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Long-run Effects on Poverty of Public Expenditure in Education*

Marisa Hidalgo-Hidalgo and Iñigo Iturbe-Ormaetxe**

Abstract

Household characteristics may have long-run effects on individual outcomes in adulthood. For instance, individuals who lived when young in households experiencing financial problems are more likely to be poor when adults. Public intervention in education is one of the most important means by which governments try to reduce these effects and to promote equality of opportunity. The objective of this paper is to check whether public expenditure in education has an effect in reducing the probability of being poor when adult, and to what extent. Our main finding is that public expenditure in primary education has a strong long-run effect on reducing incidence of poverty in adulthood. We also find that this effect is concentrated mainly among individuals who have parents with a low level of education.

Keywords: public expenditure in education, poverty rate, intergenerational transmission of poverty.

JEL classification numbers: H52, I21, I23, J24, J31.

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1 Introduction

There is a growing literature documenting how inequality has increased during the last decades in many developed countries (see Piketty, 2014, Atkinson, 2010 for the EU; Atkinson, Piketty, and Saez, 2011 or Jenkins et al. 2011 for the US). For instance, in most OECD countries the gap between the rich and the poor has widened continuously prior to 2008 (OECD, 2011). In addition, recent OECD data (OECD, 2013) show that the global economic crisis has squeezed incomes in most countries, but this reduction is not shared evenly across the two extremes of the income distribution, with larger reductions at the bottom part of the distribution, thus suggesting further increases in inequality and poverty. It is also well-known that living in poverty may have long-run negative effects. Children from poor families are more likely to be poor when adults, are also more prone to suffer health problems, and less likely to stay at school after compulsory education. These long-run effects reflect the degree of intergenerational mobility in a society. In countries where social mobility is low, being poor when young is a good predictor of the probability of being poor when adult.

There are two plausible mechanisms underlying the intergenerational transmission of poverty. First, there may be genetic differences in ability that are transmitted from parents to children leading to intergenerational persistence in poverty. Second, rich parents invest more in the human capital of their children who end up with more education. This second mechanism suggests a role for public provision or financing of education to equalize opportunities. Indeed, public intervention in education is seen as one of the most important tools to reduce these long-run effects of poverty and to promote equality of opportunity.

Our objective is to study whether public expenditure in education helps to mitigate some of these long-run negative effects of poverty, and to what extent. In order to do so, we combine individual and aggregate variables by merging data from two cross sections of the EU-SILC (2005 and 2011, since they include a special module on "Intergenerational transmission of poverty") with data on public expenditure in education that we retrieve from the UNESCO database to analyze which factors contribute to cross-country and cohort differences in the probability of falling below the poverty line.

The main finding is that, focusing on expenditure in primary education, public expenditure in education seems to have a strong long-run effect on reducing the incidence of poverty in adulthood. We also find that the effect of public expenditure in education on poverty is not linear, but has decreasing returns. In addition, we find that the beneficial effect of public expenditure on education is concentrated mostly among individuals with low-educated parents. An increase in expenditure on primary education of the size of one standard devi-

ation is associated with a reduction of 4.25 percentage points in the incidence of poverty in adulthood for children from low-educated families. At the same time we do not find an effect on children from educated families. This suggests that public expenditure in education helps to increase intergenerational mobility.

The mechanism at work seems to be simple. Increasing expenditure in primary education has a strong and significant positive effect on the probability of having more than just compulsory education. Since more education means a reduced probability of living below the poverty line, this explains a large part of the effect. However, we also find that spending more resources in primary education reduces the probability of being poor among individuals with a level of education beyond compulsory education.

Our identification strategy to assess the impact of government educational spending on individual's particular outcomes (poverty status) consists of exploiting country and time differences in expenditure. We identify the effect of public intervention by exploiting changes in spending across countries from the initial period in our sample. Other authors have used a similar approach focussing on different outcomes, as infant mortality or scores. For example, state per-pupil spending on elementary and secondary schooling is associated with higher post-schooling wages (Grogger, 1996). Some studies find that expenditure on schools has little effect on test scores (e.g., Hanushek, 1996, 2001), while others find that spending increases test scores (e.g., Hedges et al., 1992). Mayer (2002) uses data from New Zealand, and she finds that greater spending on elementary and secondary schools increases low-income but not high-income children's educational attainment. She also finds that greater spending on college financial aid increases schooling for high-income, but not for low-income children. This result points out that it is spending in elementary and secondary schooling, and not spending in post-secondary schooling that promotes intergenerational mobility. Within this literature on the relationship between education spending and educational outcomes, there are other authors who use alternative identification strategies. For example, Meghir and Palme (2004) evaluate the impact of a school reform, that took place in the 1950s in Sweden on educational attainment and earnings. This reform consisted of increasing compulsory schooling, among other aspects, and thus can be seen as an increase in per capita public expenditure on education. They find that this reform increased both educational attainment and earnings of those whose fathers had just compulsory education. Jackson et al (2014) use US data and find a significant effect of increased school spending on children from poor families. In particular, they find that an increase of 20% in K-12 spending reduces the incidence of adult poverty by 19.7 percentage points.

Our paper is also related to a second strand of the literature that studies intergenerational

income mobility. In particular, it is related to several works that estimate the relationship between parents' economic status and a child's economic status in adulthood. There have been some contributions in terms of measurement of correlations and the forces driving this relationship (see Black and Devereux, 2011). While most theoretical works on the intergenerational transmission of economic status consider only parental investments in children, governments also invest in children's human capital. Solon (2004) is one of the authors in that research line. He departs from a standard human capital model similar to Becker and Tomes (1979), by incorporating public investment in human capital. Among other results, he finds that the intergenerational income elasticity decreases with the progresivity of public investment in human capital, thus suggesting that cross-country differences in intergenerational mobility could arise from differences in this factor. Mayer and Lopoo (2008), in the paper most closely related to ours, provide an empirical contribution that takes into account government expenditure. They assess the relationship between government spending and intergenerational economic mobility using PSID data together with data on state spending from the U.S. Census of Governments. They find greater intergenerational mobility in high-spending states compared to low-spending ones. They also find that spending on elementary and secondary schooling has the largest impact on low-income children's future income.

We perform a number of robustness checks. In particular we check the validity of our results to alternative measures of parental circumstances and current poverty status. We also incorporate to our analysis a measure of the size of country social spending to isolate the impact of public expenditure in primary education on poverty reduction in adulthood.

Our paper contributes to this line of research in several aspects. First, we focus on intergenerational poverty transmission rather than on transmission of income, as most of this literature does. Surprisingly, there is almost no evidence on the potential mitigating effect of public expenditure in education on poverty, despite the recent trends in poverty and income inequality. Second, we focus on a group of European countries using data from the EU-SILC. Finally, we also add to this debate by using a more narrowly defined measure of expenditure on children schooling.

The paper is organized as follows. Section 2 describes the data used in the paper. Section 3 presents the empirical model. We discuss our empirical results in Section 4. Section 5 provides a robustness analysis of the main results. Finally, Section 6 concludes.

2 Data and descriptive statistics

Estimating whether government expenditure increases intergenerational mobility requires individual-level data on adult's income together with information on the characteristics of the household where that adult grew up. It also requires a source of variation in government expenditure. In this study we merge data drawn from both the 2005 and 2011 cross sections of the EU-SILC database with data from the UNESCO database for Education. We build a database comprising 17 European countries.[1] These are the countries in the EU-SILC database for which we have enough historical data on public expenditure in education.

The reason for using the 2005 and 2011 cross sections of the EU-SILC database is that they include special modules on inter-generational transmission of poverty.[2] These modules contain retrospective information on parental background and childhood circumstances. This information includes, in particular, family composition, year of birth of parents, occupation and level of education of parents. Individuals also provide retrospective information about the economic situation when teenagers. In principle we could use this information as a summary of the household situation when young. We decided not to do so for three reasons. First, this variable does not take the same categorical values in both cross sections.[3] Second, there are many missing values in the 2005 cross section since four countries in the 2005 cross section (Austria, France, Greece, and Portugal) do not report information on economic circumstances when young. Third, this variable can be seen as an extremely subjective indicator. In any case, we use this variable to check the validity of our results to alternative measures of childhood circumstances (see Section 5 below).

We propose to use parental education as a measure of individuals' childhood circumstances. Individuals report the highest level of education attained by the mother and the father. We summarize this information building a dummy variable called "*educated_family*" that takes value 1 when at least one of the parents has secondary education.[4] We have also explored the possibility of introducing separately the educational levels of both parents. The results are very similar, although the sample size gets much lower because of the large

[1] The list of countries is: Austria, Belgium, Cyprus, Denmark, Finland, France, Greece, Hungary, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden and United Kingdom.

[2] For an overview of EU-SILC, see Wolff, Montaigne, and Rojas González (2010). To access further information about EU's regulations concerning the SILC, data documentation provided by Eurostat, and SILC variable lists, we recommend the EU-SILC web portal provided by the GESIS research institute at http://www.gesis.org/.

[3] Individuals are asked how frequent financial problems in the household were when they were young teenagers. In the 2005 cross section there are five possible answers: 1 (most of the time), 2 (often), 3 (occasionally), 4 (rarely), and 5 (never). In the 2011 cross section there are six possible answers: 1 (very bad), 2 (bad), 3 (moderately bad), 4 (moderately good), 5 (good), and 6 (very good).

[4] The mean value of educated-family is .412 (st. dev. is .492). Requiring tertiary education would be too restrictive, since only a 14.93% of individuals in the sample have at least one parent with tertiary education.

increase in missing values.[5]

Since we want to use the intergenerational module, we exclude from the 2005 and 2011 cross sections all individuals who are not in the age range (25-65) or are not the selected respondent. To assess the long-run effect of household characteristics, we also have to exclude those individuals who lived in a collective house or in some institution when young.

As we said above, we merge data on public expenditure in education from the UNESCO Database for Education to the EU-SILC sample. The UNESCO Database for Education contains, for several years, country data on public expenditure in education per student as a % of per capita GDP at three levels (primary, secondary, tertiary).[6] We cannot use directly these ratios because a large value in this ratio can be due either to high spending or to low per head GDP. What we do is to use data on per capita GDP to recover data on expenditure in primary, secondary and tertiary education for every country and year. Since data on per capita GDP are in US dollars of year 2000, the same applies to the resulting expenditure per individual.

To illustrate the data we use, Figure 1 shows per capita expenditure on primary and secondary education for the 17 countries in our sample.

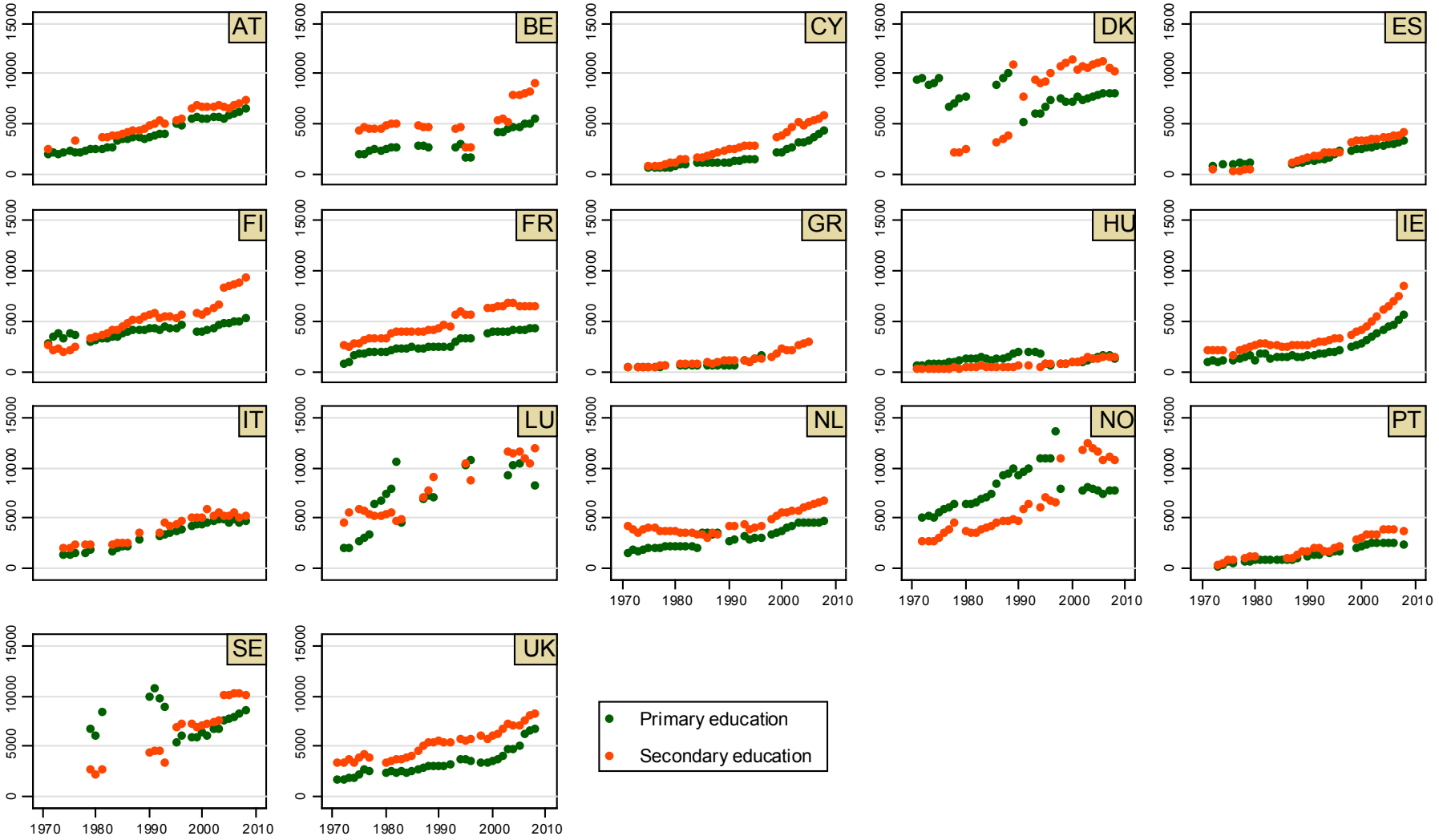
As can be seen in Figure 1, there is variation both across countries and through time. If we focus on primary education, Greece and Norway are the lowest and highest spending countries in this period, respectively. We also see that per capita expenditure in primary education was below per capita expenditure in secondary education for most countries (with the exceptions of Hungary, Norway and Sweden). Regarding expenditure in secondary education, Greece is again the lowest spending country, while Denmark is now the highest spending country.

We want to construct a variable reflecting the exposure to educational spending for each individual in our sample. In principle, there are many alternatives. In this paper we focus on expenditure in primary education. The reason is that, since primary education was compulsory in all countries in the sample during the period we consider, we are confident that all individuals in our sample must have benefitted from this type of expenditure. In contrast, expenditure in secondary education corresponds to an education level that was not compulsory for all individuals in our sample. This problem exacerbates with expenditure in tertiary education, since we cannot assume that attendance to post-compulsory levels of

[5] Our dummy variable "*educated_family*" is missing only when the education level of both the father and the mother is missing.

[6] See http://www.uis.unesco.org/Education/Pages/default.aspx

Figure 1: Expenditure in education, dollars of 2000



Source: UNESCO database.

education is an exogenous decision.

We illustrate how we build our measure of exposure to spending in primary education as follows. Suppose that a given individual in the sample attended primary education from 6 to 11 years old. For instance, an individual born in Spain in 1970 went through primary education between 1976 and 1981. Using our data on expenditure in primary education for Spain corresponding to the years 1976 to 1981, we calculate the average of these six numbers. We call PEE the variable we construct in this way.[7] Because of availability of data on public spending, we have to restrict our sample to include individuals born between 1960 and 1980 (2005 cross section) and between 1960 and 1986 (2011 cross section). We also exclude those individuals who were not born in the country, since we do not know whether they attended primary education in a different country. Our final sample consists of 144,767 individuals from 17 countries. A 45.09% belong to the 2005 wave (65,274 individuals) and the remaining 54.91% (79,493 individuals) to the 2011 wave.[8]

Our objective is to study whether public expenditure in education helps to mitigate the effects on adult circumstances of being raised in a disadvantaged household. In particular, we focus on individual's current poverty status. This is the information contained in the variable HX080, which is an indicator of whether the individual lives in a family with income below the poverty threshold.[9] The argument for using a relative measure of poverty is that individuals sometimes think of themselves as poor when they compare themselves with their neighbors. We define a dummy variable called "*poor*" which is 1 whenever HX080 is 1. The mean value of *poor* in our final sample is 12.33%. It is 12.08% in the 2005 wave and 12.53% in the 2011 wave. We represent in Figure 2 the percentage of individuals below the poverty line in each country. The maximum value corresponds to Spain (17.9%) and the minimum to Denmark (5.4%). The red line is the mean value for the whole sample. It is important to remember that these numbers are not representative of the whole population, since we are considering only those individuals who at the time of the survey were 25-45 in the 2005 wave

[7] Since entry and exit ages in primary education may vary across countries, we compute average spending for different age intervals in each country. See Table A.1 in the Appendix for details.

[8] An alternative possibility could be to consider public expenditure in primary education lagged for three or four years. For instance, money spent in school construction may affect far away in the future, and not only the current year. A problem with this approach is the big reduction in sample size, since we have to eliminate the first three or four years of observations. We comment below on how results may change when we consider this alternative approach.

[9] The poverty line corresponds to 60% of equivalized household disposable income and corresponds to the standard measure of poverty in the European Union. Equivalized household disposable income (HX090) is equal to the product of total disposable household income (HY020), multiplied by an inflation factor for within-household non-response (HY025), divided by equivalized household size (HX050). That is, $HX090 = \frac{HY020 * HY025}{HX050}$.

Table 1: Summary Statistics

Variable	Mean	Std. Dev.	Min	Max	Obs
Poor	0.123	0.329	0	1	144,753
PEE (thousand US$)	2.195	1.803	0.259	10.443	144,767
Female	0.512	0.500	0	1	144,767
Educ_fam	0.412	0.492	0	1	138,815
Number of siblings	1.593	1.549	0	40	141,169
Single mother family	0.081	0.273	0	1	142,147
Poor_past	0.139	0.346	0	1	126,670
Father unemployed	0.009	0.097	0	1	132,924
Non citizen	0.004	0.066	0	1	144,568
Year 2011	0.549	0.497	0	1	144,767
Gdp_p (thousand US$)	12.253	5.106	2.481	36.054	144,767
Ineq_p	34.941	4.230	26.079	43.271	141,404
Teen_ur	34.424	17.478	0	99.06	113,056
socwel	26.178	4.544	17.888	40.521	90,810
Country dummies					
AT					7,249
BE					5,456
CY					4,255
DK					3,715
ES					17,731
FI					6,886
FR					12,626
GR					8,016
HU					14,092
IE					4,813
IT					25,795
LU					3,517
NL					7,614
NO					3,728
PT					6,346
SE					1,908
UK					11,020

or 25-51 in the 2011 wave. In particular, the elderly are excluded from our sample.

In addition to parental education, we consider a set of household characteristics when the individual was young (unemployed father, number of siblings, single mother family, etc.). We do not use information on parents occupation, since these variables contain a large fraction of missing values. Table 1 shows the main descriptive statistics. A complete description of all the variables used in this analysis can be found in Appendix 2.

We illustrate in Table 2 below the correlation between current poverty status and past poor parental circumstances, measured by parental education. We compute probabilities for the current poverty status (as measured by the variable *poor*), conditional on the two possible values of the variable *educated_family*. We do it separately for the two cross sections and also pooling all the data. As Table 2 shows, there is a strong correlation between these two variables.

Table 2: Long-run effects of parental education

	Poor 2005	Poor 2011	Poor All
educated_family=0	15.20	16.55	15.92
educated_family=1	6.83	7.03	6.95
All	12.08	12.53	12.33

To read Table 2, let us focus on the first column ("Poor 2005"). In the 2005 cross section, the proportion of individuals who had low-educated parents that are below the poverty line is 15.20%. However, for those individuals with educated parents this probability is just 6.83%. We find similar differences in the 2011 cross section (16.55% vs. 7.03%) and with the two cross sections combined (15.92% vs. 6.95%). So, roughly speaking, the probability of being below the poverty line for individuals without educated parents is twice as big, compared with that of individuals with educated parents. We also illustrate these correlations in Figure 3 below where we represent poverty rates by country for individuals with educated and non-educated

Figure 2: Poverty rate by country

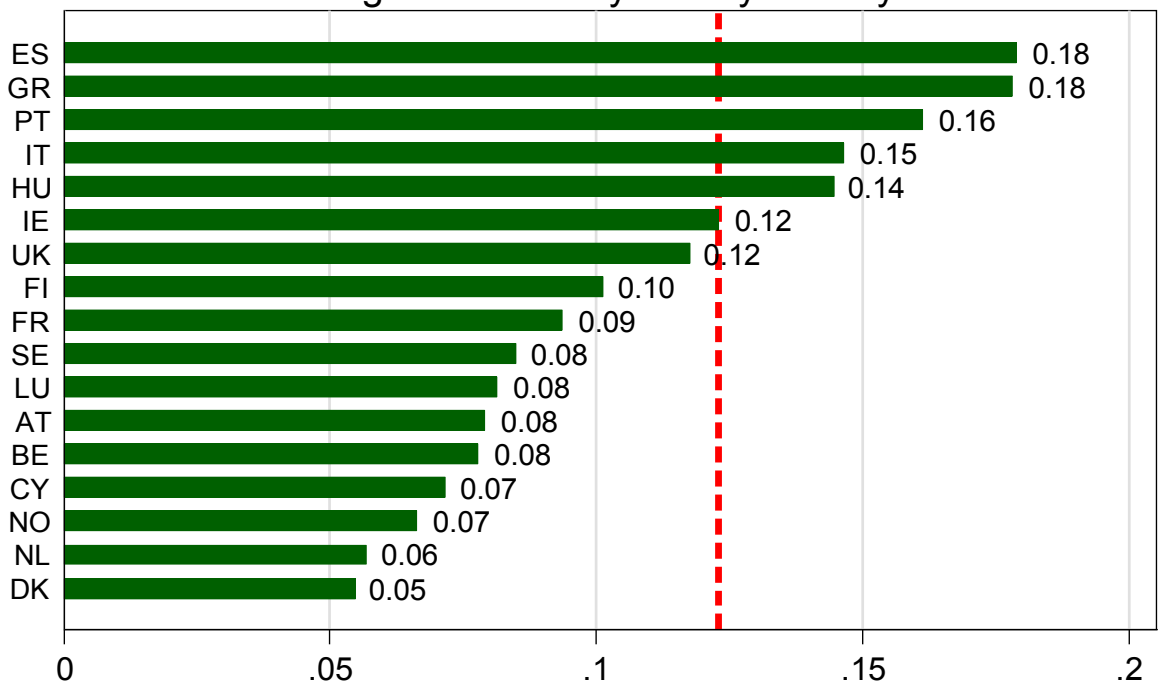
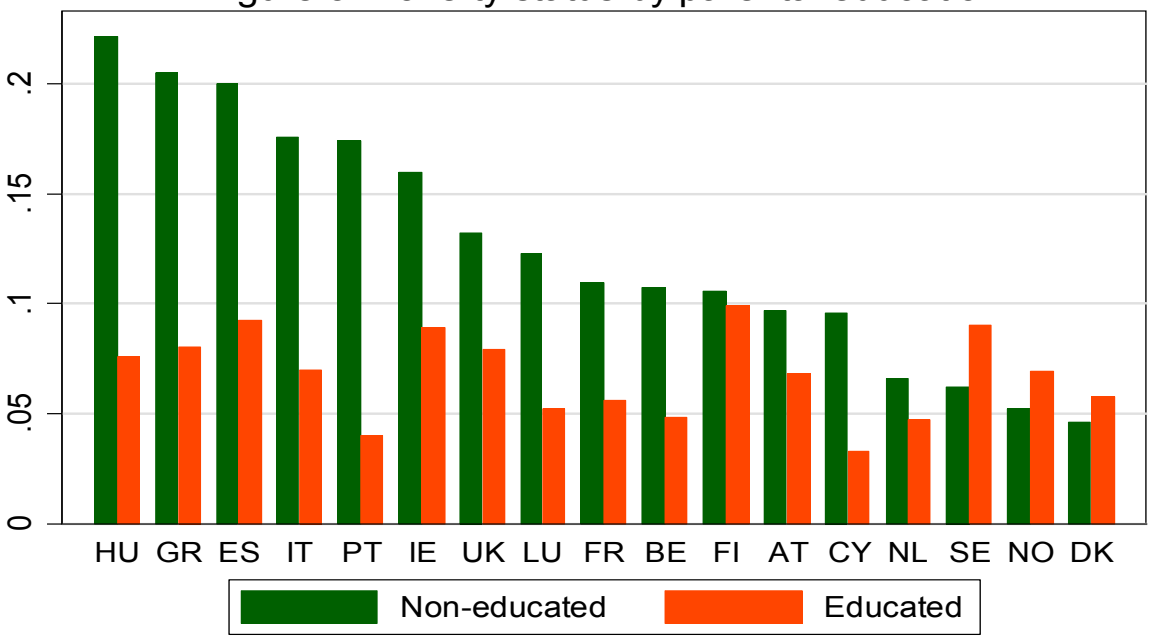


Figure 3: Poverty status by parental education



parents, respectively.

We find striking differences across countries. While the general pattern is that poverty rates are higher among those who have non-educated parents, there are three countries (Denmark, Norway, and Sweden) where poverty rates are larger for individuals from educated families. These four countries have in common that in all of them poverty rates are very low.

Figure 4 represents the connection between public expenditure in education in the past and poverty rates today. We represent the average value of *PEE* and *poor* for each country. Countries that spent more in primary education in the past have typically lower poverty rates today. We also fit a quadratic line to illustrate the fact that the effect of public spending seems to have decreasing returns.

To see the effect of expenditure by family type, we compute in each country poverty rates according to the education of parents. As seen in Figure 3, poverty rates are typically higher among individuals with non-educated parents. Figure 5 shows poverty rates for these two groups as a function of average public expenditure in primary education. Again we fit a quadratic line for each group. We find that higher expenditure is associated with lower poverty rates only for individuals whose parents have little education.

In the rest of the paper we analyze whether these relationships observed at the country level also hold at the individual level.

3 Empirical model

Our aim is to study the effect that has public expenditure in education on reducing the long-run negative effects of having a disadvantaged background when young. We need to control as accurately as possible for additional factors affecting our dependent variable. Household characteristics consist of parental education, number of siblings, and having been raised in a single-mother family. Our set of additional explanatory variables includes gender, time dummies, and a dummy variable that indicates not being a citizen of the country. A first

Figure 4: Expenditure in education and poverty rates

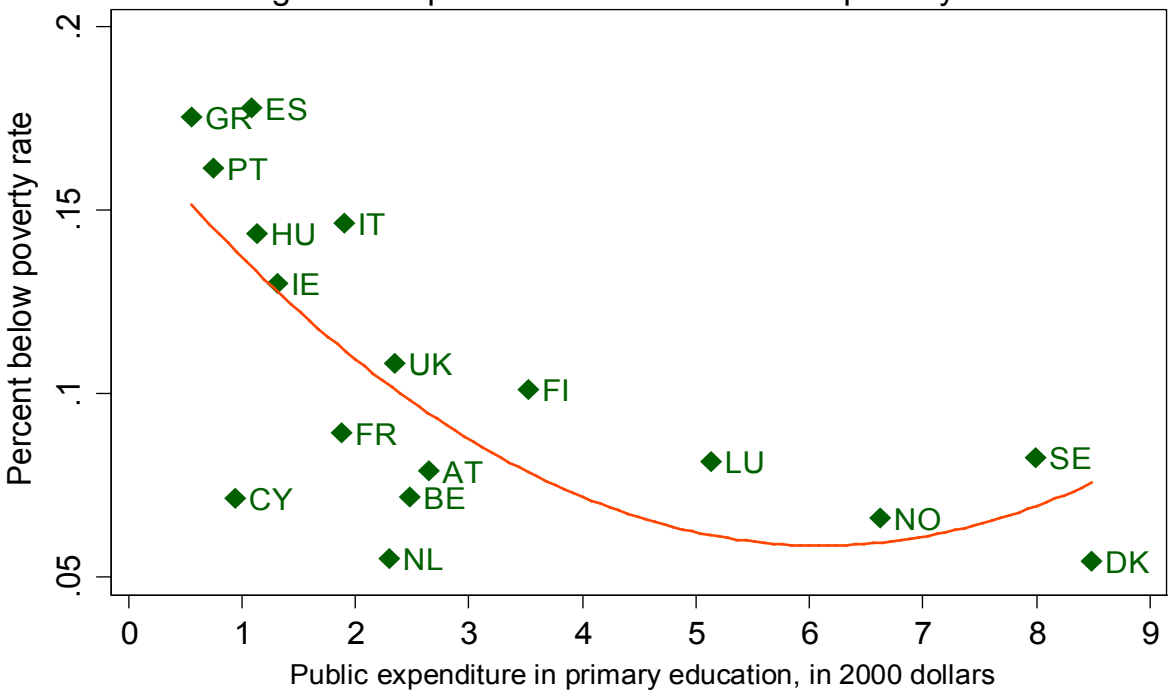
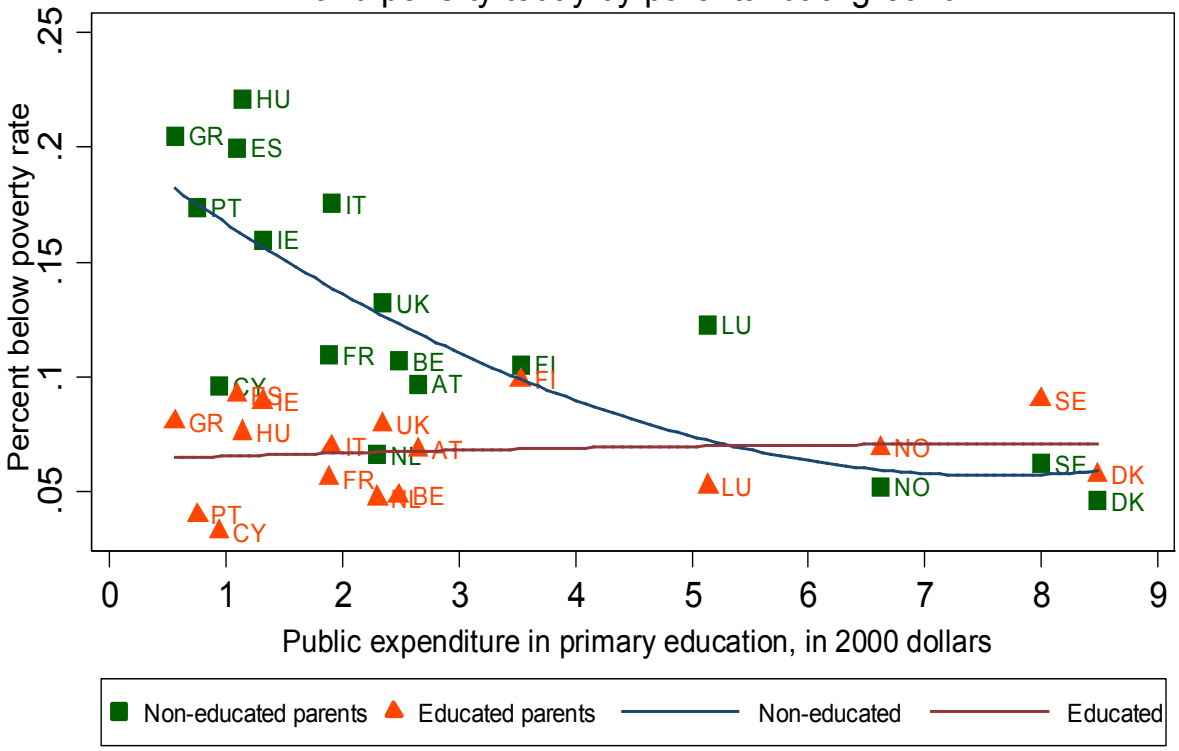


Figure 5: Public expenditure in education and poverty today by parental background



possibility is to estimate the following linear probability model (Model A):

$$poor_i = \beta_0 + \beta_1 PEE_{ct} + \beta_2 (PEE_{ct})^2 + \beta_3 educ\_fam_i + X_i\gamma + \beta_c + \beta_t + \varepsilon_i, \qquad (1)$$

where $poor_i$ is an indicator that equals 1 if individual i belongs to a household that has disposable income below the poverty line. Variable PEE_{ct} is our measure of the exposure to public spending in primary education of a particular individual in country c born in year t. In particular, we use the average public expenditure in primary education. Since the country evidence from Figure 4 suggests the existence of decreasing returns, we include a quadratic term for PEE_{ct}. We will test the functional form of this relationship, captured by parameter β_2.

The vector X_i contains the remaining explanatory variables, apart from parents education. First, there are variables that capture current circumstances (gender, non-citizen status, etc.). Second, we include a set of parental background variables (single mother family, etc.). Third, we include average per capita GDP during individual's period of primary school attendance (denoted by gdp_p). If we do not do this, the impact of expenditure in education might be biased. Rich countries raise more revenue from taxes and can dedicate more resources to education. At the same time, they have lower poverty rates. Then, the impact of public expenditure in education will be overestimated. The idea is that average per capita GDP may capture the general effect of government expenditure, while PEE_{ct} captures only expenditure in basic education. Not surprisingly, the two variables PEE and gdp_p are strongly correlated.[10] However, this is not a problem because of our large sample size. In addition, in Section 5 below we check the robustness of our findings by incorporating a measure of the size of public social expenditure.

Four, we also include a measure of "initial inequality" (denoted by $ineq\_p$). It is well known that some forms of spending are entitlements. But then, countries that are initially more unequal or with many poor households will need to spend more than countries with fewer poor families. If it is so, and we do not account for this effect, the impact of PEE could be underestimated. In Appendix 2 we provide a detailed description of all the variables we use.

The crucial issue for identification is the assumption regarding exogeneity of public expenditure. Variation in this variable arises because of differences in expenditure across countries at the same point in time and differences in country expenditure over time. Either difference could be partly endogenous with respect to the poverty rate and related to both country ex-

[10] The correlation coefficient is 0.7603.

penditure and children's eventual income. The inclusion of gdp_p and $ineq\_p$ as regressors help to correct this endogeneity problem, since the remaining variation in our regressor of interest cannot be due to a general trend in government spending or to changes in inequality in the society. We also include country fixed effects to the model, captured by the term β_c which contains a set of dummy variables, to control for invariant factors within countries. Finally, parameter β_t is a vector of year of birth indicator variables to capture any factors influencing country public expenditure at a point in time. In particular, it addresses a possible time trend toward increasing public expenditure.

We assume that the error term ε_{ic} is uncorrelated with public expenditure in primary education PEE_{ct} and with the remaining regressors. Finally, since we combine individual-level data with group-level data in our variable of interest (PEE_{ct}), errors are clustered at the country and year of birth level.[11] Since our dependent variable is a binary variable, we also estimate a Probit model.

To study the role of public expenditure in education on intergenerational mobility we test whether individuals that grew up in families in which both parents had little education benefit more or less from government investment in education compared to other individuals. To do this, we estimate a model similar to Model A above, but adding an interaction term of expenditure in primary education with the dummy variable *educated_family*. This is Model B:

$$\begin{aligned} poor_i &= \beta_0 + \beta_1 PEE_{ct} + \beta_2 (PEE_{ct})^2 + \beta_3 educ\_fam_i + X_i\gamma + \beta_c + \beta_t \\ &\quad + \beta_4 (PEE_{ct} \times educ\_fam_i) + \beta_5 ((PEE_{ct})^2 \times educ\_fam_i) + \varepsilon_i. \end{aligned} \tag{2}$$

According to this model, if public expenditure in education increases intergenerational mobility, the term $\beta_4 + 2\beta_5 PEE_{ct}$ should be positive. In the section below we provide not only the estimated coefficients of these models, but also the marginal impact of PEE_{ct} for the two levels of parental education and we check the existence of intergenerational mobility. However, as it depends on the particular value of PEE_{ct}, we think that providing just one estimate might not be clear enough and thus we compute marginal effects corresponding to several values of PEE_{ct}.

[11] See Moulton (1986) for the importance of controlling for cluster effects.

4 Results

Table 3 presents the estimated coefficients of five alternative specifications in which the measure of PEE is the average public expenditure in primary education. We estimate each model by OLS and Probit. The first specification is Model A (without interactions). Next, we present four alternative specifications of Model B. Model 1 contains neither country nor year dummies. Model 2 adds country fixed effects, whereas Model 3 only adds the year dummies. Models 4 includes both country and year dummies, and it is our preferred specification. The first five rows in Table 3 show the estimates of parameters β_1 to β_5. As can be seen in the table, the impact of most explanatory variables is similar under all our specifications. Expenditure in primary education has the hypothesized effect on the probability of being poor today. The estimate of β_1 is always negative, while the estimate of β_2 is always positive, confirming the quadratic relationship we observed in Figure 4. Expenditure in primary education reduces the probability of being poor, but this effect becomes smaller as PEE increases. Women are more likely to be poor. All variables reflecting parental background have the expected sign. In addition, not being a citizen increases the probability of being poor. The same happens with the variable that reflects initial inequality, pointing out to persistence in poverty, since poverty rates are typically higher in countries with more inequality. We also find a positive effect of average GDP during the period of primary school attendance (*gdp_p)* on the probability of being poor today. This could be due to a convergence process among the country-cohorts analyzed. Countries that enjoyed in the past large values of per capita GDP have grown less through the period we consider, compared to countries with lower values.[12] Finally, the estimate for the dummy *cs2011* is positive, probably reflecting the effect of the economic crisis.

In Table 4 we calculate the average marginal effects corresponding to the variables PEE and parental education. In the bottom part of the table we also show the marginal effect of PEE calculated separately by family type for the two types of families according to their

[12] We estimate a simple growth equation with the 17 countries in our sample. The independent variable is the logarithm of per capita GDP in 1971. The dependent variable is the logarithm of the ratio between per capita GDP in 2008 and per capita GDP in 1971. The estimation we get is (standard errors in brackets, $R^2 = .1329$):

$$\ln\left(\frac{gdp\_2008}{gdp\_1971}\right) = \underset{(.9252)}{2.2875} - \underset{(.1008)}{.1528}\ln(gdp\_1971).$$

Although statistically not significant, the negative coefficient is in the direction that supports the hypothesis that countries with low initial per capita GDP grow faster than countries with high initial per capita GDP.

Table 3: Estimated coefficients. Dependent variable is *poor*

	OLS					PROBIT				
	Model A	Model B				Model A	Model B			
VARIABLES		**Model 1**	**Model 2**	**Model 3**	**Model 4**		**Model 1**	**Model 2**	**Model 3**	**Model 4**
PEE	-0.0129*	-0.0246***	-0.0339***	-0.0375***	-0.0320***	-0.113***	-0.0873**	-0.162***	-0.164***	-0.158***
	(0.00766)	(0.00766)	(0.00849)	(0.00628)	(0.00904)	(0.0435)	(0.0398)	(0.0467)	(0.0332)	(0.0483)
PEE2	0.00116*	0.00152**	0.00254***	0.00269***	0.00244***	0.00979***	0.00356	0.0116***	0.0103***	0.0113***
	(0.000631)	(0.000700)	(0.000681)	(0.000579)	(0.000771)	(0.00345)	(0.00367)	(0.00363)	(0.00305)	(0.00411)
Family educated	-0.0704***	-0.130***	-0.132***	-0.141***	-0.132***	-0.395***	-0.620***	-0.649***	-0.683***	-0.649***
	(0.00312)	(0.00839)	(0.00818)	(0.00818)	(0.00832)	(0.0154)	(0.0475)	(0.0448)	(0.0466)	(0.0452)
Family educated#PEE		0.0311***	0.0366***	0.0371***	0.0363***		0.107***	0.144***	0.140***	0.143***
		(0.00584)	(0.00520)	(0.00555)	(0.00530)		(0.0328)	(0.0284)	(0.0312)	(0.0289)
Family educated#PEE2		-0.00162***	-0.00242***	-0.00226***	-0.00239***		-0.00255	-0.00761**	-0.00608*	-0.00750**
		(0.000613)	(0.000538)	(0.000578)	(0.000547)		(0.00352)	(0.00307)	(0.00332)	(0.00312)
Female	0.0131***	0.0122***	0.0130***	0.0124***	0.0130***	0.0696***	0.0642***	0.0695***	0.0657***	0.0698***
	(0.00183)	(0.00183)	(0.00183)	(0.00182)	(0.00183)	(0.00965)	(0.00943)	(0.00962)	(0.00945)	(0.00964)
Non citizen	0.0449**	0.0519***	0.0557***	0.0528***	0.0564***	0.255***	0.255***	0.298***	0.263***	0.303***
	(0.0189)	(0.0190)	(0.0186)	(0.0191)	(0.0186)	(0.0831)	(0.0840)	(0.0822)	(0.0848)	(0.0821)
Single mother family	0.0286***	0.0228***	0.0294***	0.0197***	0.0292***	0.162***	0.124***	0.166***	0.106***	0.164***
	(0.00495)	(0.00502)	(0.00494)	(0.00503)	(0.00494)	(0.0256)	(0.0256)	(0.0256)	(0.0257)	(0.0255)
Number of siblings	0.0209***	0.0180***	0.0207***	0.0186***	0.0205***	0.0882***	0.0750***	0.0875***	0.0776***	0.0868***
	(0.00111)	(0.00112)	(0.00109)	(0.00109)	(0.00110)	(0.00422)	(0.00418)	(0.00416)	(0.00410)	(0.00420)
Father unemployed	0.139***	0.146***	0.140***	0.143***	0.140***	0.502***	0.537***	0.505***	0.523***	0.508***
	(0.0135)	(0.0134)	(0.0134)	(0.0134)	(0.0134)	(0.0408)	(0.0401)	(0.0407)	(0.0398)	(0.0406)

Table 3 (cont.): Estimated coefficients. Dependent variable is *poor*

	OLS					PROBIT				
	Model A	Model B				Model A	Model B			
VARIABLES		**Model 1**	**Model 2**	**Model 3**	**Model 4**		**Model 1**	**Model 2**	**Model 3**	**Model 4**
GDP_P	0.00756***	-0.00198***	0.00515***	-0.00179***	0.00526***	0.0412***	-0.00978**	0.0315***	-0.00761**	0.0306***
	(0.00195)	(0.000749)	(0.00128)	(0.000652)	(0.00185)	(0.0109)	(0.00419)	(0.00806)	(0.00368)	(0.0104)
INEQ_P	0.00193**	0.000849	0.00145**	-0.000502	0.000777	0.00706	0.00453	0.00844**	-0.00265	0.00310
	(0.000909)	(0.000636)	(0.000712)	(0.000592)	(0.000898)	(0.00492)	(0.00320)	(0.00346)	(0.00302)	(0.00486)
Year 2011	0.0177***	0.0211***	0.0185***	0.0141***	0.0166***	0.0800***	0.103***	0.0868***	0.0649***	0.0762***
	(0.00272)	(0.00274)	(0.00266)	(0.00282)	(0.00275)	(0.0139)	(0.0139)	(0.0136)	(0.0145)	(0.0141)
Country dummies	YES	NO	YES	NO	YES	YES	NO	YES	NO	YES
Year dummies	YES	NO	NO	YES	YES	YES	NO	NO	YES	YES
Constant	-0.0828*	0.135***	0.00211	0.174***	0.0155	-2.070***	-1.166***	-1.899***	-0.943***	-1.730***
	(0.0434)	(0.0259)	(0.0246)	(0.0240)	(0.0450)	(0.228)	(0.129)	(0.129)	(0.123)	(0.234)
Observations	126,389	126,389	126,389	126,389	126,389	126,389	126,389	126,389	126,389	126,389
R-squared	0.040	0.033	0.041	0.035	0.042					

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

education levels).[13]

Except for Model A under the OLS specification, we always find a negative and significant effect of PEE on the probability of being poor in adulthood. The estimations of the marginal effects of PEE are quite similar under the OLS and Probit specifications. Considering only the models with interactions (Model B), and depending on the specification we adopt, we obtain a marginal effect of PEE between −0.00875 and −0.0183. To illustrate the size of the effects we obtain, let us consider the estimate we get in our preferred OLS specification, Model 4. We obtain a marginal effect for PEE of −.0117. This means that increasing PEE by $1,000 reduces on average the probability of being poor in 1.17 percentage points. Or, alternatively, increasing PEE in one standard deviation **($1,803)** reduces on average that probability in 1.54 percentage points (1,803*1.17). This is a sizable effect, since it represents a 12.5% of the mean value of the variable *poor* (the mean of *poor* is 0.123).[14]

The effect of having educated parents is also very strong, in line with what we saw in Table 2. Focusing again on Model 4 with the OLS specification, the marginal effect we obtain (−.0720) indicates that having at least one parent with secondary education reduces the probability of being below the poverty line in 7.2 percentage points. The effect of having educated parents is comparable in size to having an additional spending in primary education of $6,154 (7.2/1.17), more than three times the standard deviation of PEE.[15]

In the bottom part of Table 4 we see that the effect of PEE concentrates mostly on individuals from low-educated families. (This is in the bottom part of Table 4.) In most cases we do not find a significant effect on individuals with at least one parent with secondary education. In the case of Model 4 (OLS), the marginal effect of PEE estimated for individuals from low-educated families (−.0236) is negative and strongly significant, while the corresponding marginal effect for individuals with educated families is not significant. Then, increasing PEE in one standard deviation reduces the probability of being poor in 4.25 per-

[13] We also computed the marginal effect of PEE for educated and non-educated families in Model A even though this model does not include the interaction term between PEE and the dummy variable *educated_family*.

[14] We have also run all our regressions using public expenditure lagged four years. Results follow a similar pattern, although the marginal effects of PEE we obtain are smaller in size. This suggests that it is indeed current expenditure in education (expenditures for the day-to-day operation of schools, including expenditures for staff salaries, etc.) and not capital expenditure (building construction or purchases of equipment) which has an effect on students' outcomes.

[15] Results are also similar if we include separately two variables capturing both father and mother educational levels. The impact of increases in PEE reduces as both father and mother education increases. In addition, in general, the effect of mother's education on poverty reduction is somewhat larger than that of father's education.

Table 4: Marginal effects of *PEE* and *educated_family* on *poor*

	OLS					PROBIT				
	Model A	Model B				Model A	Model B			
VARIABLES		**Model 1**	**Model 2**	**Model 3**	**Model 4**		**Model 1**	**Model 2**	**Model 3**	**Model 4**
PEE	-0.00781	-0.00875**	-0.0131**	-0.0156***	-0.0117**	-0.0144**	-0.00913*	-0.0171***	-0.0183***	-0.0164**
	(0.00533)	(0.00429)	(0.00545)	(0.00345)	(0.00558)	(0.00635)	(0.00493)	(0.00653)	(0.00407)	(0.00647)
Educated_family	-0.0704***	-0.0748***	-0.0720***	-0.0785***	-0.0720***	-0.0758***	-0.0758***	-0.0732***	-0.0790***	-0.0733***
	(0.00312)	(0.00267)	(0.00280)	(0.00278)	(0.00281)	(0.00295)	(0.00267)	(0.00249)	(0.00271)	(0.00248)
Decomposition of the effect of PEE										
Educated_family==0	-0.00887	-0.0193***	-0.0251***	-0.0283***	-0.0236***	-0.0191**	-0.0182***	-0.0298***	-0.0315***	-0.0289***
	(0.00579)	(0.00539)	(0.00645)	(0.00442)	(0.00667)	(0.00817)	(0.00695)	(0.00887)	(0.00580)	(0.00888)
Educated_family==1	-0.00633	0.00590*	0.00343	0.00197	0.00461	-0.00783**	0.00337	0.000514	-5.96e-05	0.000871
	(0.00473)	(0.00342)	(0.00449)	(0.00284)	(0.00451)	(0.00386)	(0.00274)	(0.00368)	(0.00234)	(0.00355)
Observations	126,389	126,389	126,389	126,389	126,389	126,389	126,389	126,389	126,389	126,389

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

centage points (1,803*2.36) among individuals from low-educated families. This represents a 26.7% of the mean value of the variable poor among this group (0.159, see Table 2).

As a further illustration, we plot the predicted probabilities of being poor today corresponding to different values of PEE and separately according to the two levels of parental education. We do this in Figure 6. The predicted probabilities represented correspond to Model 4. We observe that the effect of PEE differs a lot by parental education level. In particular, the effect of PEE seems to affect only those individuals with uneducated parents. In addition, individuals with poorly educated families only catch up those with educated parents when the value of PEE is high.

4.1 Differential impact of PEE by country income and initial inequality

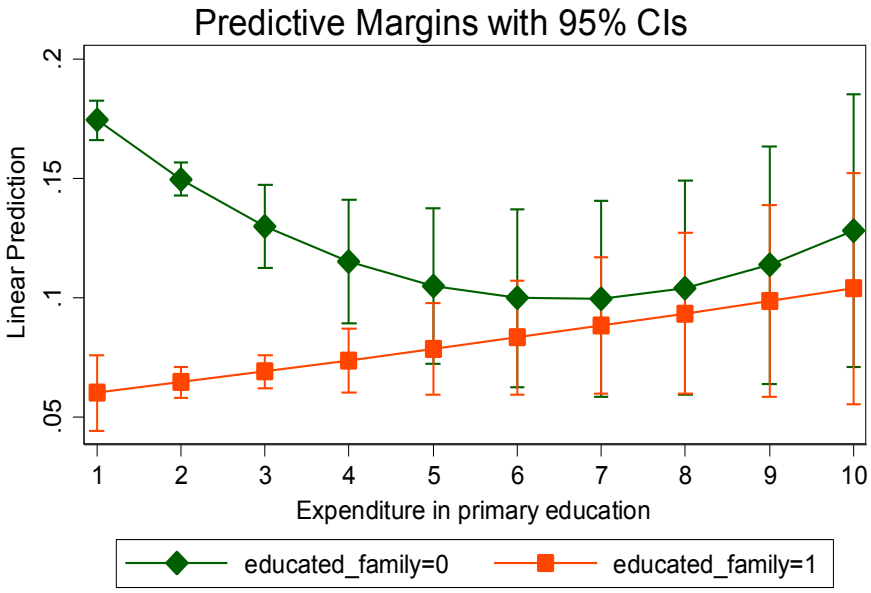
We check whether PEE has a similar impact on poverty reduction regardless of some contextual variables as country GDP or inequality. In order to do, so we modify Model B above including two additional interaction terms of expenditure in primary education: one with the variable *gdp_p* and the other with the variable *ineq_p*. In Table 5 below we calculate the average marginal effects corresponding to the variables PEE, parental education, average per capita GDP during primary school attendance and initial inequality level.

As can be observed, results are very similar to those presented in Table 4. We plot the average marginal effect of PEE on the probability of being poor today separately according to parental education for different values of *gdp_p* and *ineq_p*. This is done in the top and bottom parts of Figure 7, respectively. Similarly to Figure 6 above, the marginal effects represented correspond to Model 4, in particular, under the OLS specification.

In the top part of Figure 7 we see that the effect of PEE on reducing poverty does not seem to be affected by *gdp_p*. Regardless of country income, the effect of PEE concentrates on individuals from low-educated families.

Figure 6: Predicted probabilities of being poor for different values of PEE (Model B)

OLS



PROBIT

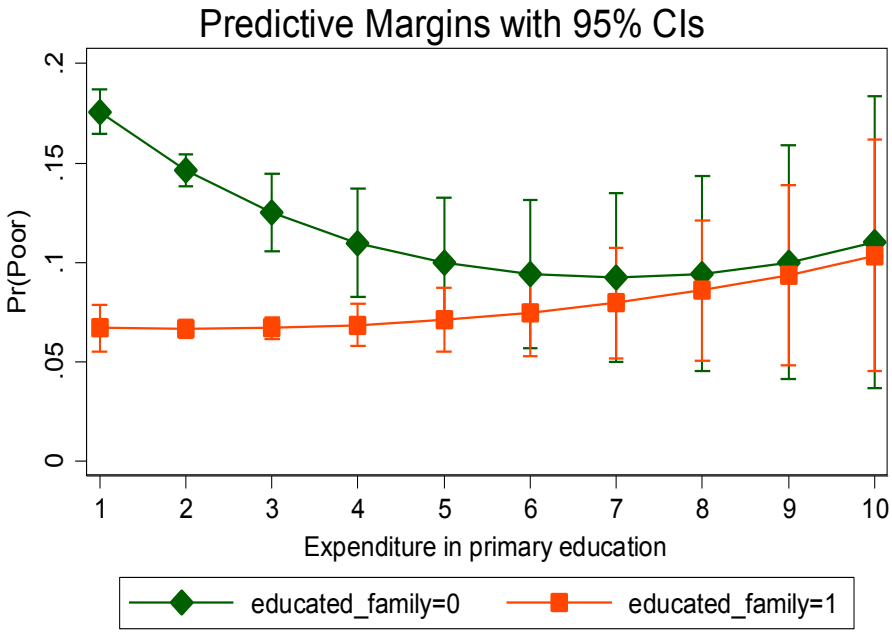
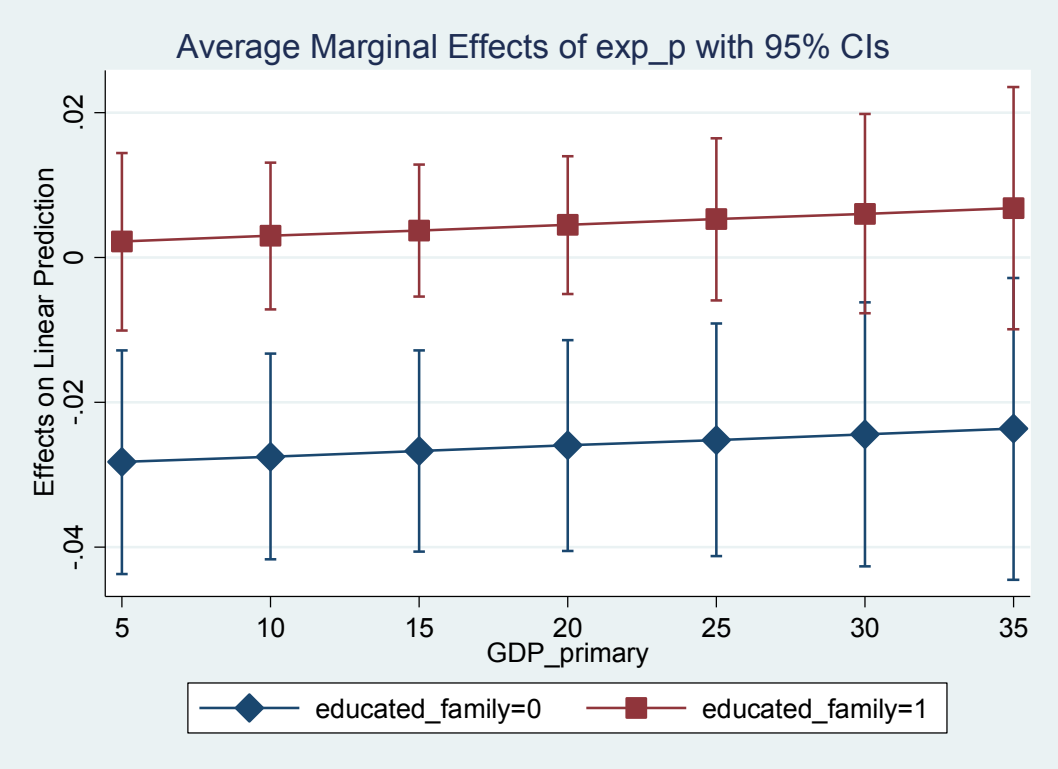


Figure 7: Marginal effects of PEE on the probability of being poor for different values of GDP_p and INEQ_p (Model B, OLS)

GDP_p



INEQ_p

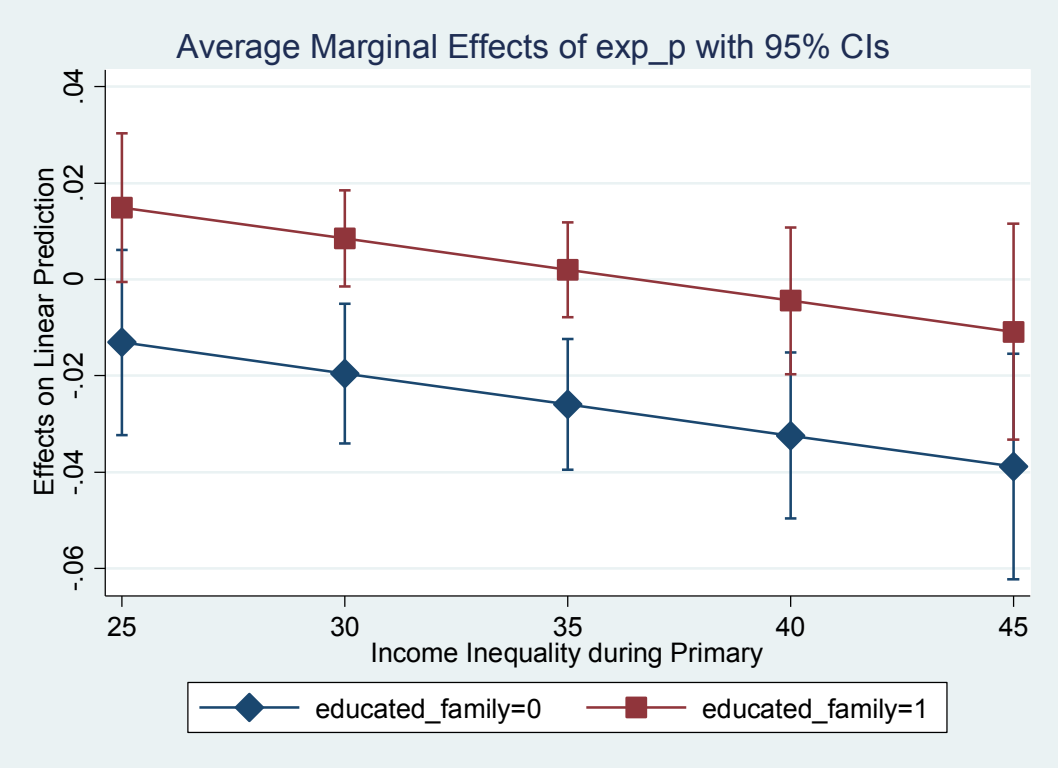


Table 5: Differential impact of PEE by country income and inequality

	Model 4	
VARIABLES	**OLS**	**PROBIT**
PEE	-0.0119**	-0.0158**
	(0.00556)	(0.00645)
Family_educated	-0.0724***	-0.0736***
	(0.00286)	(0.00252)
GDP_p	0.00499**	0.00411*
	(0.00207)	(0.00218)
Ineq_p	0.000612	0.000195
	(0.000987)	(0.000987)
Observations	126,389	126,389

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

As can be observed in the bottom part of Figure 7, the effect of PEE on poverty reduction is more effective when initial inequality is high. Then, public expenditure in education not only helps to increase intergenerational mobility but also promotes a converge process in inequality among the country-cohorts analyzed.

4.2 Background: exploring the mechanisms

The "reduced-form" model used to analyze the long-term effect of PEE might represent a shortcoming of our approach.[16] The economic theory underlying the relationship between public expenditure in education and poverty reduction is a human capital model in which individuals' outcomes today are a function of both their own endowments and of human capital investments received while young. Including the educational level of individuals among our regressors does not help, since the educational level is itself an endogenous variable. One possibility is to estimate a bivariate model in which we consider two endogenous variables, poverty status and educational level. The idea is that these two variables are interrelated. To do this, we summarize the educational level of each individual into a dichotomous variable, called "*noncomp_educ*". This variable takes value 1 when the individual has a level of education beyond what is considered in her country as compulsory schooling, and it is 0 otherwise. In the table below we illustrate how the sample is divided into 4 disjoint groups according to the values of the two binary variables:

Table 6: Poverty and Education

		Level of education		
		More than comp. educ.	Only comp. education	Total
Poverty	poor=1	.0618	.0591	.1233
status	poor=0	.6914	.1767	.8765
	Total	.7533	.2359	1

We estimate a bivariate Probit model where the two binary dependent variables are poverty status ("*poor*") and the level of education ("*noncomp_educ*"). In addition, we include "*noncomp_educ*" as a regressor in the first equation. Since this is an endogenous regressor, we propose to instrument it by including in the second equation a variable that

[16] See Jackson et al (2014) who also acknowledge this problem.

describes the regional level of unemployment during the period the individual had to decide whether or not to acquire education beyond the compulsory level. This is a variable called "*teen_ur*" (see Table 1 and Appendix 2 for details on this variable). Several authors like Gustman and Steinmeier (1981), Betts and McFarland (1995), Arkes (2010) or Johnson (2013) have found that youth market labor conditions affect school enrollment and educational attainment.[17] Table 7 below shows these results.

The effect that expenditure has in primary education seems to work through two channels. First, it has the effect of increasing the fraction of individuals with post-compulsory education. Since those with more than compulsory education are less likely to be poor, this reduces mechanically the proportion of individuals below the poverty line. Second, it has also the effect of raising above the poverty level a significant fraction of individuals with more than compulsory education.

To conclude, and even though there might be other mechanisms through which increasing expenditure in primary education reduces the incidence of poverty in adulthood (for example, by improving students' test scores and thus their productivity and wages), our results suggest that this effect is at least partially driven by pushing education acquisition beyond compulsory levels. Nevertheless, these findings are only suggestive and further work identifying and establishing causal relationships is needed.

5 Robustness analysis

In this section we study the robustness of our analysis using alternative definitions of parental background, current poverty status and incorporating additional regressors that control for the impact of general government spending policies.

5.1 Past poverty

Here we use as an alternative measure of parental background the variable that tells us whether an individual experienced difficulties when teenager or not (*poor_past*). We estimate three alternative models. In Model 1 we estimate a model similar to Equation (2), but the

[17] Indeed, Arkes (2010) uses state unemployment rates as instruments to estimate returns to schooling and find almost identical results to those found using the quarter-of-birth instruments.

Table 7: Estimated coefficients. Biprobit

VARIABLES	poor	noncomp_educ
PEE	-0.0648	0.377***
	(0.0865)	(0.0566)
PEE2	0.00173	-0.0322***
	(0.00717)	(0.00512)
Family educated	-0.286***	1.541***
	(0.0748)	(0.0487)
Family educated#PEE	0.0250	-0.415***
	(0.0383)	(0.0311)
Family educated#PEE2	0.00200	0.0344***
	(0.00397)	(0.00321)
Female	0.114***	0.153***
	(0.0118)	(0.0112)
Non citizen	0.234***	-0.188***
	(0.0858)	(0.0723)
Single mother family	0.107***	-0.243***
	(0.0318)	(0.0311)
Number of siblings	0.0505***	-0.130***
	(0.00640)	(0.00470)
Father unemployed	0.378***	-0.438***
	(0.0473)	(0.0430)
GDP_P	0.0393**	-0.00830
	(0.0156)	(0.0103)
INEQ_P	-0.0111	0.00667
	(0.00941)	(0.00662)
Year 2011	0.0695***	-0.0702***
	(0.0136)	(0.0120)
Country dummies	YES	YES
Year dummies	YES	YES
teen_ur		0.00126**
		(0.000605)
Constant	-0.848	0.363
	(0.540)	(0.465)
Rho		0.133*
		(0.0742)
Observations	97,381	97,381

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

only variable describing parental background is *poor_past*. We lose some observations from the 2005 wave since four countries do not report this variable in that wave (Austria, France, Greece, and Portugal). Model 2 is exactly the one in Equation (2) and we include it for the sake of comparison. Finally, Model 3 is the same as Model 2, but using only those observations for which the variable *poor_past* is not missing. Table 8 reports the marginal effects of PEE and the two measures of parental background. As can be observed, the impact of PEE remains strongly significant for individuals from low educated families. Moreover, the size of the effect in all three specifications is quite similar.

One interesting implication of our analysis so far is as follows. Higher levels of PEE reduce on average the probability of being poor when adult. Additionally, being raised in a non-poor household also reduces the probability of being poor when adult. Then, the impact of PEE amplifies in the long-run. Higher values of PEE on today's children will reduce the probability of being poor when adult for those children, which in turn will reduce the probability of being poor for next generation's children.

5.2 Alternative poverty measure

Now we check the robustness of our results to an alternative measure of poverty. Recall from Section 2 that we define an individual as being poor whenever he/she lives in a family with income below the poverty threshold which corresponds to 60% of equivalized household disposable income. However, this measure of *disposable* income might well be affected by current redistributive policies, in which case the effect of PEE could be biased. In order to address this limitation we construct an alternative measure of current poverty status, using disposable household income *before* social transfers other than old-age and survivor's benefits.[18] For the sake of simplicity we show in Table 9 below (columns 2 and 3) only the marginal effects computed with Model 4.

Again we see in Table 9 that public expenditure in primary education has a strong effect

[18] Our new measure of equivalized disposable household income is equal to the product of total disposable household income before social transfers other than old-age and survivor's benefits (HY022), multiplied by an inflation factor for within-household non-response (HY025), divided by equivalized household size (HX050). That is, $\frac{HY022*HY025}{HX050}$.

Table 8: Marginal effects of PEE on poor. Parental background measures

	Model 1		Model 2		Model 3	
VARIABLES	OLS	PROBIT	OLS	PROBIT	OLS	PROBIT
PEE	-0.00779	-0.0131**	-0.0117**	-0.0164**	-0.0107*	-0.0150**
	(0.00543)	(0.00640)	(0.00558)	(0.00647)	(0.00574)	(0.00667)
Poor_past	0.0636***	0.0602***				
	(0.00446)	(0.00418)				
Family_educated			-0.0720***	-0.0733***	-0.0729***	-0.0738***
			(0.00281)	(0.00248)	(0.00306)	(0.00269)
Decomposition of the effect of PEE						
poor_past==0	-0.00557	-0.0113*				
	(0.00526)	(0.00585)				
poor_past==1	-0.0230***	-0.0256**				
	(0.00835)	(0.0117)				
Family_educated==0			-0.0236***	-0.0289***	-0.0223***	-0.0270***
			(0.00667)	(0.00888)	(0.00695)	(0.00926)
Family_educated==1			0.00461	0.000871	0.00482	0.000985
			(0.00451)	(0.00355)	(0.00461)	(0.00366)
Observations	115,834	115,834	126,389	126,389	113,743	113,743

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 9: Poverty rate before transfers

VARIABLES	OLS	PROBIT
PEE	-0.0234***	-0.0251***
	(0.00735)	(0.00759)
Educated_family	-0.115***	-0.115***
	(0.00329)	(0.00315)
Effect of PEE		
Educated_family=0	-0.0357***	-0.0408***
	(0.00850)	(0.00976)
Educated_family=1	-0.00649	-0.00330
	(0.00625)	(0.00510)
Observations		
Standard errors in parentheses	126,402	126,402
*** p<0.01, ** p<0.05, * p<0.1		

in reducing poverty in adulthood, using this new definition of poverty.

5.3 Social spending

Finally, to address the concern that our results might be driven by other types of public expenditure, we replicate our analysis incorporating an additional variable that captures countries' welfare state generosity during individual's period of primary school attendance (*socwel*). In particular we use the decommodification index from Scruggs (2006) and Scruggs and Allan (2006). See Appendix 2 for a detailed description of this variable. As expected, and similarly to per capita GDP commented above, variables PEE and *socwel* are strongly correlated although that correlation is lower than that between PEE and per capita GDP.[19] Table 9 below shows the marginal effects corresponding to Model 4. We estimate three alternative models. In the first one we estimate a model similar to Equation (2), but we include the variable *socwel* and also a quadratic term to capture the existence of decreasing returns to other types of public expenditure, similarly to PEE. The second model is similar to the previous one, but adding an interaction term of *socwel* with the dummy variable *educated_family* similarly than we do for PEE. Observe that we lose some data as the decommodification index is not available for Cyprus, Greece, Hungary, Luxembourg, Portugal and Spain. Finally, the third model is the same as the previous one, but excluding individuals for which the variable *socwel* is missing. As can be observed, the size of the effect of PEE is quite similar to that documented above.

6 Concluding remarks

Being raised in a poor household may have negative long-run effects on individual welfare. Here we study whether these long-run effects of poverty are mitigated by public expenditure in education, and to what extent.

Our main finding is that public expenditure in primary education has a strong long-run effect on reducing incidence of poverty in adulthood. We also find that this effect is not linear, but has decreasing returns. In addition, we find that higher spending in primary education is associated with a reduction in poverty rates only for individuals who were raised

[19] The correlation coefficient between PEE and *socwel* is 0.6347, and between *gdp_p* and *socwel* is 0.7037. See Footnote 10.

Table 10: Social policy

	Model 1		Model 2		Model 3	
VARIABLES	**OLS**	**PROBIT**	**OLS**	**PROBIT**	**OLS**	**PROBIT**
PEE	-0.0168**	-0.0191***	-0.0129*	-0.0181***	-0.0177**	-0.0237***
	(0.00665)	(0.00682)	(0.00674)	(0.00684)	(0.00684)	(0.00669)
Family_educated	-0.0507***	-0.0516***	-0.0506***	-0.0514***	-0.0505***	-0.0514***
	(0.00311)	(0.00268)	(0.00271)	(0.00262)	(0.00310)	(0.00268)
Decomposition of the effect of PEE						
Family_educated==0	-0.0244***	-0.0329***	-0.0154*	-0.0295***	-0.0291***	-0.0398***
	(0.00848)	(0.00972)	(0.00868)	(0.00985)	(0.00824)	(0.00934)
Family_educated==1	-0.00247	-0.00419	-0.00721	-0.00593	-0.00542	-0.00630
	(0.00609)	(0.00448)	(0.00603)	(0.00447)	(0.00614)	(0.00459)
Observations	76,433	76,433	76,433	76,433	76,433	76,433

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

in families with a low level of education. This result suggests that public expenditure in primary education increases intergenerational income mobility.

We believe that our results could be relevant for several recent debates in the literature on the economics of education. In particular, they provide support for policies that promote increasing expenditure in basic education, for example, by reducing the compulsory school entry age, or improving the quality of the education provided at early stages.

This study have some limitations. We do not have a direct measure of government investment in education and thus we follow previous research in using government spending as a proxy for government investment (see Mayer and Lopoo, 2008). However, this might be an imperfect measure of actual investment. For example, countries with similar public expenditure might be spending it differently and having different results with their spending depending on several other circumstances. Besides, we lack data on private expenditure in education, although some of the variables describing household characteristics can be seen as proxies of this expenditure.

References

[1] Arkes, J. (2010): "Using Unemployment Rates as Instruments to Estimate Returns to Schooling," *Southern Economic Journal* 76, 3, 711–722.

[2] Atkinson A. (2010): "Macerata Lectures on European Economic Policy. Poverty and the EU: the New Decade," *Working Paper* 24-2010, Macerata University, Department of Studies on Economic Development (DiSSE).

[3] Atkinson A., Piketty T., and E. Saez (2011): "Top Incomes in the Long Run of History," *Journal of Economic Literature* 49, 1, 3-71.

[4] Becker G.S. and N. Tomes (1979): "An equilibrium theory of the distribution of income and intergenerational mobility," *Journal of Political Economy* 87, 6, 1153-1189.

[5] Betts, J. and L. McFarland (1995): "Safe port in a storm: The impact of labor market conditions on community college enrollments," *Journal of Human Resources* 30, 741–65.

[6] Black, S. and P. Devereux (2011): "Recent Developments in Intergenerational Mobility." In: Ashenfelter, O., Card, D. (Eds.), *Handbook of Labor Economics*, Vol. 4, Part B. Elsevier, Amsterdam, 1487–1541.

[7] Esping-Andersen, G. (1990). The three worlds of welfare capitalism. Princeton: Princeton University Press.

[8] Evans W., Hout M. and M.E. Mayer (2008): "Assessing the effect of economic inequality" In: Neckerman K. (Ed.), *Social Inequality*. Russel Sage Foundation Press, New York, 933-968.

[9] Grogger, J. (1996): "School expenditures and post-schooling earnings: evidence from the high school and beyond," *Review of Economics and Statistics* 78, 4, 628–637.

[10] Gustman, A. and T. Steinmeier (1981): "The impact of wages and unemployment on youth enrollment and labor supply," *The Review of Economics and Statistics* 63, 553–60.

[11] Hanushek, E. (1996): "School resources and student performance." In: Burtless, G. (Ed.), *Does Money Matter? The Effect of School Resources on Student Achievement and Adult Success*. Brookings Institution Press, Washington, D.C.

[12] Hanushek, E. (2001): "Spending on schools." In: Moe, T. (Ed.), *A Primer on American Education*. Hoover Institution Press, Palo Alto, CA, 69–88.

[13] Hedges, L.V., Laine, R., and R. Greenwald (1992): "Does money matter? Meta-analysis of studies of the effects of differential school inputs on student outcomes." *Educational Researcher* 23, 3, 5–14.

[14] Jackson, C.K., Johnson, R., and C. Persico (2014): "The effect of school finance reforms on the distribution of spending, academic achievement, and adult outcomes," NBER Working Paper 20118.

[15] Jenkins, S., Brandolini, A., Micklewright, J. and Nolan, B. (Eds) (2013): *The Great Recession and the Distribution of Household Income*. Oxford University Press.

[16] Johnson, M. T. (2013): "The impact of business cycle fluctuations on graduate school enrollment" *Economics of Education Review* 34, 122–134.

[17] Mayer, S. E. (2002): "The Influence of Parental Income on Children's Outcomes: A Review." *Report to the New Zealand Ministry of Social Development.*

[18] Mayer, S. E., and Lopoo, L. M. (2008): "Government spending and intergenerational mobility," *Journal of Public Economics* 92, 139–158.

[19] Meghir, C., Palme, M. (2005): "Educational Reform, Ability, and Family Background," *American Economic Review* 95, 1, 414-424.

[20] Moulton, B. (1986): "Random group effects and the precision of regression estimates," *Journal of Econometrics* 32, 3, 385-397.

[21] OECD (2011): *An Overview of Growing Income Inequalities in OECD Countries: Main Findings*. OECD Publishing, Paris.

[22] OECD (2013): *Crisis squeezes income and puts pressure on inequality and poverty.* OECD Publishing, Paris.

[23] Piketty, T. (2014): *Capital in the Twenty-First Century*, Harvard University Press.

[24] Samanni, M., Teorell, J., Kumlin, S. and B. Rothstein (2010): The QoG social policy dataset, version 22 Feb 10. http://www.qog.pol.gu.se

[25] Scruggs, L. (2006): Welfare entitlements data set: a comparative institutional analysis of eighteen welfare states, version 1.2. University of Connecticut. http://sp.uconn.edu/~scruggs/wp.htm

[26] Scruggs, L., and J. Allan (2006): "Welfare-state decommodification in 18 OECD countries: a replication and revision" *Journal of European Social Policy*, 16, 55–72.

[27] Solon G. (2004): "A model of intergenerational mobility variation over time and place." In: Corak, M. (Ed.), *Generational Income Mobility in North America and Europe*. Cambridge University, Cambridge, UK, 38-47.

[28] Wolff, P., Montaigne, F., and Rojas González, G. (2010): "Investing in statistics: EU-SILC." In A. B. Atkinson and E. Marlier (eds), *Income and Living Conditions in Europe,* Chapter 2. Luxembourg: Eurostat, 38-55.

Appendix 1: Primary education in Europe

Table A.1. Period of primary education:1960-1990

Country	Reform in primary education	Interval primary
AT, BE, CY, ES, FI, FR, GR, HU, IE, IT, NO, PT	NO	6 to 11
DK, SE	NO	7 to 11
LU	NO	4 to 11
NL	Till 1978	7 to 11
NL	1979	6 to 11
NL	Since 1980	5 to 11
UK	NO	5 to 11

Source: Brunello et al (2009)

Appendix 2: Variable Description

- *Expenditure per student, primary, secondary and tertiary (% of GDP per capita)*: Public expenditure per student is the public current spending on education divided by the total number of students at that level, as a percentage of GDP per capita. Public expenditure (current and capital) includes government spending on educational institutions (both public and private), education administration as well as subsidies for private entities (students/households and other privates entities). Source: United Nations Educational, Scientific, and Cultural Organization (UNESCO) Institute for Statistics.

- *GDP per capita*: It is gross domestic product divided by midyear population. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in constant 2000 U.S. dollars. Source: World Bank national accounts data, and OECD National Accounts data files.

- *Parental education*: It is a binary variable that captures if either the education the father or mother had attained when the individual was around 14 years old is at least upper secondary education. Source: EU-SILC

- *Past poverty*: For the EU-SILC special module on "Intergenerational transmission of poverty" individuals were asked how frequent financial problems in the household were when they were young teenagers. In the 2005 cross section it is a categorical variable that takes five possible values: 1 (most of the time), 2 (often), 3 (occasionally), 4 (rarely), and 5 (never). In the 2011 cross section there are six possible answers: 1 (very bad), 2 (bad), 3 (moderately bad), 4 (moderately good), 5 (good), and 6 (very good). We summarize the information of these questions by constructing a binary variable that takes value 1 when the corresponding variable is either 1 or 2 in the 2005 cross section and when it is 1, 2, or 3 in the 2011 cross section. We call this variable "poor_past".[20] Source: EU-SILC.

- *Father unemployed*: It is a binary variables that captures if the father was unemployed when the individual was 14 years old. Source: EU-SILC.

- *Siblings*: It is the number of siblings the individual's had when he/she was around 14 years old. Source: EU-SILC.

[20] We recognize that this is completely arbitrary, and our only justification is that by doing in this way, frequencies for poor_past are similar across the two cross sections.

- *Citizenship*: It generally corresponds to the country issuing the passport. It shall refer to current (at the time of survey) national boundaries. It is a binary variable that indicates if the citizenship corresponds to the same country as the country of residence. Source: EU-SILC

- *Inequality*: It is the country average inequality during the previous years (3-5) to the period of individual's primary school attendance. Source: Estimated Household Income Inequality Data Set (EHII), global dataset on inequality derived by the University of Texas Inequality Project (UTIP).

- *Teen unemployment rate*: It is the average regional (NUTS2) youth unemployment rate during the years the individual had to decide whether to attend post-compulsory education (16-21). Source: EU Labor Force Survey, Eurostat and US Bureau of Labor Statistics, International Comparisons.

- *Decommodification index*: This is the Scrugg and Allan (2006) replication of Esping-Andersen (1990) work who categorizes countries according to their welfare state tradition. The index relies on data on replacement rates, qualifying conditions and coverage rates in OECD countries' major insurance programs. The higher the value of the index the larger the generosity of the social insurance system. Source: Quality of Government Social Policy Dataset (Samanni et al., 2010).

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