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# Do pensions foster education? An empirical perspective

Gianko Michailidis  
Concepció Patxot  
Meritxell Solé Juvés



UNIVERSITAT DE  
BARCELONA

## Do pensions foster education? An empirical perspective

**Abstract:** In this paper we examine the effect of the demographic transition on public education, pension spending and the interaction between them. In particular, we investigate the theoretical prediction that the structure of PAYG pension systems, alongside population ageing, offers incentives for the working-age generation to invest in the public education of the young in order to "reap" the benefits of their higher productivity in the future, translated into higher income tax/contributions. The empirical evidence resulting from the application of the fixed effects approach to panel data for OECD countries shows that the increasing share of elderly people has non-linear effects on both retirement and education spending. The former suggests that political pressure to increase benefits turns out to have no effect when the ageing process is strong enough to compromise the fiscal budget and the latter indicates a certain degree of generational conflict. Nevertheless, our results suggest that a positive link arises when examining the connection between education and pensions by using the projected old dependency ratio. A more detailed analysis of total education expenditure shows that only the non-mandatory educational levels benefit from the future population ageing.

JEL Codes: H52, H53, H55, I22, J11.

Keywords: Public Finance, Population ageing, Education, Pension Politics, PAYG, Macroeconomics.

Gianko Michailidis  
Universitat de Barcelona

Concepció Patxot  
Universitat de Barcelona

Meritxell Solé Juvés  
Universitat de Barcelona

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# 1 Introduction

The welfare state has been extending its action from mere monetary transfers for poverty reduction to wider programmes, such as providing basic social goods (education and health) and income substitution programmes, such as pensions, with a high insurance component. Interestingly, in a way, this process leads to the gradual substitution of private intergenerational transfers from the public sphere. Government intervention in this case goes beyond intra-generational redistribution, introducing intergenerational redistribution. In fact, two of the most important policies are public education and pensions, which focus directly on both sides of dependency (children and the elderly). In particular, the size of public pensions in OECD countries in 2010 was on average 7.3% of GDP and expenditure on public education was on average 5.6% of GDP.

Parallel to this, population ageing is becoming an issue of increasing concern, especially as the generations of “baby boomers” reach retirement age, putting considerable pressure on current pay-as-you-go (PAYG) pension systems. More specifically, in 2010 the old age dependency ratio for the average of OECD countries was 22.4% and is expected to be 43.4% by 2040. The driving forces behind population ageing are the decreased fertility rate - preceded by the post-war “baby boom” - and increased life expectancy. Among other things, the latter is a result of better-quality services due to technological progress in the healthcare system. The former can be seen as a result of the increasing opportunity cost for women to have children in developed economies.<sup>1</sup>

The literature on intergenerational transfers has experienced considerable development due to the demographic transition. Demographic variables interact with economic variables, becoming endogenous to the economic system. The nature and magnitude of this link depend on the behavioural norms and expectations within societies and families regarding transfers to/from other generations. Therefore, the investigation of intergenerational transfers implies considering, more or less explicitly, hypotheses about the motives for private transfers and government intervention. The transfer motives might go from forward and backward altruism to strategic behaviour or, following the recent literature on endogenous preferences, they can be due to reciprocity.<sup>2</sup> Nevertheless, even on using micro data, it is very difficult to identify these

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<sup>1</sup>In Galor and Weil (1996), this is forced by a higher increase in female wages with respect to household income. Other potential channels are the increase in human capital investment per child and the quantity-quality trade-off à la Becker [Becker et al. (1990); Galor and Weil (2000)]

<sup>2</sup>Michel et al. (2006) for a survey on forward and backward altruism in the context of neoclassical growth models;

motives. The political economy literature is not an exception to this trend. More importantly, this literature somehow converges with the literature on intergenerational transfers by investigating the link between forward and backward intergenerational transfers in the absence of altruism. This link is quite intuitively present in the family but not necessarily in government action.

In the framework of a representative democracy and in the absence of intergenerational altruism, governments try to maximize political support. In order to do so, their policies are shaped by the desire of the majority of voters. This majority mainly consists of middle-aged workers and pensioners who might favour policies such as public pensions rather than public education, through a more generous reallocation of funds towards the elderly than towards the young. This prediction is well known in the literature as “generational conflict” or “elderly power” hypothesis, and it is especially reinforced under population ageing. In contrast to this hypothesis the “fiscal leakage” hypothesis predicts that population ageing exerts strong fiscal pressure on the pay-as-you-go (PAYG) pension system inducing working-age voters to favour smaller pensions.

However, when we consider both pensions and education programmes simultaneously, other mechanisms may arise. More specifically, the structure of the PAYG pension system, combined with the demographic transition, creates incentives to invest in public education. Higher spending on public education “today” can improve the productivity and consequently the wages of the workers that will pay for the pensions “tomorrow”. Hence, the working-age generation, foreseeing the benefits from the contribution rates of future workers, has an appreciable incentive to invest in the education of the young generation. Therefore, the design of the PAYG pension system creates a link between public education and public pensions. According to our findings, this link is enhanced when there is a projected worsening of population ageing in the future.

In this paper, our main goal is to examine the effect of population ageing on public education, public pensions and the potential link between these public policies. First, regarding public pensions, the impact of an increasing share of elderly people has a non-linear effect on individual retirement benefits. This suggests that political pressure to increase benefits turns out to have no effect when the ageing process is strong enough to compromise the fiscal budget. Second, population ageing appears to be negatively related to education expenditure, indicating a certain degree

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[Laferrere and Wolff \(2006\)](#) for a survey on the motives for private transfers; and [Fehr and Schmidt \(2006\)](#) for a detailed survey on altruism and endogenous preferences (others regarding preferences).

of generational conflict. However, it seems that the impact of population ageing on public education spending depends on the level of retirement spending. Third, we present empirical evidence in favour of the link between pensions and education. More specifically, we suggest that, considering the projected population ageing, the structure of the PAYG pension system provides incentives to the working-age generation to support educational transfers towards the young generation even in the absence of altruism. Finally, by decomposing total education spending by level of education, we can see that only the non-mandatory educational levels benefit from the future population ageing, probably because there is space for government intervention to enhance labour productivity.

The structure of the paper is organized as follows. In the next section, we provide an overview of the existing theoretical and empirical literature on the political economy of social security (pensions) and education spending and on the link between these programmes. In the third section, we examine the effect of population ageing on public pensions. The fourth section is devoted to an investigation of the link between pension and education spending and to an examination of the "generational conflict" hypothesis. Also, in the same section we investigate the effect of the projected old dependency ratio on education expenditure by level of education. Finally, in the last section we provide our conclusions and suggest some issues for future research.

## 2 Literature Review

The first part of our literature review regards the theoretical literature on the political economy of social security, which is quite considerable. [Breyer \(1994\)](#) and [Galasso and Profeta \(2002\)](#) provide good reviews of this literature. According to the literature, the ageing process affects the social security system through two opposing channels. On the one hand, there is the aforementioned "fiscal leakage" hypothesis, which suggests that the increased proportion of elderly people decreases the expected profitability of pay-as-you-go pension systems for current working-age voters, thereby inducing them to favour lower current pensions. Therefore, the working-age generation repudiates the social security system [[Breyer and Stolte \(2001\)](#); [Razin et al. \(2002\)](#); [Razin and Sadka \(2007\)](#)]. On the other hand, population ageing makes the median voter older and hence more inclined to support higher expenses on pensions, the well-known in the literature "political power of elderly" hypothesis [[Browning \(1975\)](#); [Mulligan and Sala-i Martin \(1999\)](#); [Persson and Tabellini \(2000\)](#)]. Alternatively, [Castles 2004](#)) argues that the higher total spending on pensions is attributed to the design and

some specific characteristics of the social security system rather than to population ageing.<sup>3</sup> However, Castles admits that the cuts in pensions are negatively correlated with an increased political clout of the elderly.

[Browning \(1975\)](#) is the first to argue that increasing social security spending is due to political factors related to the age of the median voter. He considers an economy without capital markets where the pension system is the only capital investment. The demographic transition makes the median voter older and more willing to support higher benefits through higher contributions, resulting in an overspending ("above the long-run welfare maximizing level"). [Boadway and Wildasin \(1989\)](#), in an overlapping generation (OLG) framework of continuous-time, apply a median voter model with constrained capital market and stricter institutional and behavioural assumptions reaching almost the same conclusions. These early models assume static expectations as a way of commitment to past decisions and infrequent elections.

Later on, in a theoretical model with endogenous labour supply [Breyer and Stolte \(2001\)](#) find opposite results to the prediction of median voter. In particular, they show that the demographic transition leads to an increase in political power of the elderly who, in the belief of a further drop in the fertility rate, impose a higher labour income tax. However, because of the endogenous labour supply, the working generation reacts by decreasing the level of labour, leading to a decrease in the benefits that the retirees enjoy. Thus, equilibrium is characterized by higher contributions per capita but less total benefits. A similar result in relation to pension benefits is found by [Razin et al. \(2002\)](#) in the model with heterogeneous agents (skilled and unskilled).<sup>4</sup> The authors show theoretically and empirically that the ageing of the population leads to a political equilibrium with lower taxes or lower benefits. In contrast, [Shelton \(2008\)](#), by using the old dependency ratio instead of the total dependency ratio, replicates the regressions of [Razin et al. \(2002\)](#) and obtains the opposite results.<sup>5</sup> In addition, [Disney \(2007\)](#) challenges the main idea and the empirical findings of [Razin et al. \(2002\)](#), by arguing that their model is misspecified and the results are biased. Other empirical studies, [Breyer and Craig \(1997\)](#) and [Hollanders and Koster \(2012\)](#), notice that the size of the pension system increases with the age of the median voter<sup>6</sup>. However, both fail to support the hypothesis of increased political clout of the elderly translated into higher benefits per retiree. Alternatively, using the old dependency ratio [Mulligan and](#)

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<sup>3</sup>He examines 21 OECD countries over the period 1980-1998.

<sup>4</sup>This welfare state model is extended by [Razin and Sadka \(2007\)](#), who reach the same conclusions.

<sup>5</sup>The old dependency ratio is the ratio of population over 65 to the working-age (15-64) population. The total dependency ratio also includes the young-age (0-14) population in the numerator.

<sup>6</sup> [Hollanders and Koster \(2012\)](#), using the median age of the whole population as proxy for median age of the electorate.

Sala-i Martin (1999), Tabellini (2000), Disney (2007) and Tepe and Vanhuyse (2009) reach the same conclusion of a positive relationship with pensions, considering the size of the pension system rather than individual pensions.<sup>7</sup> However, Lindert (1996) argues that the effect of the old dependency ratio on both the size and the generosity of the system is non-linear. When the old dependency ratio is low, the relationship with pension spending is positive but, as the ratio increases over the years, after a certain point the sign of the relationship becomes negative. As Lindert highlights, this point is lower for individual spending than for total spending on pensions. In addition, Tepe and Vanhuyse (2009) and Razin et al. (2002) find negative effects of the old dependency ratio when they consider the benefits per retiree. Finally, the estimations of Shelton (2008) provide weak support for the hypothesis of the “political power of elderly”.

The second part of the literature discussion regards the political economy of public education, where many studies test the so-called “generational conflict” hypothesis. The intuition behind this hypothesis is simple. The old population has different preferences in comparison with the younger population and therefore they demand different allocations of public resources. In his studies, Poterba (1997,8) argues that, in the case of the US, the effect of gerontocracy on education outlays per child is negative. In addition, according to the author, the growing number of schoolchildren depresses the expenditure per child of primary and secondary education. The latter empirical result finds support in the study by Fernandez and Rogerson (1997), who use panel data for the US in order to examine the effect of enrolments on per-student spending.<sup>8</sup> Nonetheless, Ladd and Murray (2001) contest the approach of Poterba (1997) by suggesting that the use of local government instead of state-level data weakens the negative effect of the share of the elderly on per-student education or even makes it insignificant. Later on, Grob and Wolter (2007) use state-level data for the Swiss Cantons for the period (1990-2002).<sup>9</sup> Considering only primary and lower secondary education, the authors find that both the number of pupils and the share of retirees have a negative effect on per-student spending. A subsequent study by Borge and Rattso (2008), using panel data for local governments in Denmark, finds evidence in favour of the “generational conflict” hypothesis.

In contrast, Kemnitz (2000), in a context of a small open economy OLG model, shows the potential benefits of population ageing on education and pension spending levels. According to him, the reduced fertility rate itself has a positive impact on edu-

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<sup>7</sup>Tabellini (2000) uses the proportion of old people (65+) in the population instead of the old dependency ratio.

<sup>8</sup>They use data on primary and secondary education spending.

<sup>9</sup>In this case the local government data were unavailable.

education spending per student without increasing the budget constraint. Generally, the demographic transition achieves a better backward (pensions) and forward (education) redistribution of public funds. The main result of his study is that the structure of the PAYG pension system stimulates investments in education that provide future benefits for the currently working generation. [Gradstein and Kaganovich \(2004\)](#) reach similar conclusions, having a slightly different intuition. According to their model, as the old population grows there should be two antithetical effects on public education expenditure. On the one hand, there is a growing number of retirees who want to minimize the amount spent on education. On the other hand, there are working-age agents who anticipate two facts. First, they foresee that they are going to live longer because of the increase in longevity. Second, they realize that the increased number of retirees makes the pay-as-you-go system less generous in terms of spending per retiree. Having anticipated these facts, they will react by investing more in education in the current period in order to take advantage of the future higher productivity of currently young people. In this way, they pursue an increase in future tax revenues and endeavour to ensure a higher return on their savings in order to deal with the increased fiscal needs of a prolonged retirement period. The authors find that, even in the absence of altruistic linkages, the second effect is stronger and therefore the ageing process has a positive impact on the amount spent on education.<sup>10</sup> As we will discuss below, we find empirical evidence in favour of the second effect.

The last part of our overview of the literature considers the link between public education and pension spending more explicitly. Back in the late seventies, scholars already argued in favour of the existence of the link between forward and backward public intergenerational transfers by answering the question why selfish generations choose to transfer resources to future generations.<sup>11</sup> [Pogue and Sgontz \(1977\)](#) argue that the design of the PAYG pension system creates the appropriate incentives to invest in public education because it enhances the income of the future working generation. Following the same argument, [Konrad \(1995\)](#) explains that, even in the absence of altruism, the working-class generations are willing to pay for public education only if they can "reap" gains by taxing the results of the higher productivity in the future. In the framework of the OLG model, in which human and physical capi-

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<sup>10</sup>In contrast, [Poutvaara \(2006\)](#), using a model with heterogeneous productivity, suggests that the ageing of the population is expected to have a negative effect on public education spending as the political electorate of retirees rises.

<sup>11</sup>Independently from the link, [Sala-i Martin \(1995\)](#), in his positive theory of social security, argues that the social security exists to buy out the less productive old workers and eliminate the negative effect that they have on the productivity of others by replacing them with more productive young people in order to achieve higher aggregate output.



tal are both used in production, [Boldrin \(1992\)](#) provides a slightly different intuition. The decision to invest in education reflects positively on physical capital productivity because of its complementarity with human capital productivity. This in turn enhances the future return on savings and therefore offers higher future income to the current working-age generation.

In more recent years, adopting a game theoretical framework in their study of social security, [Boldrin and Rustichini \(2000\)](#) contend that working-age generations have incentives to tax income and finance pensions because, in this way, they can affect their total income upwards through future returns on savings. Also, the game theoretical framework is used a few years later by [Rangel \(2003\)](#) in order to study the possibility of sustaining a system of public forward and backward intergenerational transfers. He uses the concept of a sub-game perfect equilibrium in order to investigate, in the context of selfish generations, the ability of non-market intergenerational arrangements to invest optimally in forward and backward transfers. With the help of simple trigger strategies (STS) in a repeated voting setting, he concludes that the provision of education for the younger generation is optimal and sustained only when it is linked to sufficiently large transfers to the older generation. Along the same lines as the previous paper but in a different framework, [Boldrin and Montes \(2005\)](#) stress the link between public education and pensions. In the presence of credit constraints to finance education, financing only public education is not sufficient to restore efficiency because in order to do so an additional intergenerational trade arrangement is needed.

### 3 Public Pensions and Population Ageing

In this section of the paper, our investigation is focused on the determinants of the size (as a percentage of GDP) and generosity (expenditure per retiree) of the public pension system and how they are affected by demographic transition.

#### 3.1 Data

In line with the previous literature, we identify and use four main categories of variables.<sup>12</sup> Furthermore, we conduct a panel data analysis for 23 OECD countries<sup>13</sup> over the period 1980-2010. We use intervals of five years for the period instead of 1

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<sup>12</sup> Definitions and sources of the variables can be found in Table 11 in the Appendix.

<sup>13</sup> Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, U.K., U.S.

year in order to capture the political cycle in which pension reforms and changes in demographic structure usually take place.<sup>14</sup>

[Insert Table 1]

In Table 1, we show some descriptive statistics of the variables used in the analysis. As we can see, the first and the second variables capture the total amount of retirement spending measured as a percentage of GDP (RST) and retirement spending per retiree (RSPR), respectively. As we can observe from Table 1, the overall differences between countries and years are 2.34 % of GDP for total retirement spending and \$5650 for retirement spending per retiree. Regarding the former variable, the differences across countries are higher than the differences in the countries over years. However, in the case of the latter variable, the cross-country differences are smaller than the differences in countries over the years.<sup>15</sup>

The Old Dependency Ratio (ODR) is the population over 65 years old as a proportion of working-age population. This variable is a proxy for the number of retired people. It is expected that the retirees will claim a higher level of pensions through their voting power which is increasing. However, at the same time, the ageing process makes the PAYG pension system less generous towards retirees. Although the old dependency ratio is a good proxy for the political power of old people, it might not cover the real power of the elderly because it takes into account only the old people who are at retirement age (active pensioners). In order to capture all the people that might have an interest in claiming more generous pensions (or at least not pushing for cuts in pensions), we employ an additional proxy for the power of the elderly, the ratio of people above 55 years old over the working-age population that represents working-age people close to retirement age. Moreover, we incorporate into our model a variable that represents the future old dependency ratio. Specifically, we use the projected old dependency ratio in 30 years (2011-2031) in order to capture the reaction of the current political and economic system to the projected ageing process.

Furthermore, we include some macroeconomic and labour control variables: GDP per capita, real GDP growth rate, long-term interest rate on government bonds and unemployment rate. The first two represent the level of economic development and its growth. The interest rate shows us the borrowing cost in order to finance social policies like the PAYG pension system. Finally, the unemployment rate represents

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<sup>14</sup>In contrast with studies by [Breyer and Craig \(1997\)](#) and [Tepe and Vanhuysse \(2009\)](#) who use 10 and 8 years, respectively. In addition, the former use a random effects estimator and the latter use a fixed effects estimator.

<sup>15</sup>See Table 10 in the Appendix.

the percentage of people that do not contribute to the pension system because they are out of work. Also, we control for the openness of the economy, measured as total trade (sum of imports and exports) as a percentage of GDP. According to the “race to the bottom” hypothesis ([Castles, 2004](#)), governments reduce taxes and therefore pension outlays because they are translated into higher wage costs in order to become more competitive in exports. In addition, the trade union density is included and corresponds to the ratio of wage and salary earners that are trade union members, divided by the total number of wage and salary earners. The trade unions assert higher pensions for their members, which would normally push up the pension cost.

Last but not least, we incorporate two qualitative variables as political controls, the type of government and the government party (or government ideology). The former is a variable that takes values that represent five different types of government starting from the strongest type (=1, single party majority) to the weakest type (=5, multi-party minority). The latter represents the ideological spectrum of the government cabinet (also known as Schmidt-Index) and goes from the hegemony of right-wing and centre parties (=1) to the hegemony of social-democratic and other left-wing parties (=5).

### **3.2 Methodological Approach**

In order to estimate the effect of the demographic transition on retirement spending, we use the time fixed effects approach. Apart from the fact that in the particular empirical literature there is a consensus to use the fixed effects (FE) model, our intuition is that, given our data (23 OECD countries), the unobserved country specific characteristics - like tradition or the level of social altruism towards the elderly - might be correlated with the current and projected old dependency ratio (independent variables) and that may affect the level of retirement spending (dependent variable), making the OLS estimator both biased and inconsistent. Using FE, we deal with the large source of omitted variable bias by controlling the cross-country unobserved heterogeneity. An additional reason comes from the theoretical perspective. In order to explain how the electoral outcomes change spending on pensions, we need to exploit the within-countries (over-time) variation of the demographic variables rather than the between or cross-countries variation, considering the time-invariant unobserved differences between countries as fixed rather than random.

The empirical reasons behind the decision to use FE are derived from the diagnostic tests. More specifically, we conduct two tests introduced by [Breusch and](#)

Pagan (1980) and Hausman (1978) that lead us to choose the FE specification.<sup>16</sup> The former test reveals that there is variance of country-specific characteristics in our panel model and therefore we cannot use the pooled OLS estimator because it is inconsistent, as mentioned above. The latter test demonstrates that the correlation between the error term and the control variables is non-zero and, therefore, the main assumption in order to obtain a consistent random effects estimator is violated. Furthermore, we conduct additional diagnostic tests in order to investigate whether there is a correlation of idiosyncratic error terms across countries (cross-sectional dependence), within countries (auto-correlation) and whether the variance of the error terms is non-constant (heteroscedasticity).<sup>17</sup> These tests demonstrate that our errors are heteroscedastic but they are not serially or cross-sectionally correlated. By using heteroscedastic-robust (also known as Huber/White) standard errors, we overcome the problem of heteroscedasticity (biased standard errors).

Therefore, with the help of FE, we remove the effects of the time-invariant characteristics that exist across countries, and we can therefore obtain the net effect of the determinants on the dependent variables. Our baseline model is constructed as a synthesis of the previous studies [Tepe and Vanhuysse (2009); Hollanders and Koster (2012)].

$$Y_{i,t} = c + \beta_1 D_{i,t} + \sum_{k=1}^4 \gamma_k M_{i,t}^k + \sum_{m=1}^2 \delta_m L_{i,t}^m + \sum_{n=1}^2 \zeta_n P_{i,t}^n + \sum_{t=1}^6 \lambda_t I_t + \alpha_i + \epsilon_{i,t}$$

where  $i=1 \dots 23$ ,  $t=1, \dots 6$ . The dependent variable  $Y$  is the total pension spending as % of GDP (RST) or pension benefits per retiree (RSPR). First, our main focus is on the demographic variables (D): current old dependency ratio (ODR) or projected old dependency ratio (PRODR) or the ratio of the population above 55 years old over the working-age population. We chose these demographic variables in order to test the “elderly power” and the “fiscal leakage” hypotheses. Second, we include as control variables four macroeconomic indicators (M): GDP per capita (GDPpc), real GDP growth (RGDPgr), interest rate (Intrate) and trade openness (Openc). Third, we add two variables related to the labour market (L): unemployment (Unemp) and union density (Un.Den.). Fourth, we include political variables (P): type of government (G.T.) and government party (G.P.). In addition, in order to fit a two-way FE model, we create time periods (I) and include all of them but one (the first period, 1980).

<sup>16</sup>The test for time fixed effects indicates the necessity of using the time periods as dummy variables in our model specification.

<sup>17</sup>We implement Frees (1995) and Pesaran (2004) tests for cross-sectional dependence, Lagrange-Multiplier test for serial correlation, also known as Wooldridge test for autocorrelation Wooldridge (2002), and modified Wald test for groupwise heteroscedasticity Baum (2001).

In this way, we control for time effects in order to capture any unexpected variation or special events that may affect the dependent variable. Finally,  $\alpha_i$  represents the unobserved country-specific characteristics and  $\epsilon_{i,t}$  is the idiosyncratic error term.

### 3.3 Results

#### 3.3.1 Basic Model

Table 2 shows the estimation results and particularly the effect of our demographic variables on total pension expenses (size) and pension spending per retiree (generosity). Other examples of proxy variables for the political clout of the elderly can be found in [Hollanders and Koster \(2012\)](#). As we can see from Table 2, the effects of the demographic variables on the size of the pension programme expenditure are positive and statistically significant for all the demographic variables, but the projected in the future old dependency ratio is negative and non-significant. The former results can be attributed to the “size effect”; the higher number of old people means more total expenditure. However, the effect of the same demographic variables on the pension disbursement per retiree is negative and significant only for the current and projected in the future old dependency ratio. These outcomes are in favour of the “fiscal leakage” hypothesis. The high current and projected in the future old dependency ratio make the pay-as-you-go system less profitable for the currently working voters who push for less generous pensions. It is interesting to notice here that, when we include part of the working-age voters in our demographic variable (Plus 55), the negative effect is moderated (column 4). This can be attributed to the fact that the working-age voters close to retirement age will not claim less generous pensions, even though the profitability of the system is lower because they are about to retire.

[Insert Table 2]

Furthermore, as we can observe from Table 2, the economic variables have the expected effects on pension spending, both on total size and per retiree. More specifically, the higher the per capita income in the economy, the higher the per capita benefits for the retirees. However, when we consider the total size of the pension programme, we obtain the opposite outcome, which is even statistically significant (column 3). This means that the higher the average income in the economy, the lower the political tendency to spend on any major type of social programme. In the case where GDP is growing faster than the outlays on pensions and the population does not change dramatically, higher GDP per capita can result in lower expenditure on

pensions (total size). As shown, the effect of real GDP growth is negative for all the specifications of the model. The interest rate, as expected, has a negative effect on the spending level because the higher the interest rate of the long-term bonds, the more expensive it is for the government to borrow. This will restrict the financial resources that can be devoted to the pension programme. Trade openness has a negative impact on pension expenditure, as predicted by the aforementioned “race to the bottom” hypothesis.<sup>18</sup> The effect of unemployment on the generosity of the system (benefits per pensioner) is counter-intuitive. The intuitive result would be that high unemployment binds extra funds that could be used for other social policies like pensions. Moreover, the high unemployment rate would mean fewer current contributions to the PAYG pension system. Finally, union density has a positive effect, as expected, because stronger unions can claim higher benefits for their workers when they retire. However, this effect is only weakly significant (p-value<10%).

The political variables show that the effect of a surplus coalition government (G.T. 3) has a more negative effect than the single majority government on the generosity of the pension system. We have the same direction effect but with an even bigger magnitude as we move towards weaker governments, single-party minority and multi-party minority government (G.T. 4 and G.T. 5, respectively). It seems that the more multitudinous a government, the easier it is to reduce the level of outlays on pensions, especially spending per pensioner. An intuitive reasoning is that voters cannot detect who is responsible, among all the coalition parties, for cuts in retirement expenses. The voters cannot blame and punish them in the next elections and, therefore, in a coalition government there is reduced responsibility for each member. The categorical variable of the government ideology shows that, compared with the government totally dominated by right-wing parties, a government of balanced power between left and right is less generous in terms of per-pensioner spending. A government with a mixed ideology cannot agree on pension reform and just keeps it the same. However, at the same time, the number of the pensioners is increasing, making the per-pensioner spending decrease. The same argument as above can be used. One more interesting result is the fact that a dominance of social-democratic and other left-wing parties in government has a positive effect on the size of the system compared to the hegemony of right-wing parties. This result can be explained in the context of the idea that the social-democratic and left-wing parties are prone to a bigger welfare state and therefore to a higher level of disbursement for pensions.

Finally, it is obvious that time has a positive effect on both generosity and the

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<sup>18</sup>Although (Castles 2004) does not find any significant evidence in favour of this hypothesis

size of the system, because the welfare state in most OECD countries was flourishing and the number of pensioners has increased significantly, increasing the total amount spent on pensions.

### 3.3.2 Non-linear regression function

In this section of the paper, we extend the scope of this empirical literature by examining the presence of non-linear effects in our model. As far as we are concerned, the only study from the empirical literature on political economy of the social security that considers the non-linear effect of ageing on social-spending patterns is the one undertaken by Lindert (1996).

First, in order to check for non-linear effects, we test which specification fits our data better with the help of simple scatter-plots and regressions.<sup>19</sup> We conclude that the cubic regression model fits the data better than the quadratic or the linear one. Furthermore, we run some regressions excluding the rest of the independent variables and we confirm that the cubic specification is better.<sup>20</sup> Therefore, as suggested by the tests, the population regression is polynomial of degree up to 3.

[Insert Table 3]

In addition to the preliminary checks, we run the “full” regressions with the whole set of independent variables. As is obvious from the Table 3, non-linear effects do not apply between the demographic variables and the size of the pension system (columns 1 and 3). However, as we can see, the effect of the population ratios (ODR and Plus 55) on retirement spending per retiree is non-linear (columns 2 and 4, respectively). More specifically, the effect of the ODR on retirement spending per retiree can be analysed through its cubic regression model. A change in the ODR from 13 to 14 % has a negative impact (-1.201) on pension expenditure, *ceteris paribus*.<sup>21</sup> The negative impact of the ODR on generosity of the system can be observed until the level where the ODR=23 %; however, the magnitude of the effect decreases gradually from 13 to 23. This direction of the effect is clearly in favour the “fiscal leakage” hypothesis; the generosity of the PAYG pension system decreases with a larger share of elderly people in society. As we can observe after this point (ODR=23 %), a change in the old dependency ratio from 23 to 24 has a positive effect on pension and this effect holds

<sup>19</sup>See Figure 1 and Figure 2 in the Appendix.

<sup>20</sup>Evidence for non-linear relationship (regressions) between the demographic variables and spending on pensions is provided by Table 9 in the Appendix.

<sup>21</sup>The range of the variable old dependency ratio in our data is from 13 to 33% and for Plus 55 is from 26 to 57 %, respectively.

until the point where the ODR=28 %. The demographic transition in this range (23 to 28) has a positive effect on pension generosity and that is in favour of the “elderly power” hypothesis. However, beyond the point where the old dependency ratio is 28, we again observe the negative impact of a change in the ODR on pension generosity, and the magnitude of the effect increases as the old dependency ratio increases, even beyond our data range. The intuition behind these results can be as follows. The initial increase in the number of retirees puts pressure on the pension system and therefore has a negative effect on it. However, as the old dependency ratio grows, it reaches a certain point (ODR=23 %) where the elderly acquire considerable political power in order to influence the government to favour more generous pensions. It seems that they manage to cancel out the negative effect on the PAYG pension system from the increasing number of old people. Nevertheless, after a certain point (ODR=28 %), the number of retirees is too big to be counterbalanced by the political power of the elderly.

From column 3 of Table 3, we can observe that the ratio of people over 55 years old to the working-age population (Plus 55) has no non-linear effect on the size of the system, just as in the case of the old dependency ratio. However, in column 4 we can see that the population regression is polynomial of degree up to 3. More specifically, if the ratio Plus 55 increases from 26 to 27 %, then the effect on the generosity of the system is negative (-1.089), *ceteris paribus*. The negative effect holds until the ratio is 39 %. Beyond this point, a percentage change in the ratio has a positive effect on the generosity, until the ratio is equal to 52 %. This constitutes evidence in favour of the “elderly power” hypothesis. Thus, the political power of an increasing population of elderly has a positive effect on pension spending per retiree. However, when we extrapolate the analysis until the end of the data range (26-57 %), the effect of an increase in the ratio Plus 55 beyond the point of 52% again has a negative effect on the generosity of the system, *ceteris paribus*. This outcome is in favour of the “fiscal leakage” hypothesis, because the pension system becomes less sustainable by having a very high number of old people.



## 4 The Effect of Population Ageing on Public Education Spending

In this section of the paper we investigate the impact of population ageing on education expenditure and empirically examine the theoretical link between pensions and education. In addition, we conduct an analysis by level of education in order to test whether ageing has a different impact on each level of education (spending).

### 4.1 Data

We use panel data for 31 OECD<sup>22</sup> countries and yearly observations over the period 1996-2012. In Table 4, we summarize the main descriptive statistics of the variables that we use in our model.<sup>23</sup> The first two variables according to Table 4 are used as dependent variables and represent the total education outlay as a percentage of GDP (EST) and per-student outlay (ESPS), respectively.<sup>24</sup> A closer look at Table 4 and Table 10 shows that, for both total education and per-student spending, the differences between countries are bigger than the differences within countries (over years). The next two variables are the total (RST) and per-retiree pension expenditure (RSPR). We incorporate the pension outlays in order to check the potential link with education expenditure.

[Insert Table 4]

The demographic variables (PRODR, ODR, PopEduc, Fertility) describe the projected old dependency ratio 17 years in the future (2013-2029), the current old dependency ratio, the population of official age for education and the fertility rate, respectively. First, the projected old dependency ratio is employed to examine the effect that future ageing has on current education expenditure. The underlying hypothesis here is that the working-age generation, realizing the forthcoming demographic crisis, chooses to invest in education in order to preserve its pension benefits in the future. Therefore, it is expected that the effect of the projected old dependency ratio will have a positive effect on education spending. Second, the current old dependency ra-

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<sup>22</sup>Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, South Korea, Mexico, The Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, U.K., U.S.A.

<sup>23</sup> Definitions and sources of the variables can be found in Table 11 in the Appendix.

<sup>24</sup>Total general (local, regional and central) government expenditure on education (current, capital, and transfers), expressed as a percentage of GDP. It includes expenditure funded by transfers from international sources to government.

tio is used to test the hypothesis that there is a conflict over public resources between generations because of the increasing political power of the elderly. Third, the young population of official age for education is used to control for the size effect, namely that a larger proportion of pupils/students could mean a higher budget allocated to education. Finally, we have the fertility rate that is used as a proxy for the proportion of parents in the voting population. Parents are expected to push for more spending on public education as their children benefit directly from a higher quality of education services.<sup>25</sup>

The macroeconomic variables GDP per capita (GDPpc) and real GDP growth (RGDPgr) are used as control variables. The former variable is an indicator of the level of economic development in a country and the latter is used as a control for the business cycle. In addition, we include two fiscal variables, tax revenues (TaxRev), total social expenditure (TotSocExp) and social expenditure not including retirement spending (SocExp), in order to control for the fact that countries with higher total tax receipts and a more generous general welfare system might spend more on education. Tax receipts include taxes on income, profits and capital gains and social security contributions. Respectively, social expenditure includes survivors and incapacity-related benefits, health, family, active labour market programmes, unemployment, housing and other social policy areas.

The variable MYS (Mean Years of Schooling) illustrates the average number of years of education received by people aged 25 and older. This variable tries to capture the quality of the educational system as referred to in [Molina-Morales et al. \(2013\)](#). It is assumed that the more you study the better your educational level. In addition, we use three institutional variables, globalization index (G.I.), index of voice and accountability (V.A.I.) and index of economic freedom (E.F.I.).<sup>26</sup> The first one shows how globalised a country is at the political, economic, cultural and social level. The underlying hypothesis is that the more open the economy is, the more countries are engaged in the "race to the bottom", reducing their spending and taxes in order to be more competitive vis a vis the rest of the world. The second index captures perceptions of the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media; in general, the variable captures the level of democracy in a country. It is expected that a higher level of democracy will lead to higher education spending. Finally, the last index includes assessments on commercial policy, government tax

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<sup>25</sup>The fertility rate variable appears only in the per-student model specifications.

<sup>26</sup>All three indices are taken from [Molina-Morales et al. \(2013\)](#).

load, government intervention in the economy, monetary policy, foreign investment and capital flow, foreign activity, financial activity, salary and price control, property rights, and black market regulation and activity. Here too, it is expected that a higher degree of economic freedom leads to a larger amount spent on education policy.

Furthermore, we include in our model a dummy variable (Left) that accounts for the political ideology of the governing party. The dummy variable takes 1 when the government is either left-wing or social-democratic and 0 otherwise. It is predicted that left-wing governments are more fervent toward redistribution through social policies and education in order to favour their electoral base that lies among poorer social layers [Castles (1989); Busemeyer (2007)]. In addition, as is shown empirically, left-wing governments favour more generous spending packages on social policies and therefore on education [Roubini and Sachs (1989); Kontopoulos and Perotti (1997)].

Finally, we show in Table 4 the descriptive statistics of pre-primary (PPES), primary (PES), secondary (SES) and tertiary (TES) education spending and the population of the official age for these levels of education, respectively (ppoap, poap, soap, toap), that are used in order to investigate the effect of projected ageing per level of education.<sup>27</sup>

## 4.2 Methodology

Our empirical approach complements the existing evidence on the determinants of public education spending [Castles (1989); Busemeyer (2007); Molina-Morales et al. (2013)]. Nevertheless, we extend the literature by focusing on the demographic transition. More specifically, we start by examining the generational conflict hypothesis in order to compare it with previous empirical studies. We then investigate how the projected population ageing influences the current investment in public education.

Previous empirical studies identify a set of variables that explains the variation in public education expenditure. We construct our model using a set of political, economic and institutional determinants, most of which have been identified by the previous studies. However, we extend the scope of the previous studies by adding, into the model, variables that capture the current and future demographic features.

In order to choose our estimation strategy we conduct some diagnostic tests. Primarily, we have to decide between pooled OLS - which takes into account both between and within variation - and Random Effects (RE) which consider that the differences across countries have a significant influence on the dependent variable. In order to decide, we use the adjusted instead of the simple Breusch and Pagan (1980)

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<sup>27</sup>See Table 8

Lagrange multiplier (LM) test. It might be the case that, in the presence of first-order serial correlation, the simple LM test by Breusch-Pagan 1980 too often rejects the correct null hypothesis of no random effects. Therefore, we have to conduct some complementary tests: the Baltagi and Li (1995) test for first-order serial correlation and the Baltagi and Li (1991) joint test for serial correlation and random effects.<sup>28</sup> According to the outcome of these tests, the  $H_0$  hypothesis that the variance of the random effect is zero or that there are no individual effects in the model is rejected. Therefore, in the presence of country-specific characteristics (individual) heterogeneity, we have to decide between using random or fixed effects. Thus, we apply the test introduced by Hausman (1978), which leads us to a strong rejection of the null hypothesis that random effects provide consistent estimates or that there is no correlation between the error term and the independent variables. Therefore, the test indicates use of the fixed effects method that produces a consistent estimator. This method takes into account the within variation (over time)<sup>29</sup> and controls for the unobserved characteristics that remain constant over the years and that might affect public expenditure on education, like culture heritage or religion, etc.<sup>30</sup>

Additionally, we conduct a series of other diagnostic tests: the modified Wald test for heteroscedasticity by Baum (2001); Frees (1995) and Pesaran (2004); cross-sectional dependence tests; and serial correlation test or the test for autocorrelation by Wooldridge (2002).<sup>31</sup> These tests first show that the idiosyncratic errors are heteroscedastic, meaning that the variation of the errors across countries is not constant. Second, there is contemporaneous correlation, namely the errors between countries are correlated, and third there is a first-order autocorrelation in errors within countries. As mentioned in Cameron and Trivedi (2010), ignoring cross-sectional dependence and correlation of errors over time can lead to systematic bias and thus to erroneous results.

Therefore, we have to use estimation methods that allow us to conduct consistent estimations in the presence of AR(1) autocorrelation within panels and cross-sectional correlation and heteroscedasticity across panels. For that purpose, we use an estimator (SCC) introduced by Hoechle (2007), that produces Driscoll and Kraay (1998) standard errors for the estimated coefficients using fixed effects. In our specification of this estimator, the error structure is assumed to be heteroscedastic, autocorrelated

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<sup>28</sup>These tests show that both serial correlation and random effects are present.

<sup>29</sup>The test for time fixed effects reveals that no time fixed effects are needed in our specification of the model.

<sup>30</sup>As referred to in Castles (1994), cultural heritage and the tradition of Catholicism can play an important role in public expenditure on education. The countries that have Catholicism as their predominant religion might have to spend less on education of children as the Catholic Church undertakes a large part of the childrens education.

<sup>31</sup>The latter is in addition to the previous Baltagi-Li test, as we saw above.

up to one lag and correlated between the countries. As mentioned in [Hoechle \(2007\)](#), Driscoll-Kraay standard errors are robust to very general forms of cross-sectional and temporal dependence when the time dimension is large enough. Additionally, their particular technique to estimate standard errors does not impose any restrictions on the number of countries, which can be even bigger than the number of periods. Finally, the implementation of Driscoll and Kraay’s covariance estimator works for both balanced and unbalanced panels [Cameron and Trivedi, \(2010\)](#). All the above properties make this estimator suitable for our panel data.

$$Y_{i,t} = b + \sum_{h=1}^2 \beta_h D_{i,t}^h + \sum_{k=1}^3 \gamma_k M_{i,t}^k + \sum_{p=1}^3 \lambda_p I_{i,t}^p + \sum_{l=1}^2 \kappa_l F_{i,t}^l + S_{i,t} + L_{i,t} + \alpha_i + \epsilon_{i,t}$$

$i=1 \dots 31, t=1996 \dots 2012$ .

Where (Y) is the dependent variable, education expenditure as a % of GDP or expenditure per student. Three demographic variables  $D_{i,t}$ : old dependency ratio (ODR) or future old dependency ratio (PR.ODR), the young population of official age for education (sPopEduc) and fertility rate. Macroeconomic control variables  $M_{i,t}$ : GDP per capita (GDPpc) and real GDP growth rate (RGDPgr). Fiscal control variables  $F_{i,t}$ : tax revenues (TaxRev) and total social expenditure (TotSocExp).<sup>32</sup> Control for the quality of education  $S_{i,t}$ : mean years of schooling (M.Y.S.). Institutional variables/indices  $I_{i,t}$ : globalization (G.I.), voice and accountability (V.A.I.) and economic freedom (E.F.I). Dummy variable for the political ideology of the government: Left  $L_{i,t}$ . Finally,  $\alpha_i$  represents the unobserved country-specific characteristics and  $\epsilon_{i,t}$  is the idiosyncratic error term.

## 4.3 Results

### 4.3.1 The effect of the current old dependency ratio on education spending

We begin the presentation of our results with Table 5, where we test the generational conflict hypothesis using as the dependent variable education spending in total (EST) as a percentage of GDP and education spending per student (ESPS).

According to the "generational conflict" hypothesis, the increasing percentage of old people in the population has a negative effect on educational spending. In order to test whether there is conflict in relation to fiscal resources between the generation of people over 65 years old and the generation of young people, we employ the old

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<sup>32</sup>Later, in the regressions, we "break" the total social expenditure into two variables, total retirement spending (RST) and the rest of social expenditure (SocExp).

dependency ratio (ODR). As we can see from Table 5, the effect of the ODR on total education spending without controlling for total social expenditure and for the institutional indices is positive and statistically non-significant (column 1). However, when we take into account total social expenditure, the effect of the ODR on education spending becomes negative, as expected by the "generational conflict" hypothesis (columns 2 and 3). The reason for running the model sequentially and starting without including total social expenditure is the plausible strong relationship between education spending and total social expenditure. It is reasonable to expect people to vote for social packages as a whole (pensions and education). For instance, if voters are willing to support an extended welfare state, then they might also be willing to support higher education spending. However, if we do not take into account social expenditure then, as our results show, the ODR can absorb these effects.

A closer look shows that an increase of 1% in the ODR generates a reduction of 0.037% in total education expenditure (column 3). However, the old dependency ratio has a negative but not significant effect on education spending per student (column 5 and 6). Furthermore, as we can see in Table 5, the sign of the young population eligible for education in education spending is positive and becomes insignificant in consideration of the level of the welfare system and certain institutional factors.

[Insert Table 5]

Regarding the performance of the control variables, it seems that the level of economic development (GDPpc) has a positive and significant impact only on per-student spending (columns 4, 5 and 6). Moreover, as is obvious, education spending is not affected significantly by the business cycle (real GDP growth). In addition, the level of fiscal resources (tax revenue) has the expected positive sign for total spending on education but they only weakly affect the level of education spending per student. Next, the size of the welfare state represented by total social expenditure has an important positive impact on both measures of education spending.<sup>33</sup> The variable used as an approximation of education quality, the mean years of schooling (M.Y.S.), has no significant influence on education. Left-wing governments have a non-important influence on education spending. Finally, the fertility rate, which reflects the interest of young parents in education spending, has a very strong and positive influence on per-student spending. A higher fertility rate means more children per couple and that makes young parents more willing to "push" for a higher level

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<sup>33</sup>The social expenditure used for these regressions also includes retirement spending.

of educational expenditure. We could call/label that the "political power of parents" hypothesis.

In regard to the institutional variables in Table 5, globalization index (GI), Voice and Accountability Index (VAI) and Economic Freedom Index (EFI) have the expected effects. The first one has a negative sign, reflecting the "race to the bottom" hypothesis that claims that more globalised countries engage more actively in competition with other countries and, hence, aim to lower the level of public spending in order to be able to lower taxes and become more competitive. The second index has a positive effect on both measures of education spending, showing that a higher level of democracy promotes the expansion of the public education system. The Index of Economic Freedom shows that the process of economic liberalization has encouraged higher spending on public education.

Therefore, we find only partial support for the generational conflict hypothesis, as the old dependency ratio has a significant and negative effect only on education spending as a percentage of GDP but not on education spending per student. This result gives us a hint that there might be something more complicated in the relationship between population ageing and education spending, that we need to examine.

#### **4.3.2 Generational conflict and the link between pensions and education**

One way to investigate further the relationship between current population ageing and education spending is to check for possible non-linear effects. One can claim that it is plausible to assume that the impact of population ageing on education expenditure depends on the scarcity of fiscal resources. For instance, the effect of the old dependency ratio on education spending might depend on the level of total retirement expenditure. Thus, we need to disentangle the effect of retirement spending from the effect of total social expenditure on educational outlays. In order to do so, we "break" total social expenditure into two parts, social expenditure (survivors and incapacity-related benefits, health, family, active labour market programmes, unemployment, housing and other social policy areas) and retirement spending (public pensions). In this way, we are able to interact retirement spending with the old dependency ratio in order to capture potential non-linearities in the relationship of population ageing and education expenditure. In addition, we obtain the direct effect of retirement spending on education expenditure in order to test whether there is a direct link between these two public policies.<sup>34</sup>

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<sup>34</sup>As suggested by [Kemnitz \(2000\)](#), in contrast with the negative predictions for the social security system due to higher life expectancy and lower fertility, the demographic transition has beneficial effects on both education and

[Insert Table 6]

As we can see from column 1 of Table 6, total retirement spending has a positive but non-significant effect on total education spending, and the new variable for social expenditure is strongly significant and positive. In addition, we do not observe any significant evidence in favour of the generational conflict. However, in column 2, where the interaction term between the old dependency ratio and retirement spending is taken into account, we can observe that the individual effect of both variables becomes significant and, additionally, the interaction term is significantly negative. In technical terms, this means that the effect of the old dependency ratio on total education outlays is non-linear and depends on the level of total retirement expenditure.<sup>35</sup> More specifically, the effect of the old dependency ratio on education is positive until a certain level of total retirement spending (RST=8%). When the level of retirement expenditure exceeds 8% of GDP, then the effect of the old dependency ratio on total education outlays becomes negative. In general, an increase in the old dependency ratio has two opposite effects on education spending. On the one hand, there is a negative effect on education spending due to the increased number of old people that put greater pressure on fiscal resources (generational conflict). On the other hand, there is a positive effect that results from the fact that the working-age generation, realizing that the increasing number of old people makes the PAYG system less profitable and unsustainable, decides to invest in the education of young people in order to boost their productivity and consequently the revenues from taxing their income in the future. Therefore, when retirement spending is low, the former effect is dominated by the latter and hence the net effect on education expenditure is positive. This effect is a result of the choice by the working-age generation to invest public resources in education in order to ensure their future pensions. However, when the total expenditure on retirement is quite high, the former effect dominates the latter, and hence the net effect on education is negative. This outcome reflects the fact that, when there are limited fiscal resources, an increase in the political power

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pensions. According to his theoretical model, in a steady state equilibrium there is higher investment in per capita human capital and a higher contribution rate to the social security

<sup>35</sup>Isolating the effect of the ODR and RST on total education spending, we obtain the expression below:

$$EST = 0.1141 * ODR + 0.3760 * RST - 0.0144 * ODR * RST$$

In order to obtain the effect of the old dependency ratio on total education spending, we take the derivative of EST with respect to the ODR:

$$\partial EST / \partial ODR = 0.1141 - 0.0144 * RST$$

In the same way, we can obtain the derivatives with respect to RST.



of the elderly is translated into a decrease in education expenditure, because the old generation tries to appropriate more public resources in their own favour.

Similarly, after a certain point (ODR=26%), the effect of increasing spending on retirement has a negative effect on total education spending. For example, when the ODR is equal to its mean value (21%), in our sample the effect of an additional percentage point of total retirement spending on total education spending is 0.07%. However, when the ODR is higher, for instance 30%, then the effect on education is -0.06%. The theoretical intuition behind this result can be derived from the generational conflict hypothesis. Thus, when the old generation is politically stronger (higher ODR), an increase in total retirement spending is financed out of the same public resources that are used for education expenditure.

Furthermore, as we can see from Table 6 (column 4), the same interaction effect is present in the case of education spending per student. The effect of total retirement spending depends on the level of the old dependency ratio. However, in this case the effect of total retirement spending on education becomes negative at the point where the level of the ODR is 37%, which is the maximum value that the ODR takes in our sample. Likewise, the effect of the old dependency ratio becomes negative only after the level of total retirement spending is above 11 % of GDP. Therefore, the negative impact of the interaction terms takes place only at a very high level of the old dependency ratio and retirement spending, respectively. This evidence is in favour of the generational conflict hypothesis that claims that there is competition for fiscal resources between young and old generations. In other words, the increasing share of old people (retirees) has a negative impact on education expenditure per student. However, we show that the effect of generational conflict is non-linear rather than linear, as is highlighted in the past literature.

Last but not least, in columns 5 and 6 we present the effect of retirement spending per retiree on education and the interaction of retirement spending with the old dependency ratio, respectively. It is obvious that there is no interaction between the old dependency ratio and average spending per retiree. Hence, the impact of retirement spending per retiree and the impact of the old dependency ratio on education do not depend on each other. As we can see from Table 6, it seems that the higher the average spending on retirees, the higher the education expenditure per student. The intuition behind this result is that an increase in education spending per student as a result of an increase in average pensions is financially backed by the working-age generation because, for them, this is a way to secure their future pensions. More specifically, an increase of \$ 100 in average pensions results in an increase of \$ 6.5 in

education spending per student. For the same reason a one percentage point increase in the old dependency ratio enhances education spending with \$37.5 per student.

After focusing on the current old dependency ratio, we find that there is competition for resources, at least from a certain point of total retirement spending. Therefore, it is plausible to claim that the current population ageing, in fact, is more related to competition for resources than to demographic expectations. In the next section, instead of the current we use the projected old dependency ratio. We thus try to separate the demographic effect on education from the competition for resources of current generations.

#### **4.3.3 The impact of the projected population ageing on education spending.**

As already mentioned in the literature review, many scholars have stressed the importance of the link between the PAYG pensions system and public education, more specifically how the particular structure of the PAYG system provides incentives to invest in education. However, it would be even more interesting to investigate the link between pensions and education by paying special attention to future demographic expectations. Thus, in this section, we test the aforementioned theoretical prediction of [Gradstein and Kaganovich \(2004\)](#) that the process of future population ageing has a positive effect on education spending. We capture the particular demographic trend using the estimated projections of the old dependency ratio. In addition, we use the young people of official age to attend any education level as a proxy for the number of pupils/students in the total population. The proportion of students in the total population has declined slightly since the beginning of our sample and is predicted to decline even more in the near future, due to the ageing process that has just started in most of the developed countries that we analyze in this paper.

[Insert Table 7]

As we can see from Table 7, the projected old dependency ratio brings about a positive impact on both total level of education spending and spending per student. A closer look reveals that a one percentage point rise in the proportion of old people in the future *ceteris paribus* generates a 0.021 % increase (column 1) in total education spending and a \$52 rise in per-student expenditure (column 2). In addition, as expected, a higher number of students increases the public spending in education as a percentage of GDP. Furthermore, a one percentage point increase in the fertility rate that captures parental willingness to support education brings about roughly a \$1300 increase in education expenditure per student (column 2). In general, most of

the control variables in these specifications of the model behave as expected by the literature. The political ideology seems to have only a weak role in the determination of education expenses. More specifically, left-wing and social-democratic governments tend to spend more per student than their ideological opponents. As in the previous section, the level of the welfare state (excluding pensions) and economic development have a positive and very significant impact on per-student spending. Finally, institutional indices have significant effects in the expected direction. Furthermore, the main results do not change when, instead of using total social expenditure, we introduce the level of total retirement spending separately from the rest of the social outlays (columns 2 and 3). Also, the effect of the projected old dependency ratio remains the same when we use retirement spending per retiree, which also has a positive impact on education spending per student, providing further evidence in favour of the link between education and pensions (column 4).

The above findings are consistent with the main theoretical outcomes of [Gradstein and Kaganovich \(2004\)](#). More specifically, in order to interpret the results, one can argue that the working-age generations, realizing the severe consequences of the ageing process upon their retirement benefits, decide to exploit the current set-up of the PAYG pension system. Thus, they react to an increasing projected old dependency ratio by investing in education of young people “today” in order to boost the labour productivity and consequently the revenues from income tax “tomorrow”. Hence, in this way the fiscal resources generated from the investment of the working-age generation in education will be used to pay for their pensions.

Last but not least, we conduct a further investigation of the effect of population ageing on public education. More specifically, we disaggregate total education spending into expenditure per level of public education (pre-primary, primary, secondary and tertiary). This allows us to examine whether the projected ageing represented by the old dependency ratio affects each education level to a different extent.<sup>36</sup> In order to estimate the effect of population ageing, we employ the same model as in [Table 7](#) (column 1). In this specification of the model, among other variables we control for total level of social expenditure (pensions plus other welfare expenditure) and the proportion of pupils/students per level of education. Dependent variables are spending by education level measured as a percentage of GDP.

The empirical outcomes of this analysis show that spending on non-mandatory, pre-primary and tertiary education is positively affected by the increasing percentage of the elderly. In contrast, the impact on the mandatory, primary and secondary ed-

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<sup>36</sup>See [Table 8](#), Appendix.

educational level is significantly negative and insignificantly positive, respectively. One can argue that an increase in the projected old dependency ratio raises the future welfare state fiscal requirements (pensions and other social expenditure) as the number of beneficiaries increases. Hence, enhancing the productivity of the current and future generations as an attempt to obtain additional resources (tax revenues) can be considered as the main policy intervention to handle the forthcoming fiscal sustainability issues of the welfare state. Thus, in order to boost current and future productivity, voters decide to support investments in the non-mandatory levels of education and those more related to productivity, pre-primary and tertiary education. In our opinion, the investment in non-mandatory education takes place only because there is a space for policy intervention. In other words, increasing the quality of the non-mandatory educational levels may have a larger positive effect on the participation rate of these educational levels than on participation in mandatory education.

More specifically, investment in pre-primary public education can positively affect the productivity of young parents (especially young mothers) by supporting them with such a time-consuming process as child-raising. Therefore, improving the quality of pre-primary education could eventually lead to an increase in productivity. However, in the case of primary and secondary education, the mandatory character of participation prevents such an investment from being beneficial for the productivity of current workers. Regarding the productivity of future workers, there is a positive impact from the projected population ageing on higher education spending. Consequently, one can expect that this could bring about an increase in participation in tertiary education and eventually lead to a future working generation with enhanced skills and productivity. In other words, as mentioned above, working-age voters considering their future public benefits choose to support investments in higher education in order to boost the productivity of the young generation and "reap" the benefits from increased income tax in the future.

The outcomes of the latter analysis by level of education should be seen only as suggestive, since further theoretical and empirical research is needed to test the robustness and consistence of the theoretical hypotheses used in our investigation. In addition, the very nature of our data, unbalanced data, different number of observations per level of education, etc., might bring about spurious results. Considering all these facts, we are led to a recommendation that the results should only be seen as suggestive rather than conclusive.

## 5 Conclusions

In this paper, we examine the impact of population ageing, which is a result of extended life expectancy and the reduced fertility rate, on public pension and education spending and on the relationship between them.

Regarding pension spending from the political economy point of view, the demographic transition enhances the political clout of older voters in favour of more generous pensions, the so-called "elderly power" hypothesis. However, at the same time, the number of people eligible for pensions increases, making the PAYG system less sustainable, and leading to spending cuts, the "fiscal leakage" hypothesis. Our empirical findings provide an indication that population ageing has a non-linear effect on pension expenditure per retiree and therefore both effects are present. Thus, the outcome and the strength of both effects depend on the proportion of old people. Hence, when the old dependency ratio is high, the "elderly power" effect is dominated by the "fiscal leakage" effect.

Concerning the impact of demographic transition on education spending, we find partial support for the "generational conflict" hypothesis. More specifically, it is shown that generational conflict is present but the effect of the old dependency ratio on education spending depends on the level of total retirement spending. Thus, when the level of total retirement spending is low and there are more public resources available, an increase in the old dependency ratio will have a positive effect on education spending. However, when the total retirement spending is quite high, an increase in the old dependency ratio has a negative impact on education spending, reflecting the struggle between generations for limited public resources. Therefore, it seems that the increased political power of the older generation that supports pro-pension policies has a negative impact on both total and per-student education spending.

Furthermore, we scrutinize how the political and economic system reacts to future demographic changes, and we find that the increase in the projected (future) old dependency ratio has a positive impact on education expenditure. The intuition behind this result is that the working-age generation, realizing the higher life expectancy and the increasing number of retirees, invests more in public education "today" in order to derive some benefits in the form of higher contributions (income tax) for pensions "tomorrow". This finding suggests the existence of a link between public education and pension expenditure. This could indicate that, even in the absence of altruism, middle-aged voters would be in favour of a public education programme as a way to improve their future prospective pensions thanks to an increase in the productivity

of future contemporaneous workers. This could have some policy implications in the face of the imminent demographic crisis of PAYG-financed pension systems. Educational expenditure can be seen as a complement or an alternative to the long-discussed transition to a capitalization system.

Finally, by disaggregating education expenditure by level of education, we try to examine whether there is a different impact of future population ageing on each educational level. The results show that there is a positive effect only on non-mandatory education spending. Our interpretation of this outcome is that investment in non-mandatory education only occurs because there is space for policy intervention in order to increase the participation and consequently the productivity of the current and future working-age generation. Although the outcomes that we have from this analysis are statistically significant, they should be seen as suggestive rather than conclusive.

In general, further research is needed on both the empirical and the theoretical side. On the empirical side, it will first be necessary to investigate how the results change once the recently started population ageing process progresses. Except for the data on the projected old dependency ratio, the rest of the data set employed finishes in 2012, when the “baby boom” cohorts start retiring in most OECD countries. Second, the current analysis could be extended – provided that the data are available - to the whole set of intergenerational public transfers, and also by taking into account education spending by level of education. In general, further research is needed in order to investigate the reasons for private transfers and how they interact with the public transfers introduced by welfare state programmes. The recent literature on endogenous preferences calls for a thorough consideration of altruism formation. Along these lines, the strong positive effect of fertility on education spending per student that we find could be indicative of the political power of parents driven by altruism or other motivations.

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## TABLES

Table 1: **Descriptive Statistics**

<b>A. Dependent Variables-Retirement Spending</b>					
	<b>N</b>	<b>mean</b>	<b>sd</b>	<b>min</b>	<b>max</b>
<b>RST: Retirement Spending (% of GDP)</b>	161	6.54	2.34	2.50	12.42
<b>RSPR: Retirement Spending per Retiree</b>	160	10.39	5.65	1.51	31.47

<b>B. Population Variables</b>					
	<b>N</b>	<b>mean</b>	<b>sd</b>	<b>min</b>	<b>max</b>
<b>Plus 55</b>	161	36.90	5.30	26.28	56.97
<b>ODR: Old Dependency Ratio</b>	161	21.25	3.67	13.42	33.43
<b>PRODR: Projected Old Dependency Ratio</b>	161	33.44	8.76	16.71	63.64

<b>C. Macroeconomic Variables</b>					
	<b>N</b>	<b>mean</b>	<b>sd</b>	<b>min</b>	<b>max</b>
<b>GDPpc: GDP per capita</b>	161	22.93	11.97	5.524	81.401
<b>RGDPgr: Real GDP Growth</b>	161	2.40	1.63	-2.00	10.31
<b>Intrate: Interest Rate</b>	152	8.24	4.35	1.29	25.83
<b>Openec: Trade Openness</b>	161	73.47	44.89	16.86	307.06
<b>Unemp: Unemployment</b>	161	6.72	3.73	0.19	20.96
<b>UnDen: Union Density</b>	161	41.10	21.35	7.62	94.07

<b>C. Political Variables</b>					
	<b>N</b>	<b>mean</b>	<b>sd</b>	<b>min</b>	<b>max</b>
<b>GT: Government Type</b>	161	2.43	1.14	1.00	5.00
<b>GP: Government Party</b>	161	2.42	1.35	1.00	5.00

**Note:** RSPR and GDPpc are measured in \$ 1000.

Table 2: **Baseline Model**

	(1)	(2)	(3)	(4)	(5)	(6)
	RST	RSPR	RST	RSPR	RST	RSPR
ODR	0.209*** (0.031)	-0.168* (0.076)				
Plus55			0.122** (0.033)	-0.0983 (0.057)		
PRODR					-0.0365 (0.048)	-0.201** (0.060)
GDPpc	-0.0667 (0.0365)	0.166** (0.0540)	-0.0898* (0.0369)	0.185** (0.0494)	-0.129*** (0.0255)	0.184*** (0.0351)
RGDPgr	-0.179** (0.049)	-0.201** (0.058)	-0.187** (0.057)	-0.194** (0.061)	-0.236*** (0.058)	-0.191** (0.059)
Intrate	-0.157** (0.052)	-0.152* (0.073)	-0.178** (0.052)	-0.136 (0.076)	-0.186** (0.056)	-0.130 (0.075)
Openc	-0.0190* (0.008)	-0.0474** (0.014)	-0.0156* (0.007)	-0.0501** (0.014)	-0.0195* (0.008)	-0.0432** (0.015)
Unemp	0.0716 (0.042)	0.179* (0.067)	0.0711 † (0.038)	0.180* (0.071)	0.0833 † (0.040)	0.156* (0.058)
Un.Den.	0.0372 (0.022)	0.0640 † (0.037)	0.0413 † (0.022)	0.0606 (0.038)	0.0451 † (0.024)	0.0644 † (0.037)
G.T.2	-0.258 (0.258)	-0.790 (0.691)	-0.307 (0.286)	-0.749 (0.675)	-0.409 (0.284)	-0.661 (0.700)
G.T.3	-0.549 (0.310)	-1.665* (0.698)	-0.519 (0.350)	-1.690* (0.666)	-0.442 (0.465)	-1.783* (0.670)
G.T.4	-0.647* (0.307)	-1.914* (0.884)	-0.654 (0.339)	-1.908* (0.855)	-0.715* (0.296)	-1.815 (0.898)
G.T.5	-1.256 (0.643)	-2.886* (1.098)	-1.303 (0.718)	-2.847* (1.047)	-1.542* (0.716)	-2.533* (0.981)
G.P.2	-0.150 (0.199)	-0.432 (0.386)	-0.134 (0.202)	-0.445 (0.383)	-0.232 (0.217)	-0.327 (0.370)
G.P.3	-0.185 (0.194)	-0.758* (0.316)	-0.169 (0.199)	-0.770* (0.305)	-0.256 (0.202)	-0.627 (0.331)
G.P.4	0.380* (0.173)	-0.326 (0.442)	0.487* (0.224)	-0.412 (0.419)	0.396 (0.226)	-0.463 (0.447)
G.P.5	0.0979 (0.286)	-0.919 (0.581)	0.129 (0.292)	-0.943 (0.595)	0.0462 (0.247)	-0.786 (0.607)
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Obs	152	152	152	152	152	152
Adj. R <sup>2</sup> -within	0.692	0.920	0.665	0.919	0.615	0.924

**Note:** Fixed effects regressions with robust standard errors reported in parentheses, \*\*\*p<0.001, \*\*p<0.01, \*p<0.05, †p<0.10. RSPR and GDPpc are measured in \$ 1000. Constant is included but not reported.

Table 3: Non-linear specification of the demographic variables

	(1)	(2)	(3)	(4)
	RTS	RSPR	RTS	RSPR
ODR	-1.422 (0.914)	-5.743** (1.980)		
(ODR) <sup>2</sup>	0.0691 (0.042)	0.229* (0.088)		
(ODR) <sup>3</sup>	-0.000935 (0.001)	-0.00300* (0.001)		
Plus 55			-0.432 (1.162)	-6.764* (2.477)
(Plus 55) <sup>2</sup>			0.00892 (0.029)	0.156* (0.061)
(Plus 55) <sup>3</sup>			-0.0000326 (0.000)	-0.00118* (0.000)
Controls	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes
Obs	152	152	152	152
Adj. R <sup>2</sup> -within	0.697	0.928	0.677	0.933

**Note.** Fixed effects regressions with robust standard errors reported in parentheses, \*\*\*p<0.001, \*\*p<0.01, \*p<0.05, †p<0.10. RSPR and GDPpc are measured in \$ 1000. Constant is included but not reported.

Table 4: Descriptive Statistics

<b>A. Education Spending-Dependent Variables</b>					
	<b>N</b>	<b>mean</b>	<b>sd</b>	<b>min</b>	<b>max</b>
<b>EST: Education Spending (% of GDP)</b>	525	5.356853	1.1779	2.9887	8.8069
<b>ESPS: Education Spending per Student</b>	524	5.9218	2.9181	.6691	15.7356
<b>PPES: Pre Primary Education Spending (% of GDP)</b>	369	.4330	.1946	.0291	1.3437
<b>PES: Primary Education Spending (% of GDP)</b>	366	1.4211	.4493	.5381	2.6816
<b>SES: Secondary Education Spending (% of GDP)</b>	373	2.0894	.4368	.9617	2.9748
<b>TES: Tertiary Education Spending (% of GDP)</b>	405	1.2395	.4439	.3059	2.6367
<b>B. Retirement Spending Variables</b>					
	<b>N</b>	<b>mean</b>	<b>sd</b>	<b>min</b>	<b>max</b>
<b>RST: Retirement Spending (% GDP)</b>	520	6.8351	2.8282	.5	13.6
<b>RSPR: Retirement Spending per Retiree</b>	520	12.9240	5.5763	.8376	30.8240
<b>C. Population Variables</b>					
	<b>N</b>	<b>mean</b>	<b>sd</b>	<b>min</b>	<b>max</b>
<b>PRODR: Projected Old Dependency Ratio</b>	527	30.3513	7.0838	10.0491	53.5608
<b>ODR: Old Dependency Ratio</b>	527	21.7864	4.9578	7.6861	39.0432
<b>PopEduc: Population of the Official Age for Education</b>	526	9,865,746	1.68e+07	93,278	8.97e+07
<b>Fertility rate</b>	527	1.6618	.3943	1.08	3.05
<b>ppoap: Population of the official age for Pre-Primary Education</b>	543	1,173,418	2,220,364	12,448	1.23e+07
<b>poap: Population of the official age for Primary Education</b>	543	2,625,343	4,776,337	29,786	2.50e+07
<b>soap: Population of the official age for Secondary Education</b>	543	3,037,286	4,952,522	29,481	2.60e+07
<b>toap: Population of the official age for Tertiary Education</b>	542	2,429,867	4,010,869	20,857	2.23e+07
<b>D. Macroeconomic and Fiscal Variables</b>					
	<b>N</b>	<b>mean</b>	<b>sd</b>	<b>min</b>	<b>max</b>
<b>GDPpc: GDP per capita</b>	527	28.5727	10.3194	6.917	66.358
<b>RGDPgr: Real GDP per capita</b>	527	2.5666	3.0219	-14.7	11.8
<b>TaxRev: Tax Revenues</b>	527	34.3577	6.9848	14.84	49.508
<b>TotSocExp: Total Social Expenditures</b>	520	20.3296	5.7230	3.4	31.7
<b>SocExp: Social Expenditures</b>	520	13.4944	3.7477	2.4	21.9
<b>E. Institutional and Political Variables</b>					
	<b>N</b>	<b>mean</b>	<b>sd</b>	<b>min</b>	<b>max</b>
<b>MYS: Mean Years of Schooling</b>	527	10.8601	1.4866	6.4723	13.086
<b>GI: Globalization Index</b>	527	79.8827	8.8547	54.3113	92.3716
<b>VAI: Voice and Accountability Index</b>	527	1.2181	.3581	-.0791	1.8263
<b>EFI: Economic Freedom Index</b>	527	69.8649	6.8704	50.4	83.1
<b>Left</b>	527	.4060	.4915	0	1

Note: RSPR, ESPS and GDPpc are measured in \$ 1000.

Table 5: Current ODR and Education Expenditures

	(1)	(2)	(3)	(4)	(5)	(6)
	EST	EST	EST	ESPS	ESPS	ESPS
ODR	0.0170 (0.017)	-0.0418** (0.012)	-0.0373* (0.013)	0.0584* (0.024)	-0.0224 (0.020)	-0.0066 (0.018)
PopEduc	0.0246* (0.011)	0.0089 (0.012)	0.0123 (0.013)			
GDPpc	0.0044 (0.012)	0.0037 (0.008)	0.0016 (0.007)	0.2308*** (0.011)	0.2271*** (0.007)	0.2274*** (0.006)
RGDPgr	-0.0346*** (0.006)	0.0054 (0.007)	0.0048 (0.006)	-0.0457*** (0.008)	0.0145 (0.012)	0.0163 (0.010)
TaxRev	0.0593† (0.034)	0.0346† (0.020)	0.0352† (0.018)	0.0345 (0.040)	0.0054 (0.022)	0.0034 (0.019)
TotSocExp		0.1534*** (0.010)	0.1607*** (0.009)		0.2196*** (0.023)	0.2228*** (0.023)
M.Y.S.	0.0704 (0.071)	0.0400 (0.047)	0.0069 (0.050)	0.0368 (0.125)	0.0053 (0.088)	-0.0344 (0.082)
Left	0.0668 (0.079)	0.0479 (0.068)	0.0387 (0.065)	0.1166 (0.085)	0.0830 (0.060)	0.0860 (0.068)
Fertility				1.0492** (0.298)	1.3420*** (0.240)	1.2889*** (0.231)
G.I.			-0.0079* (0.003)			-0.0281*** (0.006)
V.A.I.			0.8295*** (0.076)			0.3359*** (0.079)
E.F.I.			0.0218** (0.006)			0.0278** (0.009)
Obs.	524	517	517	524	517	517
R <sup>2</sup> -within	0.1112	0.2894	0.3229	0.8933	0.9192	0.9223

**Note:** Fixed effects regressions with Driscoll-Kraay standard errors reported in parentheses, \*\*\*p<0.001, \*\*p<0.01, \*p<0.05, †p<0.10. ESPS and GDPpc are measured in \$ 1000 and PopEduc is measured in millions of people. Constant is included but not reported.

Table 6: **Generational Conflict and the Link Between Pensions and Education**

	(1)	(2)	(3)	(4)	(5)	(6)
	EST	EST	ESPS	ESPS	ESPS	ESPS
ODR	-0.0144 (0.016)	0.1141*** (0.026)	0.0197 (0.020)	0.0844† (0.043)	0.0375* (0.016)	-0.0087 (0.034)
RST	0.0297 (0.036)	0.3760*** (0.077)	0.0841*** (0.018)	0.2679** (0.078)		
RST*ODR		-0.0144*** (0.003)		-0.0074* (0.003)		
RSPR					0.0649*** (0.010)	-0.0058 (0.032)
RSPR*ODR						0.0028† (0.002)
GDPpc	-0.0002 (0.006)	-0.0029 (0.007)	0.2268*** (0.006)	0.2234*** (0.005)	0.2020*** (0.007)	0.2079*** (0.007)
RGDPgr	0.0049 (0.006)	0.0019 (0.005)	0.0157 (0.010)	0.0151 (0.010)	0.0168 (0.010)	0.0168 (0.010)
TaxRev	0.0272* (0.012)	0.0263* (0.011)	-0.0063 (0.013)	-0.0042 (0.013)	-0.0011 (0.014)	-0.0037 (0.014)
M.Y.S.	-0.0064 (0.052)	0.0163 (0.056)	-0.0564 (0.081)	-0.0348 (0.079)	-0.0739 (0.082)	-0.1093 (0.090)
Left	0.0636 (0.055)	0.0773 (0.060)	0.1108† (0.059)	0.1181† (0.061)	0.0980 (0.060)	0.0843 (0.059)
PopEduc	0.0077 (0.014)	0.0002 (0.021)				
Fertility			1.1298*** (0.229)	1.3376** (0.338)	1.0222*** (0.232)	0.8426** (0.263)
SocExp	0.2126*** (0.016)	0.1994*** (0.011)	0.2762*** (0.033)	0.2686*** (0.032)	0.2782*** (0.032)	0.2874*** (0.031)
Institutional Variables	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	517	517	517	517	517	517
R <sup>2</sup> -within	0.3530	0.3831	0.9247	0.9252	0.9262	0.9265

**Note:** Fixed effects regressions with Driscoll-Kraay standard errors reported in parentheses, \*\*\*p<0.001, \*\*p<0.01, \*p<0.05, †p<0.10. ESPS, RSPR and GDPpc are measured in \$ 1000 and PopEduc is measured in millions of people. Institutional variables: Globalization index (GI), Voice and Accountability Index (VAI) and Economic Freedom Index (EFI). Constant is included but not reported.



Table 7: **Projected Old Dependency Ratio and Education Spending**

	(1)	(2)	(3)	(4)
	EST	ESPS	ESPS	ESPS
PRODR	0.0214*	0.0520***	0.0507***	0.0641***
	(0.007)	(0.010)	(0.013)	(0.011)
GDPpc	-0.0060	0.2107***	0.2104***	0.1782***
	(0.009)	(0.008)	(0.007)	(0.007)
RGDPgr	0.0023	0.0141	0.0149	0.0168+
	(0.006)	(0.010)	(0.010)	(0.009)
TaxRev	0.0359+	0.0084	0.0014	0.0109
	(0.020)	(0.022)	(0.016)	(0.017)
M.Y.S.	-0.0653	-0.1062	-0.0916	-0.1010
	(0.052)	(0.071)	(0.069)	(0.072)
Left	0.0450	0.0969	0.1172+	0.1019+
	(0.067)	(0.067)	(0.058)	(0.058)
PopEduc	0.0286***			
	(0.007)			
TotSocExp	0.1428***	0.2025***		
	(0.007)	(0.019)		
SocExp			0.2588***	0.2574***
			(0.030)	(0.027)
RST			0.0834***	
			(0.009)	
Fertility		1.3076***	1.1870***	1.1036***
		(0.254)	(0.263)	(0.264)
RSPR				0.0730***
				(0.008)
Institutional variables	Yes	Yes	Yes	Yes
Obs.	517	517	517	517
R <sup>2</sup> -within	0.3199	0.9238	0.9260	0.9279

**Note:** Fixed effects regressions with Driscoll-Kraay standard errors reported in parentheses, \*\*\*p<0.001, \*\*p<0.01, \*p<0.05, †p<0.10. ESPS, RSPR and GDPpc are measured in \$ 1000 and PopEduc is measured in millions of people. Institutional variables: Globalization index (GI), Voice and Accountability Index (VAI) and Economic Freedom Index (EFI). Constant is included but not reported.

## APPENDIX

Table 8: The effect of PRODR on education spending by level of education

	(1)	(2)	(3)	(4)
	PPES	PES	SES	TES
PRODR	0.0205*** (0.004)	-0.0136*** (0.003)	0.0039 (0.015)	0.0227*** (0.004)
GDPpc	-0.0086* (0.003)	0.0011 (0.002)	-0.0112* (0.004)	-0.0051† (0.002)
RGDPgr	-0.0036 (0.003)	0.0006 (0.003)	0.0005 (0.002)	0.0008 (0.001)
TaxRev	-0.0018 (0.005)	-0.0116† (0.006)	0.0070 (0.005)	0.0009 (0.003)
M.Y.S.	-0.0007 (0.022)	-0.0533*** (0.006)	0.0155 (0.026)	0.0020 (0.019)
Left	0.0325* (0.012)	-0.0564** (0.018)	-0.0341 (0.033)	-0.0023 (0.011)
TotSocExp	0.0083* (0.003)	0.0554*** (0.003)	0.0484*** (0.009)	0.0218*** (0.004)
ppoap	-0.0000 (0.000)			
poap		0.0000 (0.000)		
soap			0.0000*** (0.000)	
toap				-0.0000 (0.000)
Institutional Variables	Yes	Yes	Yes	Yes
Obs.	365	362	369	400
R <sup>2</sup> -within	0.2491	0.3639	0.2597	0.3471

**Note:** Fixed effects regressions with Driscoll-Kraay standard errors reported in parentheses, \*\*\*p<0.001, \*\*p<0.01, \*p<0.05, †p<0.10. Institutional variables: Globalization index (GI), Voice and Accountability Index (VAI) and Economic Freedom Index (EFI). Constant is included but not reported.

Table 9: **ODR and Plus 55 in a non-linear specifications**

	(1)	(2)	(3)	(4)	(5)	(6)
	RSPR	RSPR	RSPR	RSPR	RSPR	RSPR
ODR	1.1369*** (0.258)	2.2932* (0.840)	-12.3138** (3.902)			
(ODR) <sup>2</sup>		-0.0354* (0.016)	0.6450** (0.176)			
(ODR) <sup>3</sup>			-0.0099*** (0.003)			
Plus55				0.8672*** (0.222)	1.9623** (0.621)	-13.6602*** (3.3808)
(Plus55) <sup>2</sup>					-0.0137* (0.0062)	0.3834*** (0.084)
(Plus55) <sup>3</sup>						-0.0032*** (0.0006)
Obs.	160	160	160	160	160	160
Adj.R <sup>2</sup>	0.3168	0.3176	0.3523	0.3802	0.3903	0.4318

**Note:** Fixed effects regressions with robust standard errors reported in parentheses, \*\*\*p<0.001, \*\*p<0.01, \*p<0.05, †p<0.10. RSPR is measured in \$ 1000. Constant is included but not reported.

Table 10: **Panel Data Descriptive Statistics**

Variable		Mean	Std. Dev.	Min	Max	Observations
EST	overall	5.3568	1.1779	2.9887	8.80697	N = 525
	between		1.1015	3.3789	8.3052	n = 31
	within		.45465	2.8273	6.7835	T = 16.9355
ESPS	overall	5.9218	2.9181	.66912	15.7356	N = 524
	between		2.4411	1.4164	11.3286	n = 31
	within		1.6536	1.3138	10.3288	T = 16.9032
RST	overall	6.8351	2.8282	.5	13.6	N = 520
	between		2.7592	.9411	11.9235	n = 31
	within		.7299	4.2976	9.7998	T-bar = 16.7742
RSPR	overall	12.9240	5.5763	.8376	30.82401	N = 520
	between		4.8028	2.1447	22.9954	n = 31
	within		2.9598	4.0366	23.4140	T-bar = 16.7742

**Note:** ESPS and RSPR are measured in \$ 1000

Figure 1: Scatter plot of RSPR and ODR

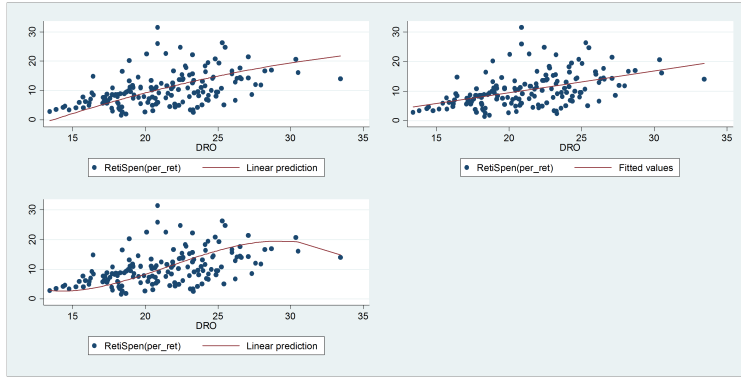


Figure 2: Scatter plot of RSPR and Plus 55

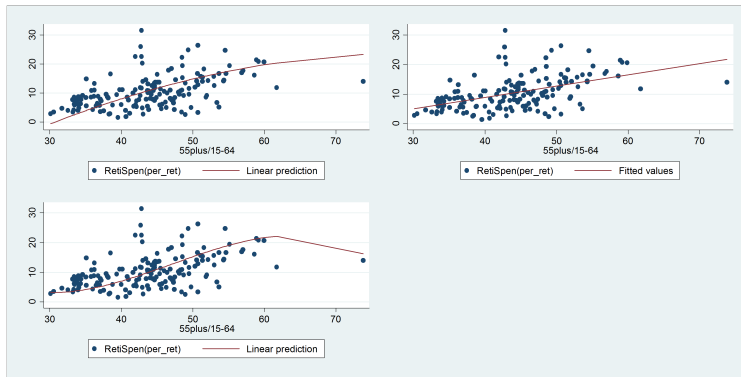


Table 11: **Data Definitions and Sources**

<b>Variable</b>	<b>Definition and Source</b>
EST	Public Education Spending as % of GDP. Source: UNESCO (2015), <a href="http://data.uis.unesco.org/Index.aspx?DataSetCode=EDULIT_DS">http://data.uis.unesco.org/Index.aspx?DataSetCode=EDULIT_DS</a>
ESPS	Public Education Spending per Student., Source: Our own calculation using Public Education Spending as a percentage of GDP, GDP PPP (US \$ current) and the population of the official age for education.
RST	Public Pension Spending as percentage of GDP. Source: OECD (2015) Social Expenditure-Aggregate data, <a href="http://stats.oecd.org/Index.aspx?DataSetCode=SOCX_AGG">http://stats.oecd.org/Index.aspx?DataSetCode=SOCX_AGG</a>
RSPR	Public Pensions Spending per Retiree. Source: Our own calculations using Public Pension Spending as % of GDP,GDP PPP (US \$ current) and the number of people over 65 years old.
Plus55	Population over 55 years old as a proportion of the working age population (15-64). Source: OECD (2015) Demography and Population, <a href="http://stats.oecd.org/#">http://stats.oecd.org/#</a>
ODR	Old Dependency Ratio. Population over 65 years old as proportion of the working age population (15-64). Source: OECD (2015) Demography and Population, <a href="http://stats.oecd.org/#">http://stats.oecd.org/#</a>
PRODR	Projected Old Dependency Ratio. Source: OECD (2015), <a href="http://stats.oecd.org/">http://stats.oecd.org/</a> Historical population data and projections.
GDPpc	GDP per capita PPP (US current \$) Source: OECD (2015) <a href="https://stats.oecd.org/index.aspx?queryid=60702#">https://stats.oecd.org/index.aspx?queryid=60702#</a>
GDP Growth	<b>In section 3:</b> Growth of real GDP, percentage change from previous year. Source: Armingeon (2012) <a href="http://www.cpds-data.org/">http://www.cpds-data.org/</a> <b>In sections 4,5 and 6:</b> GDP growth (annual %) Source: World Bank (2015), <a href="http://databank.worldbank.org/data/">http://databank.worldbank.org/data/</a>
Interest rate	Long-term interest rate on government bonds. Source: Armingeon (2012) <a href="http://www.cpds-data.org/">http://www.cpds-data.org/</a>
Openc	Openness of the economy, measured as total trade (sum of imports and exports) as a percentage of GDP, in current prices. Source: Armingeon (2012) <a href="http://www.cpds-data.org/">http://www.cpds-data.org/</a>
Unemp	Unemployment rate as a percentage of civilian labour force. Source: Armingeon (2012) <a href="http://www.cpds-data.org/">http://www.cpds-data.org/</a>
Union Density	Ratio of wage and salary earners that are trade union members, divided by the total number of wage and salary earners. Source: OECD (2015), <a href="http://stats.oecd.org/Index.aspx?DataSetCode=UN_DEN">http://stats.oecd.org/Index.aspx?DataSetCode=UN_DEN</a>
G.T.	Type of Government. Source: Armingeon (2012) <a href="http://www.cpds-data.org/">http://www.cpds-data.org/</a>
G.P.	Cabinet composition (Schmidt-Index). Ideology of the government parties(-ies). Source: Armingeon (2012) <a href="http://www.cpds-data.org/">http://www.cpds-data.org/</a>

Table 11 (continuation): **Definitions and Sources**

<b>Variable</b>	<b>Definition and Sources</b>
Tax Revenue	Tax revenue as % of GDP. Source: OECD (2015), <a href="http://stats.oecd.org/viewhtml.aspx?datasetcode=REV&amp;lang=en#">http://stats.oecd.org/viewhtml.aspx?datasetcode=REV&amp;lang=en#</a>
TotSocExp	Total Social Expenditure. Source: OECD (2015) Social Expenditure-Aggregate data, <a href="http://stats.oecd.org/Index.aspx?DataSetCode=SOCX_AGG">http://stats.oecd.org/Index.aspx?DataSetCode=SOCX_AGG</a>
M.Y.S.	Mean years of schooling. Source: UN (2014), <a href="http://hdr.undp.org/en/dataviz-competition">http://hdr.undp.org/en/dataviz-competition</a>
Left	Dummy variable for Left ideology of the government. Source: Armingeon (2012).
G.I.	Globalization Index. Source: KOF, ETH Zurich, <a href="http://globalization.kof.ethz.ch/">http://globalization.kof.ethz.ch/</a>
V.A.I.	Voice and Accountability Index. Source: Worldwide Governance Indicators (WGI) project, <a href="http://info.worldbank.org/governance/wgi/index.aspx#home">http://info.worldbank.org/governance/wgi/index.aspx#home</a>
E.F.I.	Economic Freedom Index. Source: Heritage Foundation Research Institute/Wall Street Journal, <a href="http://www.heritage.org/index/">http://www.heritage.org/index/</a>
PopEduc	Population of the official age for education in total population. Source: UNESCO (2015) Education, <a href="http://data.uis.unesco.org/Index.aspx?DataSetCode=EDULIT_DS">http://data.uis.unesco.org/Index.aspx?DataSetCode=EDULIT_DS</a>
Fertility	Fertility rate. Source: OECD (2015) Demography, <a href="https://data.oecd.org/pop/fertility-rates.htm">https://data.oecd.org/pop/fertility-rates.htm</a>
PPES	Education spending by level of education as percentage of GDP, pre-primary (PPES), primary (PES), secondary (SES) and tertiary (TES). Source: UNESCO (2015), <a href="http://data.uis.unesco.org/?queryid=181">http://data.uis.unesco.org/?queryid=181</a>
ppoap	Population of the official age for education in total population by level of education, pre-primary (ppoap), primary (poap), secondary (soap) and tertiary (toap). Source: UNESCO (2015), <a href="http://data.uis.unesco.org/?queryid=181">http://data.uis.unesco.org/?queryid=181</a>