more likely to support other social expenditures such as health and pension. This is, of course, one important difference between Italy and Portugal. In 2010, in Portugal the ratio of elderly to young was 1.22 while in Italy was 1.45, compared to an OECD average smaller than one (<https://data.oecd.org/pop/population.htm>).

**Table 2** Education expenditures, OECD countries, 2010–17 (Source: OECD- <http://stats.oecd.org/>)

Country	Year	Average total education expenditure % GDP <sup>a</sup>		Average public education expenditure % GDP K-12		Average private education expenditure % GDP K-12		Average public education expenditure % GDP tertiary		Average private education expenditure % GDP tertiary		Average private expenditure % GDP		Bias public tertiary/public K-12 <sup>b</sup>
		education expenditure % GDP	education expenditure % GDP K-12	education expenditure % GDP	education expenditure % GDP K-12	education expenditure % GDP	education expenditure % GDP K-12	education expenditure % GDP	education expenditure % GDP tertiary	education expenditure % GDP tertiary	education expenditure % GDP tertiary	education expenditure % GDP	education expenditure % GDP	
Australia	2010–17	5.85	3.33	0.72	4.07	1.06	0.74	1.78	1.06	1.78	0.71	1.78	0.71	
Austria	2012–17	4.86	2.99	0.14	4.62	0.11	1.63	0.24	0.11	0.24	1.74	0.24	1.74	
Belgium	2010–17	5.67	4.12	0.16	5.35	0.17	1.23	0.33	0.17	0.33	0.95	0.33	0.95	
Canada	2010–17	6.17	3.30	0.34	4.63	1.20	1.32	1.54	1.20	1.54	1.28	1.54	1.28	
Chile	2010–17	5.79	2.74	0.68	3.47	1.65	0.73	2.33	1.65	2.33	0.85	2.33	0.85	
Czech Republic	2010–17	3.75	2.43	0.24	3.27	0.24	0.84	0.48	0.24	0.48	1.11	0.48	1.11	
Denmark <sup>c</sup>		6.13	4.34	0.12	5.94	0.08	1.60	0.19	0.08	0.19	1.18	0.19	1.18	
Estonia	2010–17	4.56	3.00	0.11	4.16	0.29	1.16	0.40	0.29	0.40	1.23	0.40	1.23	
Finland	2010–17	5.63	3.87	0.03	5.53	0.07	1.67	0.10	0.07	0.10	1.38	0.10	1.38	
France	2010–17	5.22	3.44	0.35	4.58	0.29	1.14	0.64	0.29	0.64	1.06	0.64	1.06	
Germany	2010–17	4.29	2.69	0.40	3.71	0.17	1.02	0.58	0.17	0.58	1.21	0.58	1.21	
Greece <sup>d</sup>	2012–17	3.66	2.63	0.21	3.29	0.11	0.68	0.32	0.11	0.32	0.83	0.32	0.83	
Hungary	2010–17	3.87	2.61	0.21	3.33	0.39	0.73	0.60	0.39	0.60	0.89	0.60	0.89	
Iceland	2010–17	5.65	4.30	0.17	5.38	0.10	1.09	0.27	0.10	0.27	0.81	0.27	0.81	
Israel	2010–17	5.97	3.96	0.46	4.80	0.71	0.83	1.17	0.71	1.17	0.67	1.17	0.67	
Italy	2010–17	3.85	2.80	0.14	3.39	0.32	0.60	0.45	0.32	0.45	0.68	0.45	0.68	
Japan <sup>e</sup>		4.20	2.56	0.20	3.02	0.98	0.46	1.18	0.98	1.18	0.58	1.18	0.58	
Korea	2016–17	5.06	3.09	0.46	3.61	0.99	0.62	1.45	0.99	1.45	0.65	1.45	0.65	
Latvia	2010–17	4.35	3.04	0.08	3.87	0.39	0.84	0.48	0.39	0.48	0.88	0.48	0.88	
Lithuania	2010–17	4.18	2.61	0.10	3.69	0.40	1.07	0.49	0.40	0.49	1.31	0.49	1.31	
Mexico <sup>f</sup>	2010–17	5.08	3.13	0.63	4.05	0.40	0.92	1.04	0.40	1.04	0.93	1.04	0.93	
The Netherlands	2010–17	5.26	3.17	0.46	4.31	0.48	1.14	0.95	0.48	0.95	1.15	0.95	1.15	
New Zealand	2012–17	6.56	3.94	0.82	4.87	0.88	0.93	1.70	0.88	1.70	0.76	1.70	0.76	

Table 2 (continued)

Country	Year	Average total education expenditure % GDP <sup>a</sup>	Average public education expenditure % GDP K-12	Average private education expenditure % GDP K-12	Average public education expenditure % GDP	Average private education expenditure % GDP tertiary	Average private expenditure % GDP	Bias public tertiary/public K-12 <sup>b</sup>
Norway	2010–17	6.37	4.65	0.01	6.28	0.08	0.09	1.12
Poland	2010–17	4.57	3.04	0.26	4.04	0.27	0.53	1.06
Portugal <sup>c</sup>	2010–17	5.20	3.56	0.49	4.32	0.44	0.94	0.68
Slovak Republic	2010–17	3.82	2.46	0.30	3.25	0.27	0.56	1.02
Slovenia	2010–17	4.60	3.18	0.32	4.12	0.15	0.48	0.94
Spain	2010–17	4.35	2.73	0.36	3.62	0.36	0.72	1.05
Sweden	2010–17	5.31	3.73	0.00	5.13	0.17	0.17	1.20
Turkey <sup>b</sup>	2010–17	5.15	2.50	0.83	3.80	0.44	1.27	1.67
UK <sup>i</sup>	2010–17	6.35	3.81	0.67	4.47	1.14	1.81	0.49
USA	2010–17	6.25	3.30	0.31	4.27	1.67	1.98	0.93
OECD average		5.08	3.24	0.33	4.25	0.50	0.83	1.00

<sup>a</sup>Total expenditure is the sum of public and private spending. If one of the two values is not available for a specific year, we do not consider total expenditure for that year.

<sup>b</sup>The “tertiary bias” index is computed 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.

<sup>c</sup>Missing values for all expenditures in 2015 and 2016 and for in private tertiary expenditure and total private spending for 2012.

<sup>d</sup>Data for private spending are not available for 2016 and 2017.

<sup>e</sup>Missing data from 2013 to 2015.

<sup>f</sup>2012 data are not available for private tertiary and total private spending.

<sup>g</sup>Missing data for 2010 and 2011 private basic K-12 expenditure and total private spending.

<sup>h</sup>Missing data for 2010 private basic K-12 spending and total private spending.

<sup>i</sup>Data missing for 2010 and 2011 total public expenditure and public tertiary spending; and 2010 basic and tertiary private spending.

## Appendix 1

See Table 2.

### Appendix 2

To find the family optimal choices of consumption and private investment in basic and tertiary education, write the family (expected) utility function:

$$\begin{aligned} EU_{ij} &= \ln c_{ij} + \gamma \{ p_i \ln [B^\alpha (T_{ij} + T)] + (1 - p_i) \ln B^\alpha \} \\ &= \ln c_{ij} + \alpha \gamma \ln B + \gamma p_i \ln (T_{ij} + T) = \ln c_{ij} + \alpha \gamma \ln B + \gamma p_i \ln (T_{ij} + T) \end{aligned}$$

This utility function is maximised under the family budget constraint and the non-negativity constraints:

$$c_{ij} + T_{ij} = (1 - \tau)Y_j$$

$$T_{ij}, c_{ij} \geq 0$$

The first order conditions are:

$$\frac{\partial EU_{ij}}{\partial T_{ij}} = \frac{-1}{c_{ij}} + \frac{\gamma p_i}{T_{ij} + T} \leq 0 \quad (6)$$

$$T_{ij} \geq 0, \frac{\partial EU_{ij}}{\partial T_{ij}} T_{ij} = 0$$

If  $T_{ij} > 0$  condition (6) holds with equality: the marginal utility loss from reduced consumption is equal to the marginal utility gain from increased child's income. If condition (6) holds as inequality, then we have a corner solution in which  $T_{ij} = 0$ . The family would reduce  $T_{ij}$  because  $T$  provides enough education for the child.

In case of an interior solution ( $T_{ij} > 0$ ), it can easily be shown that the optimal choice is:

$$\begin{aligned} T_{ij}^* &= \frac{\gamma p_i (1 - \tau) Y_j - T}{1 + \gamma p_i} \\ c_{ij}^* &= \frac{(1 - \tau) Y_j + T}{1 + \gamma p_i} \end{aligned} \quad (7)$$

Note that, while  $c_{ij}^*$  is always positive, an interior solution with  $T_{ij}^* > 0$  requires income to be greater than a threshold value; namely,  $Y_j > g(\tau, T) = \frac{T}{\gamma p_i (1 - \tau)}$

To derive preferences for public education, write the family indirect utility as a function of Government's choice variables

$$W_{ij}(\tau, B, T) = \ln c_{ij}^* + \alpha \gamma \ln B + \gamma p_i \ln (T_{ij}^* + T) \quad (8)$$

Given its budget constraint, the Government can choose only two variables. Substituting  $B = \tau Y - T$  and the optimal choices  $(c_{ij}^*, T_{ij}^*)$  from (7), the family indirect utility becomes

$$W_{ij}(\tau, T) = \ln \left[ \frac{(1 - \tau)Y_j + T}{1 + \gamma p_i} \right] + \alpha \gamma \ln(\tau Y - T) + \gamma p_i \ln \left[ \frac{\gamma p_i [(1 - \tau)Y_j + T]}{1 + \gamma p_i} \right]$$

The net benefits from public education expenditures are:

$$\frac{\partial W_{ij}}{\partial \tau} = - \frac{(1 + \gamma p_i)Y_j}{(1 - \tau)Y_j + T} + \frac{\alpha \gamma Y}{\tau Y - T} \tag{9}$$

$$\frac{\partial W_{ij}}{\partial T} = \frac{(1 + \gamma p_i)}{(1 - \tau)Y_j + T} - \frac{\alpha \gamma}{\tau Y - T} \tag{10}$$

It can be easily verified that (9) and (10) are simultaneously equal to zero only if  $Y_j = Y$ . In this case, policy preferences are:

$$T^* = \left( \tau^* - \frac{\alpha}{p_i + \alpha + 1/\gamma} \right) Y \tag{11}$$

If  $Y_j > Y$  then the derivative  $\frac{\partial W_{ij}}{\partial T}$  in (10) is always negative and policy preferences are

$$T^* = 0 \quad \text{and} \quad \tau^* = \frac{\alpha}{p_i + \alpha + 1/\gamma}$$

In this equilibrium, there is no public tertiary education and families are willing to invest privately  $T_{ij}^* = \frac{\gamma p_i (1 - \tau) Y_j}{1 + \gamma p_i}$  in tertiary education (cfr. 7).<sup>38</sup> Note that if there exists a private university but the fee is higher than this value, then children from poor and less educated families will not be able to access tertiary education.

In case of a corner solution ( $T_{ij}^* = 0$ ),<sup>39</sup> the family indirect utility is

$$W_{ij}(\tau, T) = \ln[(1 - \tau)Y_j] + \alpha \gamma \ln[\tau Y - T] + \gamma p_i \ln T$$

The FOC with respect to the policy variables are:

$$\frac{\partial W_{ij}}{\partial \tau} = - \frac{Y_j}{(1 - \tau)Y_j} + \frac{\alpha \gamma Y}{\tau Y - T} = 0 \tag{12}$$

<sup>38</sup> Note that in this equilibrium, the threshold value  $g(\tau, T) = 0$  so that  $T_{ij}^* > 0$  for all families.

<sup>39</sup> Which requires  $Y_j < g(\tau, T) = \frac{T}{\gamma p_i (1 - \tau)}$

$$\frac{\partial W_{ij}}{\partial T} = \frac{\gamma p_i}{T} - \frac{\alpha \gamma}{\tau Y - T} = 0 \quad (13)$$

In this case, policy preferences are:

$$T^* = \frac{p_i}{p_i + \alpha + 1/\gamma} Y \quad \text{and} \quad \tau^* = \frac{p_i + \alpha}{p_i + \alpha + 1/\gamma} \quad (14)$$

Note that these preferences also satisfy (11) and the income threshold value is exactly equal to average income:  $g(\tau, T) = Y$ .

In this equilibrium, poor families (i.e. those with  $Y_j < Y$ ) will not invest in private education while rich families will spend  $T_{ij}^* = \frac{p_i(Y_j - Y)}{(p_i + \alpha + \frac{1}{\gamma})(1 + \gamma p_i)}$

Finally, note that if there is no supply of private (tertiary) education (i.e.  $T_{ij}^* = 0$  for all) preferences are as in (14) for all families, independently of income.

### Appendix 3

See Tables 3, 4, 5 and 6.

**Table 3** Income inequality, education persistence, and share of graduates, OECD countries (Source: OECD- <http://stats.oecd.org/> and GDIM, 2018)

Country	Gini net disposable income 2010 <sup>a</sup>	COR	Share of graduates 2010 <sup>b</sup>
Australia	0.33	0.25	37.60
Austria	0.28	0.46	27.74
Belgium	0.27	0.49	34.99
Canada	0.32	0.32	50.31
Chile	0.51	0.51	17.81
Czech Republic	0.26	0.38	16.76
Denmark	0.25	0.17	33.26
Estonia	0.32	0.32	35.42
Finland	0.27	0.30	38.15
France	0.30	0.39	29.01
Germany	0.29	0.32	26.61
Greece	0.34	0.49	24.74
Hungary	0.27	0.63	20.12
Iceland	0.25	0.38	32.63
Israel	0.38	0.40	45.56
Italy	0.33	0.45	14.80
Japan	0.34	0.31	44.81
Korea	0.31	–	39.04
Latvia	0.36	0.38	26.95
Lithuania	0.34	0.39	32.44
Mexico	0.47	0.50	14.65
The Netherlands	0.28	0.38	32.39
New Zealand	0.32	0.21	34.80
Norway	0.25	0.28	37.28
Poland	0.31	0.45	22.47
Portugal	0.35	0.40	15.45
Slovak Republic	0.26	0.42	17.33
Slovenia	0.25	0.31	23.72
Spain	0.34	0.43	31.02
Sweden	0.27	0.39	33.87
Turkey	0.42	0.51	13.12
UK	0.35	0.27	38.19
USA	0.38	0.41	41.66
OECD average	0.38	0.32	29.84

<sup>a</sup>Data for Chile, Japan and New Zealand refer to 2009.

<sup>b</sup>Data for Chile refer to 2011.

**Table 4** Standardized variables used for cluster analysis

Variables	Description						
COR	Pearson's correlation coefficient between parents and children years of education for the cohort 1980						
GINI	Gini net disposable income (2010)						
SHARE	Share of population 25–64 with tertiary education (2010)						
TotPub	Public expenditure % GDP (average 2010–17)						
TotPriv	Private expenditure % GDP (average 2010–17)						
BasPub	Public K-12 education expenditure % GDP (average 2010–17)						
TerPub	Tertiary public education expenditure % GDP (average 2010–17)						
Country	COR	GINI	SHARE	BasPub	TotPriv	TotPub	TerPub
AUS	-1.37612	0.1567288	0.781749	0.1311994	1.603995	-0.2421651	-0.8679885
AUT	0.7744676	-0.6514034	-0.2114783	-0.4178202	-0.9335611	0.4248313	1.887899
BEL	1.081694	-0.8130296	0.5188362	1.406863	-0.7852623	1.310118	0.649298
CAN	-0.6592575	-0.0048979	2.062066	0.0827566	1.208532	0.4369588	0.9279834
CHL	1.286512	3.066004	-1.211757	-0.8215112	2.510265	-0.969798	-0.8989534
CZE	-0.0448039	-0.9746564	-1.317527	-1.322088	-0.5380979	-1.212342	-0.5583383
DNK	-2.195391	-1.136283	0.3445678	1.762112	-1.015949	2.025624	1.795004
EST	-0.6592575	-0.0048979	0.562151	-0.4016726	-0.6699189	-0.1330206	0.4325427
FIN	-0.8640752	-0.8130296	0.8371525	1.003172	-1.164248	1.528408	2.011759
FRA	0.0576049	-0.3281504	-0.0835473	0.3088237	-0.2744556	0.3763225	0.3706127
DEU	-0.6592575	-0.4897771	-0.3253065	-0.9022493	-0.3733215	-0.6787449	-0.0009677
GRC	1.081694	0.3183551	-0.5136773	-0.9991351	-0.80174	-1.188088	-1.053779
HUN	2.515419	-0.8130296	-0.9790637	-1.031431	-0.3403661	-1.139579	-0.8989534
ISL	-0.0448039	-1.136283	0.2811062	1.697521	-0.8841282	1.3465	0.2157876
ISR	0.160014	0.9648606	1.583584	1.148501	0.5988591	0.6431215	-0.5893033
ITA	0.6720585	0.1567288	-1.514963	-0.7246255	-0.5875307	-1.066816	-1.301499
JPN	-0.7616664	0.3183551	1.508034	-1.112169	0.6153367	-1.515523	-1.735009
LVA	-0.0448039	0.6416081	-0.2910573	-0.3370821	-0.5380979	-0.4847097	-0.5583383
LTU	0.0576049	0.3183551	0.2619667	-1.031431	-0.5216202	-0.7029994	0.1538577
MEX	1.184103	2.419498	-1.530073	-0.1917531	0.3846498	-0.2664195	-0.3106179
NLD	-0.0448039	-0.6514034	0.2569302	-0.1271626	0.2363511	0.0488877	0.3706127
NZL	-1.785756	-0.0048979	0.4996967	1.116206	1.472174	0.7280116	-0.2796529
NOR	-1.068893	-1.136283	0.7495145	2.262688	-1.180726	2.437949	1.887899
POL	0.6720585	-0.1665242	-0.7423413	-0.3370821	-0.4557097	-0.278547	-0.0628977
PRT	0.160014	0.4799814	-1.449487	0.5025952	0.2198735	0.0610152	-0.8060585
SVK	0.3648317	-0.9746564	-1.260109	-1.273645	-0.4062767	-1.236597	-0.7131633
SVN	-0.7616664	-1.136283	-0.616425	-0.1110149	-0.5380979	-0.1815294	-0.2486879
ESP	0.4672408	0.3183551	0.118926	-0.8376589	-0.1426345	-0.78789	-0.4035131
SWE	0.0576049	-0.8130296	0.4060149	0.7771052	-1.048905	1.043319	1.206668
TUR	1.286512	1.611366	-1.684195	-1.209055	0.7636355	-0.5696001	0.897018
UK	-1.171302	0.4799814	0.8411815	0.9062862	1.653428	0.242923	-1.332464
USA	0.2624229	0.9648606	1.190725	0.0827566	1.933548	0.0003789	-0.1867579



**Table 5** Principal components analysis

Principal components/correlation		Number of obs = 32						
Rotation: (unrotated = principal)		Number of comp. = 7						
		Trace = 7						
		Rho = 1.0000						
Component	Eigenvalue	Difference	Proportion	Cumulative				
Comp1	3.427	1.790	0.490	0.490				
Comp2	1.637	0.755	0.234	0.723				
Comp3	0.881	0.421	0.126	0.849				
Comp4	0.461	0.061	0.066	0.915				
Comp5	0.399	0.204	0.057	0.972				
Comp6	0.195	0.195	0.028	1.000				
Comp7	0.000		0.000	1.000				
Principal components (eigenvectors)								
Variable	Comp1	Comp2	Comp3	Comp4	Comp5	Comp6	Comp7	Unexplained
COR	-0.341	-0.324	0.504	0.320	0.613	0.217	-0.002	0
GINI	-0.335	0.407	0.532	0.038	-0.206	-0.628	-0.001	0
SHARE	0.318	0.436	-0.284	0.673	0.363	-0.206	0.002	0
BasPub	0.459	0.195	0.275	-0.446	0.381	-0.038	0.575	0
TotPriv	-0.216	0.667	0.127	-0.003	-0.116	0.693	0.006	0
TotPub	0.502	0.065	0.361	-0.153	0.078	0.047	-0.763	0
TerPub	0.401	-0.228	0.400	0.469	-0.534	0.181	0.296	0

**Table 6** Principal components scores (eigenvectors)

Country	Principal component 1	Principal component 2	Principal component 3
AUS	-0.0790023	2.136775	-1.039097
AUT	0.8751124	-1.700445	0.7733784
BEL	1.808449	-0.7514656	0.9797335
CAN	1.26166	1.759033	-0.2257165
CHL	-3.589872	1.950254	1.971454
CZE	-1.394615	-1.508195	-1.262956
DNK	4.008809	-0.1943855	-0.0056222
EST	0.4830214	-0.1653011	-0.5752124
FIN	3.125973	-0.6103513	0.3746443
FRA	0.6115296	-0.3587786	0.2038678
DEU	-0.380898	-0.5830109	-1.047917
GRC	-1.931008	-1.002643	-0.3800407
HUN	-2.222694	-1.854415	0.009943
ISL	2.222517	-0.5276279	0.2172804
ISR	0.6257896	1.835113	0.5136931
ITA	-2.015072	-1.110116	-0.3397481
JPN	-1.455485	1.531802	-2.124409
LVA	-0.7838129	-0.1732376	-0.1736651
LTU	-0.6823643	-0.3963512	-0.4308769
MEX	-2.106028	0.2031175	2.063992
NLD	0.3865005	-0.0728434	-0.2869838
NZL	1.227998	2.115291	-0.4106906
NOR	4.263002	-0.3893873	0.7493436
POL	-0.6206887	-0.9707397	0.1748357
PRT	-0.7721975	-0.047739	0.5980154
SVK	-1.596566	-1.484835	-1.113656
SVN	0.3234753	-0.8023849	-1.079177
ESP	-1.126679	-0.1793219	-0.3364331
SWE	1.979399	-0.9120117	0.4164263
TUR	-2.139705	-0.4623404	1.878165
UK	0.1656726	2.547702	-0.575036
USA	-0.4722215	2.178839	0.4824639

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## References

- Aakvik A, Salvanes KG, Vaage K (2010) Measuring heterogeneity in the returns to education using an education reform. *Eur Econ Rev* 54(4):483–500
- Afifi A, May S, Donatello R, Clark VA (2019) *Practical multivariate analysis*. CRC Press
- Arcalean C, Schiopu I (2010) Public versus private investment and growth in a hierarchical education system. *J Econ Dyn Control* 34(4):604–622
- Arts W, Gelissen (2002) Three world of welfare capitalism or more? A state-of-the-art-report. *J Eur Soc Policy* 12(2):137–158
- Bernasconi M, Profeta P (2012) Public Education and redistribution when talents are mismatched. *Eur Econ Rev* 56:84–96
- Blankenau W (2005) Public schooling, college subsidies and Growth. *J Econ Dyn Control* 29:487–507
- Blankenau W, Cassou S, Ingram B (2007) Allocating government education expenditures across K-12 and college education. *Econ Theor* 31(1):85–112
- Bowles S, Gintis H (2000) Does schooling raise earnings by making people smarter? In: Arrow BS, Durlauf S (eds) *Meritocracy and economic inequality*. Princeton University Press, Princeton
- Brinkman PT, Leslie LL (1986) Economies of scale in higher education; sixty years of research. *Rev High Educ* 10(1):1–28
- Bukodi E, Goldthorpe JH (2010) Market versus meritocracy: Hungary as a critical case. *Eur Sociol Rev* 26(6):655–674
- Busemeyer M (2012) Inequality and the political economy of education: an analysis of individual preferences in OECD countries. *J Eur Soc Policy* 22(3):219–240
- Cohen J (1987) Parents as educational models and definers. *J Marriage Fam* 49(2):339–351
- Cohn E, Rhine SLW, Santos MC (1989) Institutions of higher education as multi-product firms: economies of scale and scope. *Rev Econ Stat* 71:284–290
- De Groot H, McMahan W, Volkwein JF (1991) The cost structure of American Research Universities. *Rev Econ Stat* 73(3):424–431
- Di Gioacchino D, Sabani L, Tedeschi S (2019) Individual preferences for public education spending: does personal income matter? *Econ Model* 82:211–228
- Doyle WR (2007) The political economy of redistribution through higher education subsidies. In: Smart JC (ed) *Higher education: handbook of theory and research*. Springer, New York, pp 335–409
- Epple DS, Romano RE (1996) Ends against the middle: determining public services provision when there are private alternatives. *J Public Econ* 62(3):297–325
- Esping-Andersen G (1990) *The three worlds of welfare capitalism*. Polity Press, Cambridge
- Garroute C (2010) 100 years of educational reforms in Europe: a contextual database. MPRA Paper No. 31853
- GDIM (2018) *Global database on intergenerational mobility*. Development Research Group, World Bank. World Bank Group, Washington, D.C.
- Glomm G, Ravikumar B (1992) Public versus private investment in human capital: endogenous growth and income inequality. *J Polit Econ* 100(4):818–834
- Glomm G, Ravikumar B (2003) Public education and income inequality. *Eur J Polit Econ* 19:289–300
- Glomm G, Ravikumar B, Schiopu IC (2011) The political economy of education funding. *Handb Econ Educ* 4:615–680. <https://doi.org/10.1016/B978-0-444-53444-6.00009-2>
- Gok E (2016) The Turkish higher education system from the kaleidoscope of Martin Trow. *Educ Sci* 41:147–168. <http://egitimvebilim.ted.org.tr/index.php/EB/article/view/3193/2413>
- Goldthorpe J (2003) The myth of education-based meritocracy. *New Econ* 10(4):234–239
- Gradstein M (2019) Misallocation of talent and human capital: political economy analysis. *Eur Econ Rev* 118:148–157
- Hall PA, Soskice D (2001) *Varieties of capitalism: the institutional foundations of comparative advantage*. Oxford University Press
- Jacobs B, van der Ploeg F (2005) *Guide to reform of higher education: a European perspective*. Working Paper, CEPR Discussion Paper, 2005/532/7

- Johnes G, Schwarzenberger A (2011) Differences in cost structure and the evaluation of efficiency: the case of German universities. *Educ Econ* 19(5):487–499
- Keane MP, Wolpin KI (2001) The effect of parental transfers and borrowing constraints on educational attainment. *Int Econ Rev* 42(4):1051–1103
- Kirchsteiger G, Sebald A (2010) Investments into education—doing as the parents did. *Eur Econ Rev* 54:501–516
- Meltzer A, Richard S (1981) A rational theory of the size of government. *J Polit Econ* 89:914–927
- Naito K, Nishida K (2017) Multistage public education, voting, and income distribution. *J Econ* 120:65–78
- Nordblom K (2003) Is increased public schooling really a policy for equality? The role of within-the-family education. *J Public Econ* 87(9–10):1943–1965
- OECD (2012) Equity and quality in education: supporting disadvantaged students and schools
- Viaene JM, Zilcha I (2013) Public funding of higher education. *J Public Econ* 108:78–89
- West A, Nikolai R (2013) Welfare regimes and education regimes: equality of opportunity and expenditure in the EU (and US). *J Soc Policy* 42(3):469–493
- Willemsen N, de Beer P (2012) Three worlds of educational welfare states? A comparative study of higher education systems across welfare states. *J Eur Soc Policy* 22(2):105–117
- Worthington AC, Higgs H (2011) Economies of scale and scope in Australian higher education. *High Educ* 61:387–414

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