How do we explain "low education" traps? The role of income inequality and the inclusiveness of the education system.

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DRAFT
June 2019

Abstract: In this paper, we document differences in education systems across OECD countries and argue that these differences reflect individual preferences for education and their interaction with the specific socio-economic context. To investigate the determinants of these preferences, we build a model in which agents are heterogeneous in terms of income and human capital. The model takes into account the hierarchical nature of education by separating basic and tertiary education. Together with individual characteristics, we emphasize the role played by institutional and socio-economic country features, such as income inequality and the inclusiveness of the education system. Our results show that the public education expenditure redistributive conflict strongly depend on income inequality, education inequality and on the inclusiveness of the education system. The majority of countries featuring low levels of public education expenditure are characterized by low level of inclusiveness, high income inequality and a low share of graduated among adult population. In these contexts, the preferences of low-income and high-income households might be aligned to reduce the overall level of education expenditures. These results might help to explain why some OECD countries, like Italy, seem to remain stuck in "low education" traps.

Keywords: Redistributive effect, public education expenditure, individual preferences, education system
JEL codes: H23, H26, H42, H52, I28.

1. Introduction

Education systems vary considerably over the world, even among developed countries. Not only the share of GDP devoted to education is different, but also the composition of education expenditures by level of education (primary/secondary vs. tertiary), years of compulsory schooling and school tracking, type of financing (*e.g.* public vs private) and thus the level of tuition fees as well as the presence of subsidies and financial aid to students. The strict relationship between the structure of the education system and its capacities of ensuring an inclusive and equitable quality of education to all motivates the research effort towards understanding the reasons behind the variation of national education systems

In this paper, we seek to contribute to this research agenda by taking the view that the education system observed in a country is the outcome of a political process which aggregates individuals' conflicting

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preferences for public education spending. Understanding the determinants of these preferences is therefore essential to explain the variation of education systems across different societies.

At the individual level, the literature has indicated household income as an important determinant of preferences for public education spending. Standard redistributive arguments à la Meltzer and Richard (1981) suggest that, the impact of income on preferences should be negative since richer families are likely to oppose the redistributive effect of public funding.[1] However, given the hierarchical nature of educational systems, the argument is not so clear-cut. Indeed, even when education fully relies on public funding, children from lower socio-economic status have lower enrolment rates at increasing levels of education.[2] This evidence has been explained in the literature by the role of parental education in the children's human-capital production function, and by the effects of family connections, social relations and neighbourhood networks on the chances of being allocated into better paying jobs.[3]

At the country level, the characteristics of the education system, such as the social inclusiveness and the allocation of public spending between basic and higher education, affect the distribution of net benefits from public education spending among social classes and in turn preferences.[4] Since children from low social status families are disadvantaged in education systems featuring low inclusiveness, the standard effect of income on preferences towards public spending can be offset or even reversed, the more so the higher the share of public spending allocated to tertiary education. While this effect can be dampened by a more egalitarian distribution of human capital, income inequality strengthens the progressive redistributive effect of public education expenditures, and thus contributes to accentuate the negative effect of income on preferences.

Against this background, in this paper we graft a model to analyse the determinants of individual preferences for public education expenditures. Our model takes into account the hierarchical nature of the education system by separating basic (K-12) from tertiary education.[5] [6] In the specific, we assume that the probability of acceding to university depends on parents' human capital and on K-12 school design features - such as school tracking,

[1] Empirical evidence does not confirm such prediction. See for example Busemayer (2012) and Di Gioacchino et al. (2019)

[2] See De Fraja (2004) and Cunha et al. (2007). Moreover, children with highly educated parents are more likely to be educated in academically selective schools than those with less educated parents (Dustmann, 2004). On this point, Brezis and Hellier (2017) argue that the division between elite and standard universities is another factor that contributes in generating permanent social stratification.

[3] Glomm and Ravikumar (1992 and 2003) argue that a sufficiently high elasticity of parental human capital in the learning technology might be responsible for low intergenerational mobility of human capital. Bowles and Gintis (2002) and Goldthorpe and Jackson (2008) emphasize the impact of family models on the development of children's non-cognitive traits such as risk aversion, extroversion, the willingness to work in team, the sense of discipline or leadership. All these traits seem to be extremely relevant in determining labour market success. On the role of family ties, see also Alesina and Giuliano (2014) and Franzini et al. (2013).

[4] Standard features of an inclusive education system should be 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. On the contrary, low inclusiveness features include formal differentiation (students are separated by ability through early tracking) and/or informal differentiation (socio-economic segregation among schools).

[5] K-12, from kindergarten to 12th grade, refers to primary and secondary education.

[6] Much of the literature on education treats basic (K-12) and tertiary education symmetrically, or simply assumes a single type of education. However, some recent works have begun to model explicitly the two types of educational expenditures focusing on preferences for public education in a political economy perspective. To this respect, see Viane and Zilcha (2013) and Blankenau et al. (2007).

socio-economic segregation among schools etc.- which determine the level of inclusiveness of the education system. Moreover, we take into account the possibility of talent mismatching, allowing returns from human capital accumulation to depend on family background, with pupils coming from rich families earning, ceteris paribus, higher returns than pupils from poor families do.

The model shows that the position in the income ladder fully drives the preferences of high-income individuals, who oppose the redistributive content of public education expenditure at any level and however small. Quite interestingly, middle-income agents share the same preferences of rich individuals for public expenditures in basic education, while they prefer a higher level of public expenditures in tertiary education, where the support increases with the level of their human capital and with the inclusiveness of the education system. Low-income households' preferred allocation of public funds over the two tiers of education depends on the degree of inclusiveness of the education system. As the inclusiveness increases, the preferred level of public expenditures in basic education decreases, while that in tertiary education rises more than proportionally. In case of low inclusiveness of the education system, the preferences for tertiary education of low-income and high-income households are aligned and they might form a coalition to reduce the overall level of education expenditures.[7] The likelihood of this event is greater if the education premium is strongly related to family background and if the education system is not inclusive.

The paper's contribution is twofold: on the one hand, it contributes to the theoretical literature by modelling individual preferences for public education by taking explicitly into account the hierarchical nature of the education system; on the other, it contributes to understanding the documented differences in education systems across OECD countries, in particular it might help to explain why some countries seem to remain stuck in "low education" traps.

The paper is organized as follows. Section 2 presents some descriptive evidences on the main features characterizing educational systems across OECD countries. We focus in particular on public and private expenditures on different education tiers. In section 3, we present a model ….. Section 4 contains a discussion of the results, some policy implications, and indicates directions for future research.

2. Stylized facts

In this section, we provide evidence on the variation of education systems across OECD countries, focusing on expenditures (levels and composition) and source of financing (private vs. public).[8]

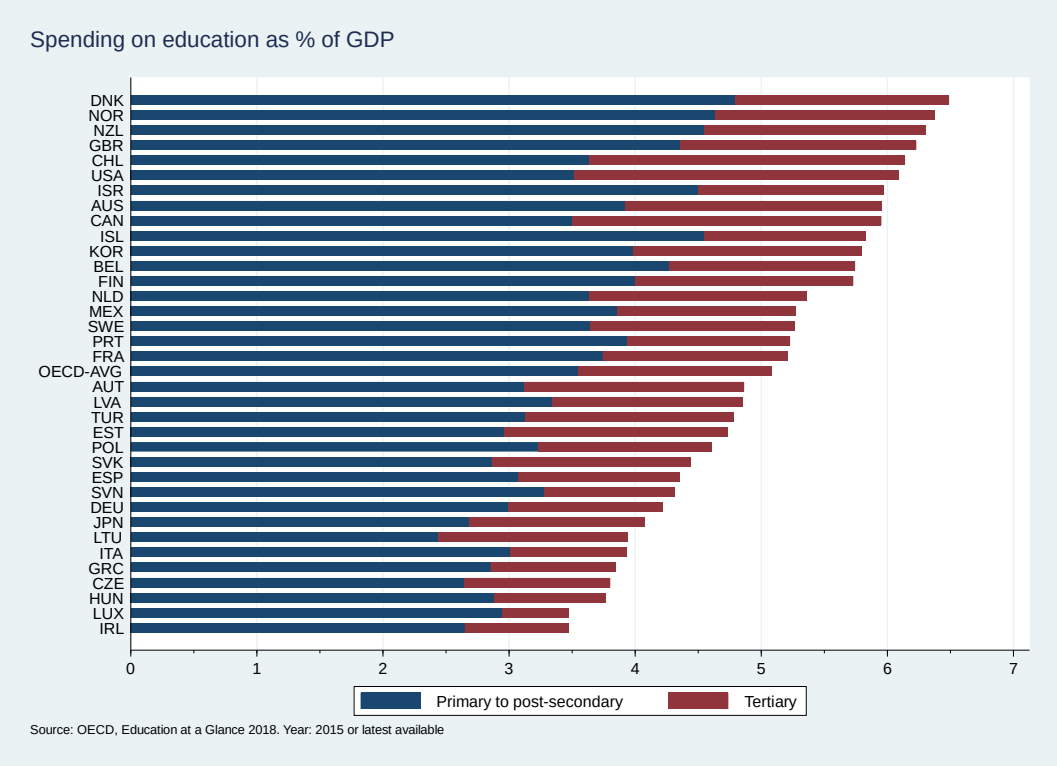
Figure 1 shows countries' differences in terms of spending on education as a share of GDP, regardless of the funding system. The OECD average share is 5.2%; seven countries (Ireland, Luxembourg, Hungary, Czech

[7]See on this point Apple and Romano (1996).

[8]Data are taken from OECD (2018). A summary table, at the end of the paper, summarizes all the original variables used for the following descriptive analyses.

Republic, Greece , Italy and Lithuania) spend less than 4%, while top spenders (Denmark, Norway, New Zealand, Great Britain, Chile and USA) allocate more than 6% of their GDP to education.[9]

Figure 1: Education expenditures as a share of GDP

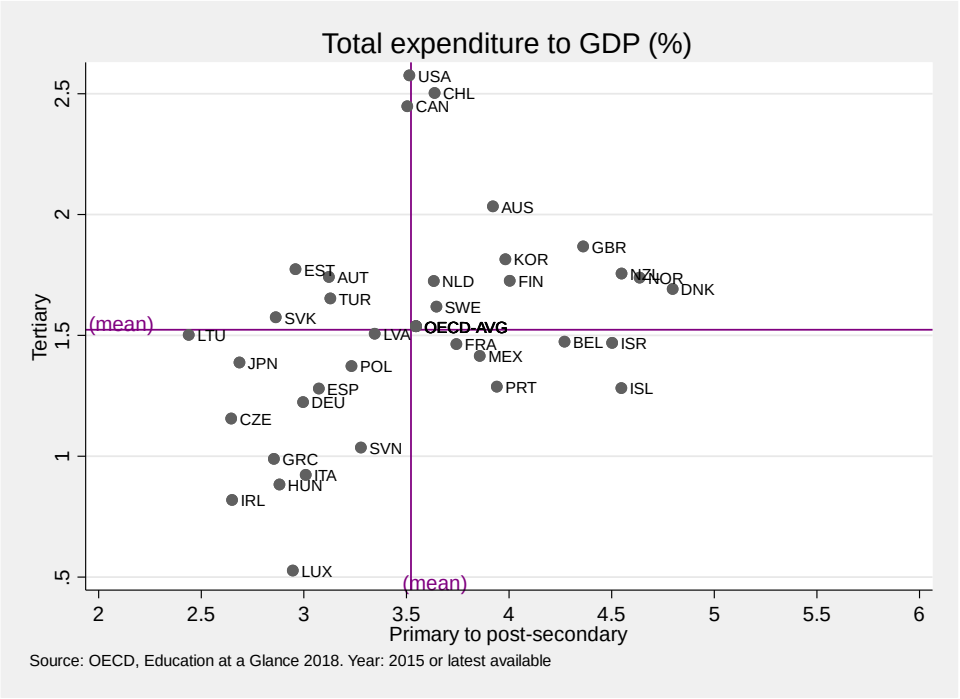


As expected, on average the greater share of spending is allocated to non-tertiary education: [10] 3.7% of GDP compared to 1.5% of GDP to tertiary education. Relative to the average, we find a certain variation across countries in the distribution of this flow of resources between the two tiers of education. This is summarized in figure 2, which plots total expenditures in tertiary and non-tertiary education as a share of GDP. While the scattered points cover all four regions formed by the intersection of the two lines representing the average values, most countries are either at the bottom left or top right. This indicates the presence of a positive

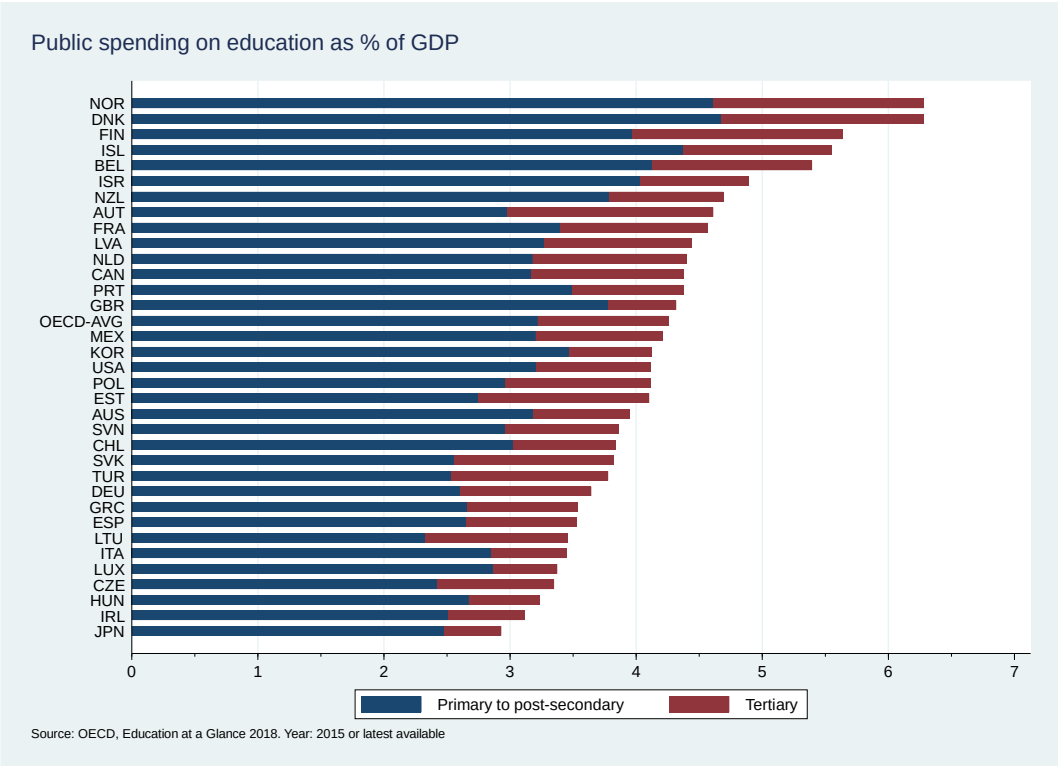
[9]Please note that if two countries differ in terms of per-capita GDP and demographic structure, a given share of spending corresponds to different levels of spending per student (see summary table at the end of the paper). For this reason, we have eliminated Luxemburg, which is too much of an outlier in terms of GDP per capita.

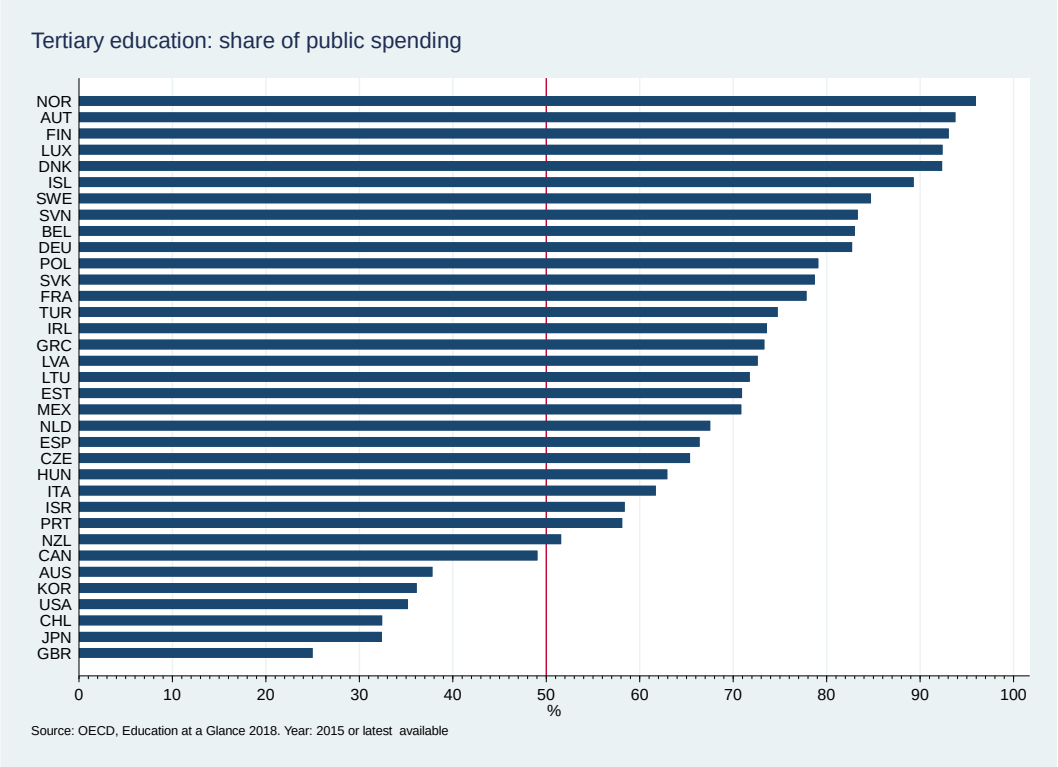
[10] Hereafter we use the term *basic* or *non–tertiary* to indicate K-12 education.

correlation between the two spending tiers.

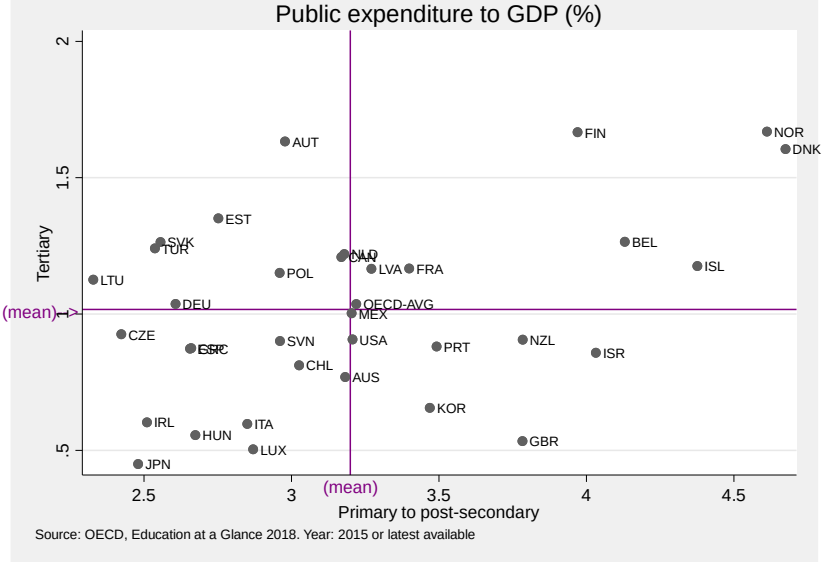


Looking at the source of funding, figure 3 plots public expenditures in tertiary and non-tertiary education as a share of GDP. While basic education is everywhere almost entirely publicly funded, huge disparities exist in the degree of public funding of tertiary education (figure 4).





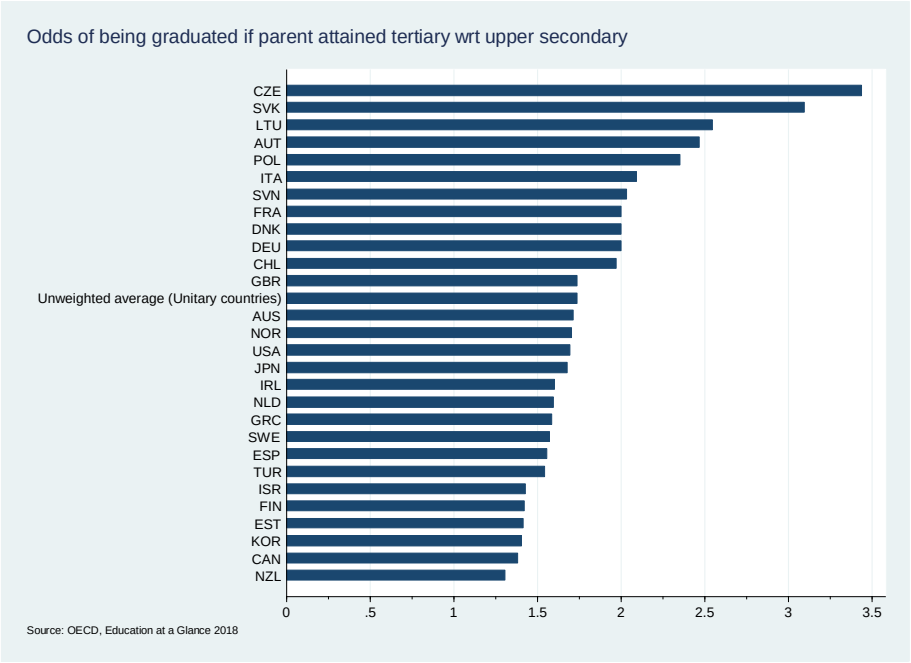
Lastly, figure 5 plots public expenditures on tertiary and non-tertiary education as a share of GDP. Similarly, to figure 2, although the scattered points are slightly more widespread over the four regions, a certain positive correlation emerges between public spending on the two tiers of education.



Looking simultaneously at the level, the composition and the source of funding (figures 1-5), we see that some countries (Czech Republic, Hungary, Luxembourg, Ireland Greece, Spain, Italy, Japan, Slovakia) are low-spenders on both education levels and from both funding sources. On the other hand, high spending countries

have different ways of allocating expenditures as for the proportion of private versus public financing and the expenditure composition (basic vs tertiary). Some (Norway, Denmark, Finland, Iceland and Belgium) are high spenders on both education levels. They spend around 6% of GDP in education, almost entirely publicly financed. Others (Canada, Chile and USA) favour tertiary education - above 2% of GDP - with a high share of private financing. Another group (France, Belgium, Israel, Mexico, Portugal and Iceland) consists of countries that spend more than the average on basic education - around 4% of GDP - with a prevalence of public funding. To understand the above documented differences in education systems, in this paper we follow a political economy approach and argue that these differences are the outcome of a political process that aggregates conflicting preferences for education. In the next section, we develop a model of preferences over basic and tertiary education focusing on individual characteristics and country level features. In particular, we stress the role of income inequality and of the inclusiveness of the education system as possible determinants of the intensity of conflict on the two dimensions of individual heterogeneity we consider (income and human capital). To this purpose, we consider the disposable income Gini index as a measure of the intensity of the income redistributive conflict and the country-level "odds of being graduated if at least a parent attained tertiary with respect to upper secondary" as a measure of the inclusiveness of the education system, which is meant to reflect the intensity of the human capital conflict (figure 6).[11]A high value of this variable is interpreted as low inclusiveness of the education system and an indication of a strong conflict between highly and low educated individuals.

[11] As an alternative, we have also considered the "odds of being graduated if at least a parent attained tertiary with respect to less than secondary"



Section 3: The model

In the economy, there is a continuum of families of measure one. A family consists of a parent (old agent) and a child (young agent). Old agents are endowed with an exogenous income Y_j, consume and make educational transfers to their children.[12] Young agents get educated in a hierarchical schooling system in which basic (K-12) education might be followed by tertiary education. The educational transfer is distributed over the two educational stages and the family allocates the transfer in order to maximize expected utility derived from family consumption and returns from the human capital accumulated by the offspring.

Old agents are heterogeneous along two dimensions: income and human capital. Income is distributed in the old population according to a given distribution function with mean Y. Human capital, indexed by i, is high ($i=H$) if the parent has graduated from university and low ($i=L$) if the parent has not obtained a university degree. We assume that a fraction k of the old agents has a university degree.

Child's future income is determined by his accumulated human capital, which depends on public and private expenditures on education.[13] We assume that the elasticity of the child's income with respect to his human capital is higher for high-income families. The idea is that for a given level of human capital, the chances of finding a job, and a well-paid job, are higher for "connected" families, where family connections are supposed to be positively correlated with parent's income.

3.1 Human capital formation

[12]The educational transfer might be thought of as goods or time. In this last case, increased time with children reduces income endowment and, as in the case of investment in goods, reduce disposable income for consumption.

[13]Since our focus is on the role of the family and its 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 talent is randomly distributed among families. Note that, in the empirical estimates we argue that unobserved talent is one possible explanations for the variability in the income coefficient.

Human capital formation is modelled as a two-stage process. The first stage (basic education) is mandatory and corresponds to primary and secondary education. Parent's investment (B_{ij}) and Government's expenditures (B_G) are substitutes in the formation of a child's basic education.[14] Access to the second stage (tertiary education) requires the successful completion of a basic education final exam.[15] We assume that the minimum amount of basic education necessary to take the final exam ($\bar{B}$) is provided by public expenditures and for simplicity we normalize $\bar{B}$ to zero. [16]

Tertiary education expenditures, both private (T_{ij}) and public (T_G) augment basic education. Again, parent's investment and public expenditures are substitutes.

The probability of passing the basic education final exam and entering university is not the same for all children. We assume that children whose parent has a university degree pass the final exam with probability p_H,while if the parent is not graduated from university, the probability of successful completion of the final exam is p_L, with $0 \leq p_L < p_H < 1$.[17] The ratio $\frac{p_H}{p_L}$ can be interpreted as an indicator of the inclusiveness of the education system: the closer this ratio is to one, the less access to tertiary education is correlated to parents' education and the higher is the equality of opportunity in education.

Each child accumulates human capital according to the following production function, where, for simplicity, we assume the same elasticity (α) of basic and tertiary education:

$$h_{ij} = \begin{cases} (B_{ij} + B_G + \bar{B})^{\alpha}\left(T_{ij} + T_G\right)^{\alpha} & if\ tertiary\ education\ is\ completed \\ (B_{ij} + B_G + \bar{B})^{\alpha} & otherwise \end{cases} \quad (3.1)$$

where the indexes *i* and *j* identify, respectively, parent's education and income.

Given human capital, child's future income is given by

$$y_{ij} = {h_{ij}}^{\mu_j} \quad (3.2)$$

where, as discussed above, the elasticity $\mu_j \geq 1$ is higher for richer families.

[14]Parents' investment in education could be substitutes or complements with public expenditures. Glomm and Ravikumar (1992) and Kaganovich and Zilcha (1999) assume that public and private investment are complements, whereas Becker and Tomes (1986) that they are substitute. See Nordblom (2003) for a discussion and further references. In line with this literature, we assume that public education is the same for all children, that is we are excluding the possibility of "opting out". As will become clear below, since we are interested in preferences for public education expenditures, adding opting out would not alter the ranking of preferences. In fact, the first to opt out would be those with higher income who, in our model, always prefer zero public expenditures.

[15]We do not distinguish between access to tertiary education and its completion. In other words, for simplicity we assume that entering university implies that the degree is eventually obtained with certainty.

[16] This assumption simplifies our analysis and can be justified appealing to as a minimum provision of public education guaranteed by the Constitution.

[17]We are aware that these probabilities should depend on the quantity (and the quality) of public and private investment in basic education. For analytical tractability, we skip this aspect and assume exogenous probabilities. This assumption is less strong than it might seem. In fact, time and money on children's education are not wasted as their human capital positively depends on it. Moreover, if the probability of access to University increases with private expenditures, which in turn increase with income, this would imply that the gap in access probabilities between children of highly educated and those of low educated parents would decrease with income. Even if this gap were to close at the high end of the income distribution this would not change preferences for public education spending of the rich, as they always prefer zero spending (although it would change their private expenditures).

3.2 Public and Private educational expenditures

Total public education expenditures (TEE) are financed by a proportional income tax (τ) so the government budget constraint can be written as:

$$TEE = B_G + aT_G = \tau Y \tag{3.3}$$

where Y is the average income in the old population and $a = kp_H + (1-k)p_L$ indicates the fraction of the young population acceding to tertiary education.[18]

Following Glomm and Kaganovich (2003), we assume that the family utility function is logarithmic in consumption and child's future income, with relative weight γ measuring parent's altruism:[19]

$$U_{ij} = lnc_{ij} + \gamma lny_{ij} \tag{3.4}$$

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

$$c_{ij} + B_{ij} + T_{ij} = (1-\tau)Y_j \tag{3.5}$$

$$B_{ij}, T_{ij}, c_{ij} \geq 0 \tag{3.6}$$

In the appendix, we solve the family optimal choices of consumption and private investment in basic and tertiary education. At the optimum$(c_{ij}^*, B_{ij}^*, T_{ij}^*)$, families choose private expenditures to balance marginal benefit from basic and tertiary education, thus they spend relatively more on the level of education in which the Government spends less. Moreover, we show that (i) as income and connections increase, families spend more on both education levels; (ii) highly educated parents, spend more on tertiary education and less on basic education than low educated parents do.

3.3 Preferences for education

To derive preferences for public education expenditures, we write the family indirect utility as a function of the Government's choice variables:[20]

$$W_{ij}(B_G, T_G) = lnc_{ij}^* + \alpha\gamma\mu_j ln\left(B_{ij}^* + B_G\right) + \alpha\gamma\mu_j p_i ln\left(T_{ij}^* + T_G\right) \tag{3.7}$$

Substituting the optimal solution $(c_{ij}^*, B_{ij}^*, T_{ij}^*)$ found in the appendix in equation (A.4), we can compute net benefits from basic and tertiary public education:

$$\frac{\partial W_{ij}}{\partial B_G} = \left(1 - \frac{Y_j}{Y}\right) \frac{\left(1+\alpha\gamma\mu_j(1+p_i)\right)}{\left[Y_j + \left(1-\frac{Y_j}{Y}\right)(B_G) + \left(1-\frac{aY_j}{Y}\right)T_G\right]} \tag{3.8}$$

[18]In a dynamic model, we would have

$$a = k_{t+1} = k_t p_H + (1-k_t)p_L$$

which converges to

$$k^* = \frac{p_L}{1-(p_H - p_L)}$$

[19]See also Zilcha (2003), Bernasconi and Profeta (2012), Viane and Zilcha (2013) and Sarid (2017) for the same assumptions about the family's utility function.

[20]Given its budget constraints, the Government can choose only two variables.

$$\frac{\partial W_{ij}}{\partial T_G} = \left(1 - \frac{aY_j}{Y}\right) \frac{\left(1+\alpha\gamma\mu_j(1+p_i)\right)}{\left[Y_j+\left(1-\frac{Y_j}{Y}\right)(B_G)+\left(1-\frac{aY_j}{Y}\right)T_G\right]} \tag{3.9}$$

From (3.8), we see that net benefits from basic education are positive (negative) for families whose income is below (above) the average, suggesting that public spending in basic education is a way of redistributing income.

From (3.9), we see that net benefits from tertiary education are positive (negative) if income is lower (higher) than a threshold level $\frac{Y}{a}$, which depends positively on parents' average income and negatively on university enrolment in the young population (*a)*.[21] As for the intensity of preferences, it is easy to check that net benefits (losses) from basic education increase with the distance between family income and average income, and for tertiary education they increase with the distance between family income and the threshold level $\frac{Y}{a}$.

Thus, with regard to income, we have three groups of families: low ($Y_j < Y$), middle ($Y \leq Y_j < \frac{Y}{a}$) and high ($Y_j \geq \frac{Y}{a}$).[22] For simplicity, we set $\mu_j = \mu_L$, for $Y_j < Y, \mu_j = \mu_M$ for $Y \leq Y_j < \frac{Y}{a}$ and $\mu_j = \mu_H$ for $Y_j \geq \frac{Y}{a}$ $with\ \mu_L < \mu_M < \mu_H$.

Matching education (i= H, L) and income (j=L, M, H), we have five groups of families (high income families –shown in the last column- have the same preferences, regardless of parent's education). For each one of them we derive the preferences shown in the Table below, where $g_{ij} = \frac{\alpha\gamma\mu_j}{1+\alpha\gamma\mu_j(1+p_i)}$.

Table 1: Individual preferences for basic, tertiary and total education

	Low-income ($Y_j < Y$) $\mu_j = \mu_L$	Middle-income($Y \leq Y_j < \frac{Y}{a}$) $\mu_j = \mu_M$	High-income ($Y_j \geq \frac{Y}{a}$) $\mu_j = \mu_H$
Low education *(i=L)*	$B_G = g_{LL}Y$ $aT_G = g_{LL}p_LY$ $TEE = g_{LL}(1+p_L)Y$	$B_G = 0$ $aT_G = g_{LM}p_LY$ $TEE = g_{LM}p_LY$	$B_G = 0$ $aT_G = 0$ $TEE = 0$
High education *(i=H)*	$B_G = g_{HL}Y$ $aT_G = g_{HL}p_HY$ $TEE = g_{HL}(1+p_H)Y$	$B_G = 0$ $aT_G = g_{HM}p_HY$ $TEE = g_{HM}p_HY$	$B_G = 0$ $aT_G = 0$ $TEE = 0$

Excluding high-income families, whose preferences are fully driven by their position on the income ladder, we see that, for any given level of income, parents' education positively (negatively) affects support for tertiary (basic) education. Since access to tertiary education is higher for children from highly educated families, they tend to prefer a higher level of tertiary education expenditures and a lower level of basic education expenditures than low-educated families with the same income. Overall, support for education (basic plus tertiary) increases with education. Turning to the effect of income on preferences, this depends on which education level is

[21]Being connected and/or highly educated does not change preferences, but it increases net benefits (or losses) from each education level.

[22]The gross enrolment rate in 2006 ranges from 46% in Switzerland to 93% in Finland (OECD 2012). Accordingly, while definition of middle income for Switzerland would include families whose income is between the average and twice the average, for Finland, this group would include families with income around the mean.

considered: low-income families prefer comparatively more spending on basic education, while middle-income families prefer comparatively more spending on tertiary education.23 The total effect is ambiguous and depends on parameters value (The reason is that, differences in the premium for education, which is positively related to family income, mitigate the redistributive content of education expenditures and thus the negative effect of income on preferences. In a more complex (and realistic) setting in which the probability of access to university would depend not only on parental education but also on family income (through for example private expenditures on children education) an additional effect would increase middle-income families' support for education expenditures. Finally, it is important to note that preferences for public expenditures in education depend also on the human capital formation technology parameter (α) other than on the premium to education (μ_j). Both these parameters are at least partially country-specific, being related to the productive and social structure of the country itself.

To see how conflicting preferences are composed in (a political) equilibrium, one would have to consider the conflict on each dimension of heterogeneity (income and human capital), which in turn depends on inequality in that dimension. …

In the next section, we relate the spending characteristics of the education system to variables measuring inequality in income and in (access to) education.

4.

In this section …

We use the Gini index to measure (disposable) income inequality and the "odds of being graduated if at least a parent attained tertiary with respect to upper secondary" as an indication + the conflict between educated and non-educated. A high value of this variable indicates low inclusiveness of the education system. The variation of both these variables across countries can be found in the summary table at the end of the paper.

Although the small number of observations does not allow any type of causal or simply robust inference, the SUR estimation presented in table XX shows the contemporary covariances between spending variables and measures of conflict, controlling for the residual correlation. Looking at the Table, the first equation shows a clear-cut negative correlation between public education spending as a share of GDP and both the income Gini index and the stratification of the education system in the 26 OECD countries considered. The second equation reveals a significant contemporary negative correlation between the share of public financing of education and the Gini index. Finally, the third equation shows a (small and barely significant) negative correlation between the share of tertiary to total public education spending and the inclusiveness of the education system. These

[23] In the extreme case, if p_L=0, the preferences for tertiary education of low-income and low educated individuals coincide with those of rich families.

correlations are consistent with the hypotheses – based on our model's results - that high inequality should be associated with less public spending (especially in tertiary) and low inclusiveness with proportionally more public spending on tertiary. THE

Table XXX

Maximum likelihood seemingly unrelated regressions

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Mixed-process regression                        Number of obs     =         26
                                                LR chi2(6)        =      29.45
Log likelihood =  52.065595                     Prob > chi2       =     0.0001

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
1. Total public education expenditures
        gini |  -8.242455   2.400038    -3.43   0.001    -12.94644   -3.538467
  oddstry2sec |  -.7586764   .2333556    -3.25   0.001    -1.216045   -.3013078
       _cons |    8.33906   1.008574     8.27   0.000     6.362291    10.31583
-------------+----------------------------------------------------------------
2. Public spending share on education
        gini |  -1.303792   .2870292    -4.54   0.000    -1.866359    -.741225
oddstry2nosec |   .0016365   .0039417     0.42   0.678    -.0060891    .0093621
       _cons |   1.243561   .0978654    12.71   0.000     1.051749    1.435374
-------------+----------------------------------------------------------------
3. Tertiary public share on total public
        gini |  -.0846276   .2135487    -0.40   0.692    -.5031755    .3339202
  oddstry2sec |   .0318086   .0200539     1.59   0.113    -.0074964    .0711136
       _cons |   .2181243   .0884946     2.46   0.014     .0446781    .3915706
-------------+----------------------------------------------------------------
      rho_12 |   .2537957   .1879444                    -.1334582     .573814
      rho_13 |    .132062   .1926996                    -.2463755    .4755563
      rho_23 |   .5032339   .1473838                     .1652681     .735432
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4. 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 of individual preferences emphasizing income and education heterogeneity, thus relating individual preferences to country-level characteristics such as income inequality and inclusiveness of the education system. Based on our model results, on the empirical evidence presented in section 2 and the correlations in section 3, the main policy message of our analysis is that focusing on public expenditures to favour equality of opportunities in education is not enough. In fact, how these expenditures are allocated to different education stages and also the specific design of the education system are crucial dimensions in shaping the outcome. Both these aspects determine how resources are distributed across the population and thus the degree of equality of opportunities achieved. Furthermore, from a political economy perspective, our theoretical analysis of preferences highlights the fact 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 education premium is strongly related to family ties and/or 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.

Appendix 1: *Private expenditures in education and Preferences for public education expenditures*

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

$$EU_{ij} = lnc_{ij} + \gamma\left\{p_i ln\left[(B_{ij}+B_G)^{\alpha}(T_{ij}+T_G)^{\alpha}\right]^{\mu_j} + (1-p_i)ln\left[(B_{ij}+B_G)^{\alpha}\right]^{\mu_j}\right\}=$$
$$= lnc_{ij} + \alpha\gamma\mu_j ln(B_{ij}+B_G) + \alpha\gamma\mu_j p_i ln(T_{ij}+T_G)$$

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

$$c_{ij} + B_{ij} + T_{ij} = (1-\tau)Y_j$$
$$B_{ij}, T_{ij}, c_{ij} \geq 0$$

The first order conditions are:

$$\frac{\partial EU_{ij}}{\partial B_{ij}} = \frac{-1}{c_{ij}} + \frac{\alpha\gamma\mu_j}{B_{ij}+B_G} \leq 0 \qquad \text{(A.1)}$$

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

$$\frac{\partial EU_{ij}}{\partial T_{ij}} = \frac{-1}{c_{ij}} + \frac{\alpha\gamma\mu_j p_i}{T_{ij}+T_G} \leq 0 \qquad \text{(A.2)}$$

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

If $Bij > 0$ condition (A.1) holds with equality: the marginal utility loss from reduced consumption is equal to the marginal utility gain from increased child's income. If condition (A1) holds as inequality, we have a corner solution in which $B_{ij} = 0$. The family would reduce B_{ij} because B_G provides enough education for the child. Analogously, if $T_{ij} > 0$ condition (A.2) holds with equality: the marginal utility loss from reduced consumption is equal to the marginal utility gain from increased child's income. If condition (A.2) holds as inequality, then we have a corner solution in which $T_{ij} = 0$. The family would reduce T_{ij} because T_G provides enough education for the child.

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

$$B_{ij}^* = g_{ij}\left[(1-\tau)Y_j + T_G\right] - \left(1-g_{ij}\right)B_G$$
$$T_{ij}^* = g_{ij}p_i\left[(1-\tau)Y_j + B_G\right] - \left(1-g_{ij}p_i\right)T_G \qquad \text{(A.3)}$$
$$c_{ij}^* = \left[1-g_{ij}(1+p_i)\right]\left[(1-\tau)Y_j + B_G + T_G\right]$$

with $g_{ij} = \frac{\alpha\gamma\mu_j}{1+\alpha\gamma\mu_j(1+p_i)}$.

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

$$W_{ij}(\tau, B_G, T_G) = lnc_{ij}^* + \alpha\gamma\mu_j ln(B_{ij}^* + B_G) + \alpha\gamma\mu_j p_i ln(T_{ij}^* + T_G) \qquad \text{(A.4)}$$

Given its budget constraint, the Government can choose only two variables. Substituting for $\tau = \frac{B_G + aT_G}{Y}$ in the optimal solution $(c_{ij}^*, B_{ij}^*, T_{ij}^*)$, gives

$$B_{ij}^* + \bar{B} + B_G = g_{ij}\left[Y_j + \left(1-\frac{Y_j}{Y}\right)B_G + \left(1-\frac{aY_j}{Y}\right)T_G\right]$$
$$T_{ij}^* + T_G = g_{ij}p_i\left[Y_j + \left(1-\frac{Y_j}{Y}\right)B_G + \left(1-\frac{aY_j}{Y}\right)T_G\right]$$
$$c_{ij}^* = \left[1-g_{ij}(1+p_i)\right]\left[Y_j + \left(1-\frac{Y_j}{Y}\right)B_G + \left(1-\frac{aY_j}{Y}\right)T_G\right]$$

which substituted in equation (A.4) gives

$$W_{ij}(B_G, T_G) = ln\left[1-g_{ij}(1+p_i)\right]\left[Y_j + \left(1-\frac{Y_j}{Y}\right)B_G + \left(1-\frac{aY_j}{Y}\right)T_G\right]$$
$$+ \alpha\gamma\mu_j ln\left\{g_{ij}\left[Y_j + \left(1-\frac{Y_j}{Y}\right)B_G + \left(1-\frac{aY_j}{Y}\right)T_G\right]\right\} +$$

$$+\alpha\gamma\mu_j p_i ln\left\{g_{ij}p_i\left[Y_j+\left(1-\frac{Y_j}{Y}\right)B_G+\left(1-\frac{aY_j}{Y}\right)T_G\right]\right\}$$

The net benefits from public education expenditures are easily computed:

$$\frac{\partial W_{ij}}{\partial B_G}=\left(1-\frac{Y_j}{Y}\right)\frac{\left(1+\alpha\gamma\mu_j(1+p_i)\right)}{\left[Y_j+\left(1-\frac{Y_j}{Y}\right)B_G+\left(1-\frac{aY_j}{Y}\right)T_G\right]} \tag{A.5}$$

$$\frac{\partial W_{ij}}{\partial T_G}=\left(1-\frac{aY_j}{Y}\right)\frac{\left(1+\alpha\gamma\mu_j(1+p_i)\right)}{\left[Y_j+\left(1-\frac{Y_j}{Y}\right)B_G+\left(1-\frac{aY_j}{Y}\right)T_G\right]} \tag{A.6}$$

From (A.5) and (A.6), we see that, for any given level of education (characterised by p_i), we have three groups of families: low-income ($Y_j < Y$), middle-income ($Y < Y_j < \frac{Y}{a}$) and high-income ($Y_j > \frac{Y}{a}$).

Since their net benefits are positive, *low-income families* prefer the maximum level of public expenditures in both basic and tertiary education (see A.5 and A.6). To compute these preferred values, note that increasing B_G and T_G would imply a corner solution for private expenditures, that is: $B_{ij}^* = T_{ij}^* = 0$.

In this case, $c_{ij}^* = (1-\tau)Y_j = \left(1-\frac{B_G+aT_G}{Y}\right)Y_j$ and

$$W_{ij}(B_G,T_G) = ln\left(1-\frac{B_G+aT_G}{Y}\right)Y_j + \alpha\gamma\mu_j lnB_G + \alpha\gamma\mu_j p_i lnT_G$$

To find the preferred level of public education expenditures write the first order conditions:

$$\frac{\partial W_{ij}}{\partial B_G}=\frac{-1}{\left(1-\frac{B_G+aT_G}{Y}\right)Y}+\frac{\alpha\gamma\mu_j}{\bar{B}+B_G}=0$$

$$\frac{\partial W_{ij}}{\partial T_G}=\frac{-a}{\left(1-\frac{B_G+aT_G}{Y}\right)Y}+\frac{\alpha\gamma\mu_j p_i}{T_G}=0$$

Solving, gives $aT_G = g_{ij}p_iY$ and $B_G = \frac{aT_G}{p_i} = g_{ij}Y$.

Middle-income families prefer $B_G = 0$ and the maximum level of public expenditures in tertiary education (see A.5 and A.6). That is, they prefer to privately provide basic education to their children and have the Government pay for tertiary education. To compute their preferred level of public expenditure in tertiary education, notice that increasing T_G would imply a corner solution for private expenditures in tertiary education: $T_{ij}^* = 0$.

In this case, $c_{ij}^* = (1-\tau)Y_j - B_{ij}^*$ and $B_{ij}^* = g_{ij}\left[(1-\tau)Y_j + T_G\right] - \left(1-g_{ij}\right)\bar{B}$

and

$$W_{ij}(\bar{B},T_G) = lnc_{ij}^* + \alpha\gamma\mu_j lnB_{ij}^* + \alpha\gamma\mu_j p_i lnT_G$$

Substituting c_{ij}^* and B_{ij}^*, the first order condition $\left(\frac{\partial W_{ij}}{\partial T_G}=0\right)$ gives

$$aT_G = g_{ij}p_iY$$

Lastly, *high-income families* prefer $B_G = 0$ and T_G=0, because they prefer to privately provide basic and tertiary education to their children (see A.5 and A.6).

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Country	Year	(1) Total education spending/GDP	(2) Tertiary spending/GDP	(3) K12 spending/GDP	(4) Total public spending on education /GDP	(5) Public spendig on tertiary /GDP	(6) Public spending on K12/ GDP	(7) Share of tertiary spending [(2)/(1)]	(8) Share of private education spending on total	(9) 25-64 tertiary pop.	(10) Gini disposable income	(11) Odds of being graduated if parent attained tertiary wrt upper secondary*	(12) Odds of being graduated if parent attained tertiary wrt less than upper secondary*
AUS	2014	5.80	3.95	1.85	3.93	3.21	0.72	0.32	0.32	41.90	0.34	1.72	2.68
AUT	2015	4.86	3.12	1.74	4.61	2.98	1.63	0.36	0.05	30.55	0.28	2.47	4.20
BEL	2015	5.74	4.27	1.47	5.40	4.13	1.27	0.26	0.06	36.86	0.27		
CAN	2015	5.95	3.50	2.45	4.38	3.17	1.21	0.41	0.26	55.17	0.32	1.38	2.00
CHL	2015	5.21	3.18	2.03	3.35	2.63	0.72	0.39	0.36	22.48	0.45	1.97	5.58
CZE	2015	3.80	2.65	1.16	3.35	2.42	0.93	0.30	0.12	22.19	0.26	3.44	18.33
DEU	2015	4.22	3.00	1.22	3.64	2.61	1.04	0.29	0.14	27.64	0.29	2.00	3.87
DNK	2014	6.49	4.80	1.69	6.28	4.68	1.61	0.26	0.03	35.80	0.26	2.00	2.54
ESP	2015	4.35	3.07	1.28	3.53	2.66	0.87	0.29	0.19	35.08	0.35	1.56	3.04
EST	2015	4.73	2.96	1.77	4.10	2.75	1.35	0.37	0.13	38.03	0.33	1.42	2.35
FIN	2015	5.73	4.00	1.73	5.64	3.97	1.67	0.30	0.02	42.74	0.26	1.43	2.03
FRA	2015	5.21	3.74	1.46	4.57	3.40	1.17	0.28	0.12	34.09	0.30	2.00	4.24
GBR	2015	6.23	4.36	1.87	4.32	3.78	0.53	0.30	0.31	44.20	0.36	1.74	3.32
GRC	2015	3.84	2.85	0.99	3.54	2.66	0.88	0.26	0.08	29.06	0.34	1.59	3.82
HUN	2014	3.76	2.82	0.94	3.35	2.69	0.66	0.25	0.11	23.36	0.29		
IRL	2015	3.47	2.65	0.82	3.11	2.51	0.60	0.24	0.10	42.81	0.30	1.60	3.45

ISL	2014	5.92	4.64	1.28	5.63	4.46	1.17	0.22	0.05	37.09	0.25		
ISR	2015	5.97	4.50	1.47	4.89	4.03	0.86	0.25	0.18	48.82	0.36	1.43	2.48
ITA	2015	3.93	3.01	0.92	3.45	2.85	0.60	0.23	0.12	17.55	0.33	2.10	10.83
JPN	2015	4.07	2.69	1.39	2.93	2.48	0.45	0.34	0.28	49.54		1.68	3.08
KOR	2015	5.80	3.98	1.82	4.13	3.47	0.66	0.31	0.29	45.36	0.30	1.41	2.81
LTU	2015	3.94	2.44	1.50	3.45	2.33	1.13	0.38	0.12	38.72	0.37	2.55	3.92
LUX	2015	3.47	2.95	0.53	3.37	2.87	0.50	0.15	0.03	39.79	0.31		
LVA	2015	4.85	3.35	1.51	4.44	3.27	1.17	0.31	0.09	31.59	0.35		
MEX	2014	5.28	3.87	1.42	4.20	3.19	1.01	0.27	0.21	16.00	0.46		
NLD	2015	5.36	3.63	1.73	4.40	3.18	1.22	0.32	0.18	35.33	0.29	1.60	2.91
NOR	2015	6.38	4.64	1.74	6.28	4.61	1.67	0.27	0.01	42.71	0.27	1.70	2.63
NZL	2014	6.33	4.54	1.79	4.68	3.76	0.91	0.28	0.26	35.63	0.35	1.31	1.79
POL	2015	4.61	3.23	1.37	4.11	2.96	1.15	0.30	0.11	27.75	0.29	2.35	8.11
PRT	2015	5.23	3.94	1.29	4.37	3.49	0.88	0.25	0.16	22.86	0.34		
SVK	2015	4.44	2.86	1.58	3.82	2.56	1.26	0.35	0.14	21.15	0.25	3.10	10.83
SVN	2015	4.31	3.28	1.04	3.86	2.96	0.90	0.24	0.10	30.17	0.25	2.03	6.78
SWE	2015	5.27	3.65	1.62			1.44	0.31		39.79	0.28	1.58	2.48
TUR	2015	4.78	3.13	1.65	3.78	2.54	1.24	0.35	0.21	18.02	0.40	1.54	7.10
USA	2015	6.09	3.51	2.58	4.11	3.21	0.91	0.42	0.32	44.63	0.39	1.69	4.69
Unweighted average (Unitary countries)												1.74	3.30
Mean Values		5.01	3.51	1.50	4.21	3.19	1.03	0.30	0.16	34.41	0.32	1.87	4.66

Source: OECD.Stat.(2018)
Notes: *This variables refer to 2012