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Inequality of opportunity in tertiary education in Europe

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Abstract

This report provides comparable estimates of inequality of opportunity for tertiary education for about 30 countries in Europe, exploiting the two EU-SILC waves for which information on family background is available (2005 and 2011). It exploits the two point-in-time observations available for most of the countries and analyses the relationship between many institutional dimensions and inequality of opportunity in tertiary education. Although inequality of opportunity in tertiary education varies a lot across countries, parental education and occupation seem to be the most relevant circumstances for almost all of them. We also find evidence of positive correlation between inequality of opportunity for tertiary education and different features of the educational system.

1   Introduction

Educational attainment and, more generally, human capital, are among the main determinants of social progress. In the past, compulsory primary and lower secondary education have guaranteed to children from less privileged families the possibilities of moving up the social ladder. As economies in the industrialized world have become more knowledge-based, research/innovation activities and human capital have become central. In fact, human capital – and hence education – has been identified as one of the engines of growth, both for countries that are closer to the technological frontier (which compete by pushing further the frontier) and for those that are still distant from it (for which improvement in absorptive capacity might be more relevant). Irrespective of the level of technological progress of a country, upper secondary and tertiary education are recognized among the most relevant institutions determining whether individuals and countries make or break the challenges posed by the globalized modern knowledge economy. However, upper secondary and tertiary education cannot be seen just with the lenses of economic efficiency. Both have a very important egalitarian role, as they contribute to render societies more mobile. Increased access to upper secondary education and to tertiary education improves the opportunities of individuals from under-privileged background; this can produce positive effects on efficiency as well, since access to the highest positions and responsibilities in society depends also on merit and not only on socio-economic status. In fact, as long as education expansion does not happen at the expenses of its quality, there is really no trade-off between efficiency and equity.

In such context, we focus here on tertiary education, as we believe that increasing the opportunities for higher education creates the basis for the foundation of a more mobile and equitable society, reducing the influence that parental earnings exert on children future socio-economic outcomes. In practice, tertiary education is seen as a fundamental instrument to break the transmission of disadvantage from one generation to the next. Due to the strong relationship between education and earnings, equality of opportunity in education outcomes can also increase intergenerational mobility in earnings[1].

In this report we investigate the extent of inequality of opportunity in tertiary education (EIOp hereafter) in Europe using data from EU-SILC 2005 and 2011.

The concept of equality of opportunity adopted here is the one flourished in the field of normative economics and distributional analysis in the last two decades: the equality of opportunity literature. This literature has developed concepts of fairness for the context in which individual achievements are partly the outcome of morally arbitrary circumstances (such as inherited endowments and social background) and partly the consequence of individual efforts, which are expressions of personal responsibility.

Those concepts revolve around the idea that inequalities due to circumstances are unfair and should be eliminated as much as possible, while inequalities that result from unequal efforts should be considered acceptable. This literature has witnessed a rapidly growing number of empirical applications interested in measuring the degree of inequality of opportunity (IOp) and in evaluating public policies in terms of equality of opportunity, mainly in the context of income distributions (see, among others, Aaberge et al., 2011; Checchi and Peragine, 2010; Lefranc et al., 2009; Roemer et al., 2003). Book-length collections of empirical analysis

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[1] On the role of education for social mobility see Stuhler (2018).

of equality of opportunity in developing countries can be found in World Bank (2006) and de Barros et al. (2009).

In the field of education, the principle of equality of educational opportunities is often referred to as the leading normative principle for all those who consider educational achievements to be relevant in their own right (see Ferreira and Gignoux, 2014). EIOp matters also from a positive perspective: the distribution of educational achievements, in fact, plays a role in the distribution of earnings (Blau and Khan, 2005), as predicted by the human capital theory, and influences economic growth (Hanushek and Wößmann, 2008, 2010).

Because of its normative and positive relevance, an increasing number of contributions investigate equality of opportunity in education. Most of these contributions focus on inequalities in test scores caused by pupils' circumstances by using standardized measures of test scores provided in international surveys, such as TIMSS (Trends in International Mathematics and Science Study), PIRLS (Progress in International Reading Literacy Study), and PISA (Programme for International Student Assessment), regularly conducted across different groups of countries (see, among others, Betts and Roemer, 2005; de Carvalho et al., 2012; Lasso de la Vega et al., 2019; Ferreira and Gignoux, 2010; Ferreira and Gignoux, 2011; Ferreira and Gignoux, 2014; Gamboa and Waltenberg, 2012; Hashemi and Intini, 2015; Peragine et al., 2015; Salehi-Isfahani et al., 2014; Schütz et al., 2008). Using such data sources allow for consistent cross-country comparisons as they provide standardized measures of achievements and the same set of information at individual and school levels.

Inequality of educational opportunity for higher education is less investigated, partly because of the absence of proper information. Standardized tests are largely non-existent, even at national level, and the measurement of relevant circumstances is more difficult than in primary and secondary education, because students in higher education have often left the family in which they grew up. Exceptions are Peragine and Serlenga (2008) and Brunori et al. (2012), who propose an analysis of inequality of opportunity for tertiary education in Italy. Using data on final graduation marks and on the earnings of individuals with a tertiary education degree, Peragine and Serlenga (2008) find strong family effect on the performances of students in the university and on the transition of graduates to the labour market. Brunori et al. (2012) analyse equality of opportunity in the access to tertiary education in Italy and find evidence of a reduction in EIOp, especially between 1998 and 2001. More recently, Jaoul-Grammare and Magdalou (2017) analyse the French higher education system by comparing the situations in 1992 and 2004. They find evidence of inequality of opportunity for tertiary education in each of the two years, with an increasing trend during the reporting period.

In this report, building on the theory of equality of opportunity referred above, we propose a conceptual framework for the definition of inequality of opportunity for tertiary education and a consistent measurement strategy. In order to get policy relevant insights, we also focus on the relationship between EIOp in Europe and some institutional variables capturing different characteristics of the socio-economic and educational systems.

Our results show that there are large across-country differences, with Nordic countries performing much better than Mediterranean and Eastern countries (with some exceptions, such as Luxembourg). In order to shed some light on the drivers and consequences of such differences we first provide a decomposition of our

estimates of EIOp, showing that a common feature to almost all countries analyzed is that parental education and parental occupation represent the most important circumstances in determining EIOp. When regressing measured EIOp on a set of indicators that capture different characteristics of the educational systems and institutional set-ups, we find evidence that a higher share of students enrolled in vocational education courses is associated with higher inequality of opportunity. Similarly, we find that a higher students/teacher ratio is associated with higher EIOp. Importantly, we also find evidence, although not robustly, of a negative correlation between public expenditure for tertiary education and EIOp. Lastly, we argue that interventions aimed at reducing EIOp are desirable, as this kind of inequality has an impact on life-cycle achievements. Indeed, our data show that EIOp is strongly and positively associated to IOp in income.

To the best of our knowledge, this is the first paper (i) to provide cross-country estimates of IOp for tertiary education in Europe and (ii) to shed some evidence on the relationship between EIOp and characteristics of the educational systems and institutions.

The paper is structured as follows. Section 2 describes the methodology used to analyse equality of opportunity in tertiary education. Section 3 describes the data. Section 4 presents the results of EIOp estimates, Section 5 the results of the correlation analysis and Section 6 the relationship between EIOp and IOp in income. Section 7 concludes.

2   Measuring inequality of opportunity in tertiary education

The EOp approach suggests to interpret an individual's outcome (x) as the result of two different set of variables: circumstances (C) – which are outside individual control and for which she cannot be held responsible– and effort (e) – which, on the contrary, is under individual control and for which she is fully accountable. So that we can write

$$x = g(C,e) \tag{1}$$

Equation (1) can be seen as a reduced-form model in which outcomes are exclusively determined by circumstances and effort. In the context of our analysis, the outcome variable x refers to the completion of tertiary education. Equality of opportunity requires differences in outcomes due to differences in circumstances to be eliminated, while differences due to effort are deemed to be ethically acceptable. Given that we cannot directly characterize the opportunity sets available to individuals, we focus on measuring inequality of opportunity, with a two-step procedure consistent with an ex-ante approach (see Ramos and Van de gaer, 2016 and Ferreira and Peragine, 2016). Its reduced data requirements make this approach widely used in empirical analyses.[2] First, the actual distribution of the outcome variable $\left[\mathbf{X}_{ij}\right]$ is transformed into a counterfactual distribution $\left[\tilde{\mathbf{X}}_{ij}\right]$ that reflects only and fully the unfair inequality in $\left[\mathbf{X}_{ij}\right]$, while all the fair inequality is removed. In the second step, a measure of inequality is applied to $\left[\tilde{\mathbf{X}}_{ij}\right]$. Following Peragine (2002), Checchi and Peragine (2010) and Ferreira and Gignoux (2011), the counterfactual distribution $\left[\tilde{\mathbf{X}}_{BT}\right]$ is obtained parametrically by estimating the individual outcomes x_{ij} as function of circumstances only. Ultimately, this captures the extent to which circumstances – both directly and indirectly – contribute to the variation observed in the outcome variable (in our case completion of tertiary education). For example, parents' level of education may influence both directly and indirectly an individual educational attainment, through additional resources available for higher education (a direct effect) and through cultural and role models (the indirect approach). In practice, a predicted outcome based purely on circumstances is constructed for each individual[3], obtained from the reduced-form regression of tertiary educational attainment on circumstances:

$$x = c\beta + \varepsilon \tag{2}$$

Predicted values for completion of tertiary education are used as a parametric approximation to the smoothed distribution $\hat{x}_{BT}$ where $\hat{x}_{BT} = c\hat{\beta}$. Given that the outcome variable is binary (completed tertiary

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[2] The existing literature has developed two main approaches to the measurement of opportunity inequality, namely the ex-ante and the ex-post approach. According to the ex-ante approach, there is equality of opportunity if the set of opportunities is the same for all individuals, regardless of their circumstances. Hence, in the ex-ante version, the compensation principle is formulated with respect to individual opportunity sets: it requires reducing the inequality between opportunity sets. On the other side, according to the ex-post approach, there is equality of opportunity if and only if all those who exert the same effort end up with the same outcome. The compensation principle, in the ex-post version, is thus defined with respect to individuals with the same effort but different outcomes: it requires reducing outcome inequality among the individuals with the same effort.
[3] The approach is inspired by the "min of means" criterion proposed by Van de gaer (1993).

education or not), a probit model is employed to estimate equation (2). This approach follows Ferreira and Gignoux (2011), which in turn draws on Bourguignon et al. (2007).

Once the smoothed distribution $\left[\widetilde{\mathbf{X}}_{BT}\right]$ is obtained, any inequality measure I applied to such a distribution, $I\left(\widetilde{\mathbf{X}}_{BT}\right)$ is to be interpreted as a measure of inequality of opportunity.

A particular measure is required where the outcome of interest is binary – as in our case. A commonly used measure is a "dissimilarity index" (D-index) – broadly speaking, the average distance between predicted outcomes and the mean predicted outcome. Formally:

$$D = \frac{1}{N\bar{\hat{x}}}\sum_{i=1}^{N}\left|\hat{x}_i - \bar{\hat{x}}\right| \tag{3}$$

The interpretation of this index is very similar to the Gini index: a dissimilarity index equal to 0 means that opportunities are equally distributed across individuals, a dissimilarity index approaching 1 means that all opportunities are concentrated on one individual. Thus, a low value of D means a low level of EIOp, a higher value of D means a high level of IOp. Higher than average predicted outcomes, based on favorable circumstances, will lead to a higher D-index, as will lower than average predicted outcomes due to unfavorable circumstances.

Finally, each circumstance may play a different role in the determination of EIOp. If one or more relevant circumstances are not observable, and if we cannot exclude that they are correlated with observable circumstances, an exact causal identification of the relative role of each circumstance is not possible. However, a description of the relative role of observable circumstances may be of some interest (Ferreira and Gignoux, 2011). In order to describe the specific contribution of each circumstance to EIOp, we make use of a sequence of counterfactual distributions comparisons.

The importance of a given circumstance *i* in generating EIOp is measured by comparing the estimate of EIOp when all circumstances, including *i,* are allowed to vary to the estimated EIOp when the specific circumstance *i* is held fixed (i.e. we measure inequality with a distribution that eliminates variation across individuals that could arise from that circumstance). The contribution of a given circumstance to inequality may depend on the order in which each circumstance is eliminated. We account for this by implementing a Shapley-value decomposition (see Shorrocks, 2013), assessing all possible elimination sequences and taking the average across the estimated contributions.[4]

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[4] For instance, suppose we have three circumstances – parental education, parental occupation and birthplace – and we want to assess the contribution of parental occupation to EIOp. We should make the following three comparisons: compare the EIOp obtained on the base of a partition into types that are constructed using all the three circumstances to EIOp obtained on the base of a partition into types constructed using parental education and birthplace only; compare EIOp using parental education and parental occupation to EIOp obtained using parental education; compare EIOp estimated using birthplace and parental occupation and EIOp computed using birthplace; compare EIOp using parental occupation and EIOp using no circumstances. The average across all four comparisons represents the marginal contribution of parental occupation to EIOp (For details on the methodology see Brunori et al., 2016).

3 Data

We use data from the 2005 and 2011 waves of the European Survey on Income and Living Conditions (EU-SILC), which is annually run by national Central Statistics Offices and collects information on the income and living conditions of households in the EU (plus Norway, Iceland and Switzerland). The survey contains information on a large number of individual and household characteristics as well as specific information on poverty and social exclusion. We use the 2005 and 2011 waves because they are the only two waves containing the special module on intergenerational mobility, which includes information on individuals' circumstances.

Respondents between the ages of 25-60 were asked to provide additional information about their parents' social and economic situation during their childhood (in particular, when aged 14-16). These additional modules report information on educational attainment, occupation as well as the labour market activity status of respondent's mother and father and the presence of financial problems in the household. The 2005 survey includes 26 countries, while the 2011 survey consists of 31 countries.[5] The main advantage of EUSILC is the relatively large number of countries covered, which allows the cross-country comparative analysis of inequalities. Some descriptive information concerning the countries included in this analysis is reported in Table 1, where it is possible to observe their high heterogeneity in terms of both mean income and inequality as measured by the Gini index.

The outcome variable of interest here is represented by the educational attainment of individuals (with respect to tertiary education): a binary variable indicating whether or not the individual has obtained a tertiary education degree. We look at completion of tertiary education since it is well known that socio-economic background plays an important role in accounting for access to and completion of tertiary education. Higher completion rates should foster intergenerational mobility and, possibly, more equality in wage, income, or consumption.

As for the variables capturing circumstances, we use parental education, parental occupation, area of birth, gender, and financial problems when the individual was a teenager. Parental education is coded in four categories – no education, low, medium and high level of education - on the basis of the highest education level attained by at least one parent. The four levels are defined as follows: a) no education/less than primary; b) low education: parental highest educational attainment is pre-primary, primary or lower secondary education; c) medium education: at least one of the parents has achieved upper secondary education or post-secondary non-tertiary education; d) high level education: at least one parent has achieved at least the first stage of tertiary education.

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[5] The 2005 wave consists of the following countries: Austria (AT), Belgium (BE), Cyprus (CY), Czech Republic (CZ), Germany (DE), Denmark (DK), Estonia (EE), Greece (EL), Spain (ES), Finland (FI), France (FR), Hungary (HU), Ireland (IE), Iceland (IS), Italy (IT), Lithuania (LT), Luxemburg (LU), Latvia (LV), Netherlands (NL), Norway (NO), Poland (PL), Portugal (PT), Sweden (SE), Slovenia (SI), Slovakia (SK) and Great Britain (UK). In the 2011, Bulgaria (BG), Switzerland (CH), Croatia (HR), Malta (MT) and Romania (RO) are added to the previous list, counting 31 countries in total.

Table 1. Descriptive statistics

Country	Mean Income (2011)	SD (2011)	Income Inequality (2011)	Sample Size (2011)	Mean Income (2005)	SD (2005)	Income Inequality 2005	Sample Size (2005)
AT	25349.77	14253.66	27.21	6648	20953.78	11418.35	26.2	6514
BE	23735.98	23002.79	25.96	6319	20199.89	12579.48	25.1	5523
BG	3807.01	3054.81	33.63	7424	na	na	na	na
CH	42401.51	29417.91	28.4	7158	na	na	na	na
CY	21278.45	15676.09	28.59	5149	16418.11	12047.7	27.86	5364
CZ	9063.96	5135.48	26	7238	5166.60	3150.33	26.88	4980
DE	22463.7	14944.08	28.49	12756	20672.67	14306.37	27.96	14618
DK	30167.04	18797.75	27.1	2872	25745.55	12390.22	22.16	3762
EE	7110.37	4555.80	32.98	5679	3961.72	2828.72	34.33	5108
ES	17335.85	12177.23	33.6	16222	13364.34	8296.37	31.24	17176
FI	26684.8	16783.54	25.1	4991	21403.32	23243.23	25.96	6742
FR	24764.76	20822.79	29.78	11370	19197.89	10981.65	26.97	11527
GR	13562.81	9991.76	33.64	6614	11909.17	8074.29	32.49	7125
HR	6671.03	3948.45	30.97	6932	na	na	na	na
HU	5394.56	2981.08	27.82	14312	4084.22	2930.07	28.83	8400
IE	25143.04	14508.16	29.72	3309	24958.25	23364.2	32.08	4541
IS	21178.39	10721.1	23.17	1791	27527.21	18898.05	24.44	1764
IT	18887.99	14058.87	31.9	22376	17915.22	13841.28	32.23	27757
LT	4817.23	3244.89	34.59	5518	2761.45	2084.07	37.25	5479
LU	38124.97	21980.6	27.5	7238	33720.87	19878.18	27.15	4747
LV	5442.27	3825.46	35.85	6940	2921.37	2571.46	37.24	4106
MT	13277.92	7080.50	27.33	4769	na	na	na	na
NL	24121.5	12450.4	24.91	6106	20460.58	12434.26	26.42	5680
NO	42189.79	19328.92	21.39	2679	31216.93	39986.13	24.18	3711
PL	6215.61	4508.43	32.26	15666	3235.53	2757.99	37.37	21748
PT	11165.02	8136.13	33.46	6092	10234.26	8897.88	37.06	5804
RO	2600.31	1726.21	33.45	7645	na	na	na	na
SE	25503	11043.96	22.26	3236	19931.69	9065.89	22.48	3389
SI	13384.56	6053.70	23.28	5287	9987.75	4581.71	23.38	4888
SK	7483.05	3880.96	26.12	7275	3337.39	2103.81	26.94	7701
UK	23132.91	20705.71	32.73	6533	25859.56	21754.08	33.54	9674

Note: Mean income and income inequality are computed on the distribution of equivalized household disposable income, variable HX090 of EU-SILC 2005 and 2011. Income inequality is computed using the Gini Index.

Parental occupation is coded into five categories: 1) both parents are white collars; 2) father is white collar and mother is blue collar or not working/unknown; 3) mother is white collar and father is blue collar or not working/unknown; 4) both parents are blue collars; 5) both parents are not working or the information is unknown.[6]

Area of birth is also divided into three categories: i) native; ii) born in a EU country; iii) born in a non-EU country. The variable capturing financial problems is coded differently in the two waves since the questions posed to individuals were different. In 2005, the individual was asked how often she experienced financial problems when she was a teenager. We coded it into the following five categories: a) most of the time; b) often; c) occasionally; d) rarely; e) never. In 2011, the individual was asked about the financial situation of the family when she was a teenager. We coded this variable again into five categories: a) vary bad or bad; b) moderately bad; c) moderately good; d) good; e) very good.[7]

The estimates of IOp in tertiary education for 2011 are run for every country separately considering (i) the entire population and (ii) two cohorts: the first cohort is composed by individuals in the age interval 43-60 and the second cohort composed by individuals in the age interval 25–42.

The institutional variables used in the second part of our analysis are drawn from UNESCO.[8]

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[6]   Information about mother's and father's occupation is registered in EU-SILC on the base of the ISCO-88 code in 2011 and ISCO-08 code in 2005. In particular, blue collar encompasses the following code: Elementary occupation, Plant Operator, Craft/Trades occupation, Agriculture occupation. White collar encompasses: occupation in service, Clerical work, Technician, Professional, Manager. The remaining is composed by individuals for which information on mother or father occupation is missing, or their mother or father is dead or not working or unknown.

[7]   Notice that information about this circumstance is missing in the 2005 wave for Austria, Germany, France, Greece and Portugal.

[8]   http://data.uis.unesco.org/.

4 Inequality of opportunity in tertiary education

In order to get estimates of EIOp, as a first step and separately for each country, we estimate (2) with a probit model relating individual's completion of tertiary education with the set of circumstances.

The probit estimates for all countries for 2011 wave are presented in Table 2.[9] For the sake of clarity, only the estimates for 2011 are discussed in the main text, as in most of the cases they are similar to the estimates for 2005 (which are presented in the Table A1 in the Appendix). The explanatory variables' estimated coefficients are not shown when there are no observations for a circumstance in a given country. As this is a reduced-form equation, our estimates cannot be interpreted causally. In fact, the estimated coefficients capture both the direct and the indirect effects of circumstances and effort on income (see Ferreira and Gignoux, 2011).

Coefficients have the expected sign almost everywhere and, in most of the cases, they are statistically significant. Relative to the reference group (students whose parents have no education or less than primary education), students whose parents have completed secondary or tertiary education have a higher probability of completing tertiary education. Tertiary education attainment and parental occupation are also positively correlated. Results show that, with respect to the omitted category (category 5 listed above: neither of the parents is working or the information is unknown), individuals who have at least one parent employed in a white collar job have higher probabilities of completing tertiary education. Notice that the coefficients for parental occupation are usually lower than those for parental education.

Worse "financial conditions during childhood" are negatively correlated with the probability that descendants attain tertiary education.

Gender and country of birth are also significant in determining the probability of getting tertiary education. However, differently from the previous circumstances, the sign of their impact cannot be stylized as it varies across countries.

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[9] Omitted categories are: female; no education; occupation not know/not working; native; very good financial situation when teenager.

Table 2. Reduced-Form Regression of tertiary education achievement on Circumstances

	AT	BE	BG	CH	CY	CZ	DE	DK	EE	ES
Male	0.186*** (0.00148)	-0.174*** (0.00124)	-0.499*** (0.00169)	0.365*** (0.00141)	-0.062*** (0.00447)	-0.047*** (0.00165)	0.221*** (0.000456)	-0.236*** (0.00224)	-0.612*** (0.00354)	-0.118*** (0.000567)
Low parental education		0.139*** (0.00309)	-0.410*** (0.00594)	-0.075*** (0.00509)	0.0578 (0.0491)	-0.906*** (0.00961)	0.355*** (0.00125)	4.641*** (0.00322)	-0.354*** (0.0104)	-0.0789*** (0.00217)
Medium parental education	5.516*** (0.00188)	0.667*** (0.00321)	0.230*** (0.00597)	0.525*** (0.00494)	0.701*** (0.0491)	-0.127*** (0.00968)	0.646*** (0.00107)	4.814*** (0.00276)	-0.071*** (0.0101)	0.363*** (0.00232)
High parental education	6.098*** (0.00232)	1.305*** (0.00336)	1.043*** (0.00633)	1.099*** (0.00514)	1.162*** (0.0492)	0.578*** (0.00986)	1.284*** (0.00112)		0.520*** (0.0104)	1.064*** (0.00235)
Both blue collar	0.0671*** (0.00233)	-0.279*** (0.00308)	-0.044*** (0.00317)	0.0051** (0.00258)	0.0407*** (0.00594)	0.218*** (0.00382)	0.176*** (0.000891)	0.308*** (0.00492)	0.0208*** (0.00657)	0.0351*** (0.00107)
F white collar M blue collar	0.197*** (0.00270)	0.125*** (0.00237)	0.206*** (0.00332)	0.119*** (0.00247)	0.116*** (0.00915)	0.370*** (0.00370)	0.0578*** (0.000753)	0.573*** (0.00327)	0.257*** (0.00640)	0.254*** (0.00128)
F blue collar M white collar	0.518*** (0.00224)	0.268*** (0.00161)	0.0544*** (0.00406)	0.321*** (0.00212)	0.165*** (0.00651)	0.271*** (0.00447)	0.237*** (0.000680)	0.701*** (0.00390)	0.263*** (0.00883)	0.420*** (0.000696)
Both white collar	0.602*** (0.00234)	0.454*** (0.00221)	0.531*** (0.00347)	0.442*** (0.00227)	0.568*** (0.00842)	0.612*** (0.00393)	0.295*** (0.000715)	0.712*** (0.00352)	0.584*** (0.00696)	0.394*** (0.00109)
Other EU	0.0843*** (0.00276)	-0.0713*** (0.00240)	-0.786*** (0.0241)	0.234*** (0.00185)	-0.188*** (0.00754)	0.412*** (0.00488)	0.322*** (0.000684)	0.0660*** (0.00689)	0.147*** (0.00509)	-0.528*** (0.00143)
Outside EU	-0.396*** (0.00256)	0.0142*** (0.00222)	0.150*** (0.0137)	-0.044*** (0.00237)	-0.072*** (0.00735)	0.856*** (0.00710)	-0.0772*** (0.00111)	0.150*** (0.00586)	-0.207*** (0.0136)	-0.265*** (0.000947)
Bad/Very Bad	-0.215*** (0.00333)	-0.387*** (0.00295)	-0.638*** (0.00562)	-0.00392 (0.00327)	-0.795*** (0.0106)	-0.141*** (0.00555)	0.0745*** (0.00103)	-0.0629*** (0.00538)	-0.321*** (0.0123)	-0.208*** (0.00224)
Moderately bad	-0.161*** (0.00317)	-0.251*** (0.00289)	-0.246*** (0.00405)	0.118*** (0.00310)	-0.311*** (0.0106)	-0.110*** (0.00474)	0.0949*** (0.000928)	0.0115** (0.00548)	-0.259*** (0.0117)	-0.0369*** (0.00217)
Moderately good	-0.071*** (0.00298)	-0.0973*** (0.00239)	-0.085*** (0.00313)	0.0961*** (0.00250)	-0.233*** (0.00967)	-0.085*** (0.00440)	0.0733*** (0.000928)	0.0274*** (0.00362)	-0.152*** (0.0120)	0.183*** (0.00209)
Good	-0.069*** (0.00303)	0.00825*** (0.00230)	0.000262 (0.00330)	0.0791*** (0.00240)	-0.111*** (0.00977)	-0.161*** (0.00445)		0.121*** (0.00357)		0.314*** (0.00209)
R-squared	0.1151	0.1611	0.2273	0.1315	0.1716	0.1799	0.0938	0.0957	0.1289	0.1279
Sample size	6648	6319	7424	7158	5149	7238	12756	2872	5679	16222

Table 2. Reduced-Form Regression of tertiary education achievement on Circumstances (continued)

	FI	FR	GR	HR	HU	IE	IS	IT	LT	LU
Male	-0.470***	-0.172***	-0.074***	-0.285***	-0.338***	0.122***	-0.550***	-0.174***	-0.387***	0.00411
	(0.00171)	(0.000544)	(0.00123)	(0.00241)	(0.00146)	(0.00232)	(0.00740)	(0.000609)	(0.00242)	(0.00599)
Low parental education	-0.0956**	0.194***	0.417***	0.0915***	0.756***	0.418***	0.627***	-0.318***	-0.360***	-0.187***
	(0.0152)	(0.00155)	(0.00299)	(0.00707)	(0.0157)	(0.0112)	(0.0273)	(0.00374)	(0.00669)	(0.0455)
Medium parental education	0.142***	0.914***	1.075***	0.586***	1.409***	1.022***	0.974***	0.254***	0.250***	0.395***
	(0.0153)	(0.00169)	(0.00324)	(0.00710)	(0.0157)	(0.0112)	(0.0269)	(0.00380)	(0.00650)	(0.0455)
High parental education	0.583***	1.282***	1.496***	1.234***	2.047***	1.557***	1.374***	0.832***	0.932***	1.246***
	(0.0153)	(0.00169)	(0.00355)	(0.00783)	(0.0157)	(0.0115)	(0.0279)	(0.00391)	(0.00673)	(0.0459)
Both blue collar	0.155***	0.223***	-0.153***	-0.064***	-0.0084***	0.231***	0.350***	-0.0157***	0.101***	-0.068***
	(0.00330)	(0.000899)	(0.00170)	(0.00425)	(0.00232)	(0.00518)	(0.0130)	(0.00113)	(0.00424)	(0.0102)
F white collar M blue collar	0.0835***	0.204***	0.0900***	0.346***	0.253***	0.346***	0.288***	0.337***	0.266***	0.172***
	(0.00327)	(0.000897)	(0.00268)	(0.00393)	(0.00244)	(0.00418)	(0.0118)	(0.00119)	(0.00475)	(0.0111)
F blue collar M white collar	0.162***	0.447***	0.398***	0.310***	-2.11e-05	0.428***	0.443***	0.288***	0.0134**	0.592***
	(0.00301)	(0.000809)	(0.00172)	(0.00359)	(0.00304)	(0.00296)	(0.0129)	(0.000829)	(0.00578)	(0.00836)
Both white collar	0.297***	0.646***	0.159***	0.437***	0.514***	0.751***	0.548***	0.519***	0.346***	0.720***
	(0.00349)	(0.000870)	(0.00222)	(0.00414)	(0.00266)	(0.00394)	(0.0120)	(0.00106)	(0.00482)	(0.00999)
Other EU	0.223***	-0.105***	0.209***	0.221***	0.246***	-0.042***	0.0867***	-0.0881***	-0.733***	0.325***
	(0.00658)	(0.00150)	(0.00409)	(0.00872)	(0.00705)	(0.00340)	(0.0160)	(0.00154)	(0.0252)	(0.00666)
Outside EU	0.336***	-0.0788***	-0.411***	0.0441***	0.308***	0.580***	-0.103***	-0.141***	0.0503***	0.267***
	(0.00697)	(0.00107)	(0.00242)	(0.00415)	(0.0102)	(0.00520)	(0.0201)	(0.00115)	(0.00564)	(0.0103)
Bad/Very Bad	-0.286***	-0.173***	-0.418***	-0.403***	-0.0331***	-0.249***	-0.505***	-0.629***	-0.304***	-0.398***
	(0.00552)	(0.00161)	(0.00304)	(0.00534)	(0.00522)	(0.00610)	(0.0178)	(0.00216)	(0.00863)	(0.0165)
Moderately bad	-0.222***	0.000419	-0.466***	-0.119***	0.0418***	-0.435***	-0.186***	-0.473***	0.0150*	-0.140***
	(0.00503)	(0.00151)	(0.00295)	(0.00528)	(0.00488)	(0.00586)	(0.0155)	(0.00201)	(0.00836)	(0.0156)
Moderately good	-0.189***	0.113***	-0.206***	-0.200***	0.193***	-0.259***	-0.185***	-0.252***	0.160***	-0.0238*
	(0.00469)	(0.00139)	(0.00262)	(0.00478)	(0.00471)	(0.00545)	(0.0132)	(0.00188)	(0.00788)	(0.0135)
Good	-0.308***	-0.0300***	-0.190***	-0.270***	0.162***	-0.320***	-0.00605	-0.245***	0.142***	0.0800***
	(0.00479)	(0.00142)	(0.00273)	(0.00481)	(0.00484)	(0.00556)	(0.0143)	(0.00194)	(0.00799)	(0.0133)
R-squared	0.0787	0.1428	0.1385	0.1498	0.1997	0.1367	0.1132	0.1661	0.1609	0.2568
Sample size	4991	11370	6614	6932	14312	3309	1791	22376	5518	7238

Table 2. Reduced-Form Regression of tertiary education achievement on Circumstances (continued)

	LV	MT	NL	NO	PL	PT	RO	SE	SI	SK
Male	-0.509***	-0.058***	0.150***	-0.252***	-0.258***	-0.528***	-0.105***	-0.334***	-0.370***	-0.122***
	(0.00281)	(0.00739)	(0.000981)	(0.00181)	(0.000710)	(0.00154)	(0.00104)	(0.00136)	(0.00288)	(0.00186)
Low parental education	-0.336***	-0.166***	0.137***	0.187***	-0.0915***	0.370***	-0.0326***	-0.168***	0.214***	0.324***
	(0.00749)	(0.0324)	(0.00265)	(0.0162)	(0.00335)	(0.00712)	(0.00234)	(0.00243)	(0.0105)	(0.0119)
Medium parental education	-0.022***	0.288***	0.330***	0.448***	0.537***	0.958***	0.964***	0.256***	0.721***	0.794***
	(0.00727)	(0.0328)	(0.00261)	(0.0161)	(0.00330)	(0.00763)	(0.00238)	(0.00229)	(0.0110)	(0.0117)
High parental education	0.642***	0.837***	1.052***	1.030***	1.126***	1.555***	1.735***	0.903***	1.123***	1.514***
	(0.00769)	(0.0339)	(0.00270)	(0.0161)	(0.00346)	(0.00778)	(0.00300)	(0.00243)	(0.0115)	(0.0119)
Both blue collar	0.0474***	-0.0615*	0.0542***	-0.186***	0.0370***	-0.214***	-0.0058***	-0.499***	0.154***	-0.015***
	(0.00481)	(0.0364)	(0.00224)	(0.00393)	(0.00104)	(0.00211)	(0.00146)	(0.00553)	(0.00432)	(0.00376)
F white collar M blue collar	0.255***	0.516***	0.188***	0.239***	0.508***	0.113***	0.370***	-0.104***	0.256***	0.239***
	(0.00458)	(0.0214)	(0.00192)	(0.00318)	(0.00111)	(0.00293)	(0.00188)	(0.00276)	(0.00497)	(0.00379)
F blue collar M white collar	0.460***	0.415***	0.365***	0.287***	0.440***	0.249***	-0.120***	0.137***	0.209***	0.388***
	(0.00657)	(0.00831)	(0.00132)	(0.00338)	(0.00142)	(0.00214)	(0.00198)	(0.00402)	(0.00558)	(0.00454)
Both white collar	0.533***	0.807***	0.614***	0.647***	0.915***	0.710***	0.372***	0.170***	0.368***	0.740***
	(0.00547)	(0.0155)	(0.00157)	(0.00323)	(0.00127)	(0.00253)	(0.00178)	(0.00293)	(0.00541)	(0.00398)
Other EU	-0.217***	0.362***	-0.128***	0.369***	0.821***	0.592***	2.272***	0.479***	-0.331***	0.0665***
	(0.00432)	(0.0148)	(0.00354)	(0.00500)	(0.0105)	(0.00360)	(0.0156)	(0.00320)	(0.00511)	(0.00920)
Outside EU	0.00112	-0.180***	-0.133***	0.136***	-0.0635***	0.146***	-0.518***	0.443***	0.130***	0.842***
	(0.00776)	(0.0309)	(0.00177)	(0.00504)	(0.00238)	(0.00278)	(0.00450)	(0.00255)	(0.00811)	(0.0180)
Bad/Very Bad	-0.059***	0.168***	-0.114***	-0.220***	-0.0665***	-0.298***	-0.306***	-0.167***	0.377***	-0.366***
	(0.00704)	(0.0293)	(0.00261)	(0.00532)	(0.00222)	(0.00689)	(0.00442)	(0.00279)	(0.00762)	(0.00571)
Moderately bad	0.178***	0.341***	0.197***	0.304***	0.174***	0.272***	-0.274***	-0.0440***	0.291***	-0.126***
	(0.00627)	(0.0280)	(0.00240)	(0.00450)	(0.00205)	(0.00676)	(0.00432)	(0.00285)	(0.00757)	(0.00494)
Moderately good	0.0532***	0.401***	0.0419***	0.250***	0.206***	0.427***	-0.138***	0.00715***	0.265***	-0.079***
	(0.00651)	(0.0278)	(0.00188)	(0.00366)	(0.00205)	(0.00657)	(0.00442)	(0.00216)	(0.00809)	(0.00463)
Good			-0.149***	0.267***		0.604***		0.00690***		-0.123***
			(0.00177)	(0.00357)		(0.00664)		(0.00205)		(0.00465)
R-squared	0.1285	0.1330	0.1131	0.1062	0.1900	0.2054	0.2154	0.0851	0.1140	0.1521
Sample size	6940	4769	6106	2679	15666	6092	7645	3236	5287	7275

Source: Authors' estimates using EU_SILC.

The estimates of EIOp in tertiary education for 2011 (those for 2005 are reported in Table A2 in the Appendix) show large across-country variation, from a minimum of 15.22 in Finland to a maximum of 36.9 in the Czech Republic. On average, EIOp is lowest in Northern European countries as compared to Mediterranean and Eastern European countries (a similar picture emerges for 2005). An exception is Luxembourg, which is

characterized by high levels of EIOp (about 35.62), possibly due to the large share of immigrants (especially Portuguese). Given that immigrants are less likely to complete tertiary education (compared to natives), a higher proportion of immigrants tends to reduce equality of opportunities.

Table 3. Inequality of opportunity for tertiary education and contribution of each circumstance, 2011

Country	EIOp	Gender	Parental education	Parental occupation	Birth place	Financial prob
AT	27,46	6,38	30,99	40,89	8,44	13,3
BE	23,9	4	48,8	31,88	1,78	13,54
BG	36,19	15,78	41,9	32,82	0,15	9,34
CH	21,97	17,98	35,82	35,42	4,72	6,05
CY	26,46	1,9	45,42	30,69	1,47	20,47
CZ	36,9	0,01	54,95	33,58	2,1	9,37
DE	21,74	9,92	55,36	22,22	3,52	8,98
DK	19,58	9,92	42,61	37,61	0,14	9,71
EE	21,5	26,14	37,93	27,48	0,12	8,32
ES	22,12	3,86	34,21	36,87	4,05	21,02
FI	15,22	29,51	42,41	16,64	0,61	10,83
FR	25,04	4,29	49,55	32,53	1,31	12,32
GR	25,79	1,3	48,21	29,99	4,34	16,16
HR	33,72	7,72	42,83	33,26	1,64	14,55
HU	36,47	8,61	45,49	33,3	0,58	12,02
IE	19,77	1,44	40,22	36,9	8,96	12,47
IS	21,02	28,56	34,52	23,91	2,07	10,94
IT	34,98	4,33	44,09	33,82	1,39	16,38
LT	26,18	10,39	49,22	26,1	0,96	13,33
LU	35,62	0,16	40,09	38,4	7,36	13,99
LV	25,64	23,96	34,53	29,67	1,98	9,86
MT	30,49	0,54	45,95	30,3	4,96	18,24
NL	21,2	4,21	49,96	39,81	0,41	5,61
NO	18,7	8,55	46,86	36,41	1,43	6,75
PL	32,87	7,21	36,6	41,98	0,14	14,08
PT	36,76	11,04	21,52	33,04	6,4	28
RO	38,52	1,61	52,57	29,56	0,27	15,99
SE	17,17	25,36	58,56	4,69	4,69	6,43
SI	25,99	11,07	39,19	32,43	6,42	10,88
SK	28,78	4,48	35,32	45,8	0,12	14,29
UK	18,19	0,24	42,66	34,21	11,23	11,64

Source: Authors' estimates using EU_SILC.

The results of the decomposition by source of inequality of opportunity are very robust to the survey year and the disaggregation by cohort (see Table 2 and 3 and Table A2 in the Appendix). In all cases, parental education and parental occupation contribute most to EIOp. Financial problems experienced by the family when the individual was a teenager is also a relevant circumstance, but much less than parental education and occupation. The relevance of financial problems is higher for the oldest cohort, possibly indicating an improvement in policies supporting tertiary education by students from low socio-economic background. Gender and area of birth, instead, appear to contribute only slightly to EIOp in tertiary education, at least relatively to the other circumstances. At the same time, we notice some relevant across-country variability in the role of the three factors that appear to contribute less. Financial distress when teenager appears quite relevant in Portugal, Spain, Cyprus, and Malta. Among Eastern countries, only Hungary and Romania show higher values for the (relative) contribution of financial constraints.

When it comes to gender, Island, Finland, Estonia and Latvia are the countries where the relative contribution of this circumstance is higher. However, this should not induce us to conclude that some sort of gender discrimination in the achievement of tertiary education is present in these countries. Since we are capturing relative contributions, as the relative role of parental education and occupation is reduced in Island, Finland, Estonia and Latvia, the values for the contributions from the other determinants are mechanically increased. The changes in EIOp between 2005 and 2011 also vary across countries (see Figure 1).

Figure 1. EIOp in tertiary education: variation from 2005 to 2011
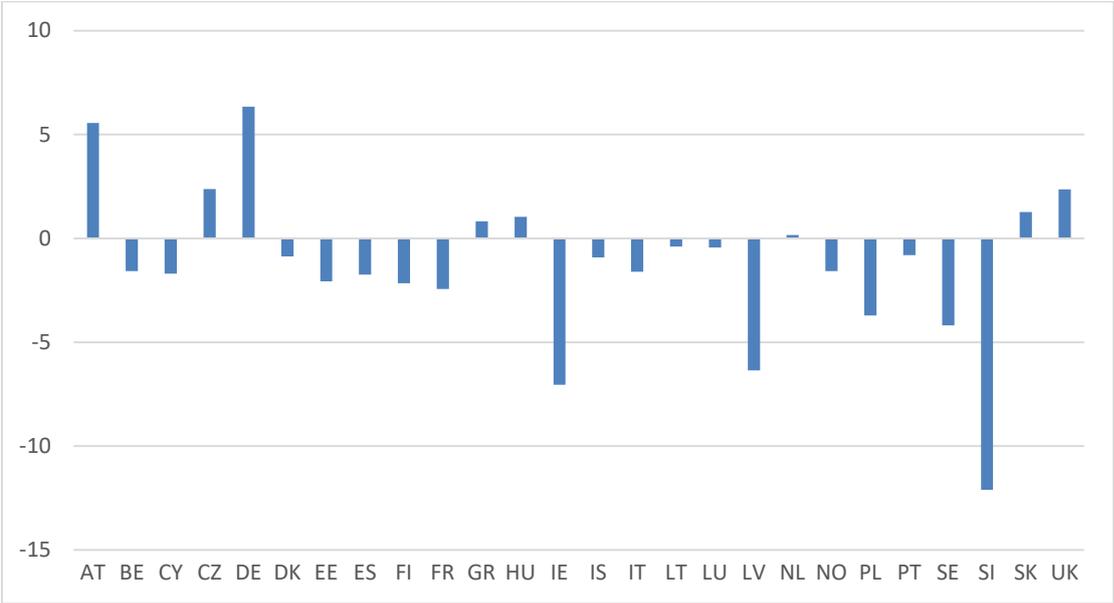
Source: Authors' estimates using EU_SILC.

Worth noticing is the considerable increase in EIOp in Germany (from 15.4 to 21.74) and Austria (from 21.9 to 27.46), which, however, have to be interpreted with caution, as this increase could reflect the introduction of the "Financial problem" circumstance, which was not available for these countries in 2005 (it became available in 2011). At the other extreme, we observe a decrease in EIOp in Slovenia (from 38.2 to 25.99), Ireland (from 26.81 to 19.77) and Latvia (from 32 to 25.64).

When interpreting EIOp in 2005 and 2011, we have to keep in mind that cohort-specific effects might play an important role, since tertiary educational attainment has a clear age-related dimension (and it is normally over by age 24). For instance, reforms affecting participation to tertiary education –for instance by changing its rules and costs- only affected individuals that – at the time of the reform- had not decided yet whether to attend university or not. Analogously, technological progress affecting the labour market returns from tertiary education might have affected more some cohorts than others. Hence, time trends can hide relevant across-cohort heterogeneity.

The disaggregation by cohort reported in Table 4 for the 2011 wave reveals that the oldest cohort (43-60) experiences a higher degree of EIOp almost everywhere, with the exception of Greece (showing slightly higher EIOp for the youngest cohort), and Romania (where this difference becomes dramatic: about 9 percentage points). There are almost no across-cohort differences, instead, in Austria, Bulgaria, Germany, Denmark, Estonia, Hungary and Sweden. For the remaining countries, EIOp for the younger cohort is much lower than the one faced by the older cohort, especially in Eastern countries, such as, Poland, Slovakia and Czech Republic. Sizable differences also arise in Cyprus, Malta, Portugal, and Ireland.

Next, we analyze the sources of inequality. The goal here is to understand the relative importance of the various factors (parental education and occupation, gender, place of birth, financial problems in childhood) in accounting for the observed patterns.

When making cohort comparisons, it is instructive to look at Table 4 reporting the difference (in percentage points) in the contribution of each circumstance between the younger and the older cohort. Here, to make comparisons clearer we merge the contributions from parental education and parental occupation.

Interestingly, gender becomes relatively less important for the younger cohort in Austria, Switzerland, Germany, Netherland, and Sweden, it is quite stable in Malta, Luxembourg, Iceland, Check Republic, UK, Romania, Ireland, and Cyprus. It becomes more important elsewhere. The contribution of place of birth is relatively stable between the two cohorts. Only for Spain (birth place being relatively more important in the younger cohort) and Sweden (birth place being relatively less important in the younger cohort) we observe considerable changes. Similarly stable or slightly decreasing it is the impact of financial problems, with the notable exceptions of Ireland and Iceland on one side – financial problems being relatively more important in the younger cohort – and Portugal, Romania, and Greece on the other side – financial problems being relatively less important in the younger cohort. Last, the difference in the contribution of parental education and occupation between the two cohorts is widely variable across countries.

Table 4. Inequality of opportunity for tertiary education by cohort and difference in EIOp and in the contribution of each circumstance between the two cohorts (value for the younger cohort minus value for the older cohort), 2011

Country	EIOp Older cohort	EIOp Younger cohort	Difference in EIOp and in the role of circumstances between younger and older cohort				
			EIOp	Gender	Parental education and occupation	Birth place	Financial Problems
AT	27,5	28,28	0,78	-12,19	0,91	9,5	1,75
BE	25,76	21,34	-4,42	11,46	-11,57	2,08	-1,96
BG	36,33	36,17	-0,16	11,28	-9,24	0,39	-2,43
CH	23,28	20,59	-2,69	-14,63	13,41	5,1	-3,89
CY	27,66	20,44	-7,22	2,84	8,88	-5,38	-6,35
CZ	41,05	31,67	-9,38	-0,91	3,25	0,96	-3,31
DE	21,69	21,26	-0,43	-14,8	7,91	2,26	4,62
DK	17,36	17,57	0,21	9,19	-5,34	0,28	-4,12
EE	21,57	22,15	0,58	9,61	-4,11	1,16	-6,66
ES	25,12	19,5	-5,62	9,14	-15,7	10,83	-4,29
FI	16,49	13,98	-2,51	37,95	-33,4	0,07	-4,63
FR	26,59	20,62	-5,97	5,48	-1,78	2,18	-5,85
GR	23,58	27,34	3,76	1,45	2,73	5,2	-9,39
HR	36,05	29,96	-6,09	21,86	-13,07	-0,76	-8,04
HU	35,94	35,18	-0,76	6,92	-2,55	-1,16	-3,22
IE	22,95	13,99	-8,96	0,28	-4,79	-4,23	8,82
IS	22,49	19,71	-2,78	-1,03	-4,67	-4,39	10,1
IT	35,87	32,79	-3,08	7,43	-9,03	4,05	-2,45
LT	26,55	20,92	-5,63	6,1	-2,91	0,62	-3,81
LU	38,26	32,27	-5,99	-1,33	5,98	-5,19	0,53
LV	26,26	23,7	-2,56	12,29	-11,01	-0,07	-1,21
MT	35,68	26,83	-8,85	-1,96	4,19	-1,63	-0,61
NL	21,41	19,3	-2,11	-10,02	5,97	0,33	3,53
NO	21,83	17,21	-4,62	11,78	-9,43	-2,71	0,37
PL	37,26	24,87	-12,39	8,69	-6,59	0,03	-2,14
PT	40,72	32,36	-8,36	10,15	1,45	-1,23	-10,38
RO	30,06	39,38	9,32	2,44	3,84	0,16	-9,31
SE	15,87	15,85	-0,02	-16,02	24,29	-9,57	1,29
SI	28,16	22,19	-5,97	17,45	-9,04	-2,74	-5,66
SK	33,28	23,65	-9,63	13,76	-7,51	-0,49	-5,84
UK	19,61	16,31	-3,3	0,2	-14	13	0,66

Source: Authors' estimates using EU_SILC.

5 The role of institutions

We are interested in investigating the channels through which circumstances affect the achievement of higher education. There exists an extensive literature studying the determinants of income inequality (see among others Perugini and Martino, 2008), but the literature is almost silent on the determinants of inequality of opportunity. To the best of our knowledge, Marrero and Rodriguez (2012) and Checchi et al. (2016) are the only published papers that shed some light on the role of (some) institutional variables on aggregate inequality of opportunity in income in Europe. We mimic their approach and analyse the potential association between certain institutional frameworks and our measures of EIOp.

We consider a variety of indicators that reflect a country's level of economic (real per capita GDP) and human capital development (the gross enrolment rate in tertiary education; the share of the population older than 25 with at least a secondary level of education; the share of individuals in the age group 15-25 enrolled in vocational education). We expect that policies supporting secondary educational attainment and enrolment in tertiary education also favour higher independence between circumstances and tertiary education attainment (i.e. lower EIOp). On the other hand, higher shares of students enrolled in vocational education are often found in countries characterized by dual systems of education and early tracking, both of which tend to contribute to exacerbating the impact of family socio-economic background on educational inequalities (Anders and Henderson, 2019).

We also consider a set of variables related to public spending, such as public expenditure on education (as a percentage of total government expenditure and as a percentage of GDP) and public expenditure on tertiary education (as a percentage of total government expenditure and as a percentage of GDP). The quality of education may also play a role, since it may compensate the disadvantage of students coming from a low socio-economic background. Unfortunately, data on school quality are not easily available. More modestly, we have considered the student/teacher ratio and the outbound and inbound mobility ratio (measuring the internalization of universities) as proxies for quality of education.

Finally, we added a group of institutional variables that try to capture the benefits from completion of tertiary education, such as: the ratio between the employment rate of individuals with tertiary education and the employment rate of individuals with secondary education; the ratio between the unemployment rate of individuals with tertiary education and the unemployment rate of individuals with secondary education; the earnings of workers with tertiary education relative to the earnings of individuals with secondary education. [10]

In order to minimise the endogeneity risk, we average the institutional measures over the five years prior to the survey year (2000-2004 for individuals surveyed in 2005 and 2006-2010 for individuals surveyed in 2011).

Table 5 reports the result of the pair-wise correlations between EIOp and all the indicators listed above; several cases are worth noting. The correlation between EIOp and per capita real GDP (GDP per capita in PPP current international $) is negative (see Figure 2). In Figure 2 we can identify two clusters of countries. The first cluster is made of Eastern European countries, characterized by higher EIOp and lower per capita GDP; most of them, in fact, are above the regression curve, meaning that their EIOp levels are above what would

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[10] Notice, however, that this variable is available only for 19 countries.

be associated with their levels of development. Lithuania, Latvia and Estonia are some exceptions as their level of development is associated to a relatively low EIOp. The second cluster is made by Western countries with middle/high level of development and middle/low level of EIOp. Exceptions are Italy and Luxembourg, exhibiting very high EIOp values, relative to their per capita GDP.

The correlation between EIOp and the gross enrolment rate in tertiary education is positive, while higher shares of individuals aged 25 and older who have at least completed secondary education are negatively correlated with EIOp, confirming our expectations. On the other hand, higher shares of 15-25 years old students enrolled in vocational education tend to be associated with higher levels of EIOp, but the coefficient is not statistically significant.

The amount of public spending allocated to education is significantly and negatively correlated with EIOp irrespective of the variable used. Similarly, public spending on tertiary education (either in percentage of GDP or in percentage of total government expenditure) is especially relevant for reducing EIOp.

The correlation analysis with respect to the quality variables generates ambiguous results when the outbound and inbound mobility are used to proxy quality (they have opposite signs). However, given that in both cases the coefficients are small and not statistically significant we do not find any robust association between internationalization and EIOp. On the other hand, when we proxy quality with the students/teacher ratio in tertiary education we find that higher student/teachers ratios are significantly and positively correlated with EIOp. From this result one could infer that a reduction in the students/teacher ratio could improve inequality of opportunity for tertiary education.

Last, we look at the association between EIOp and the economic benefits from tertiary education achievement, as proxied by (i) the relative employment rate of individuals with tertiary education, (ii) the relative unemployment rate of individuals with tertiary education (iii) relative earnings (in all three cases relative to individuals with only secondary education). Results indicate that the relative employment rate and the relative earnings of tertiary graduates are positively and significantly correlated with EIOp, while a negative but not significant correlation occurs for the relative unemployment rate. This is an interesting result as it indicates that policies directed at improving equality of opportunity are particularly needed when the labour market signals that returns to tertiary education are higher.

As a further step, these correlations are forced to more stringent tests using multi-variable regression analysis and exploiting the presence of observation in two points in time (2005 and 2011). Three different model specifications are run: a pooled OLS regression, a fixed effect model (FE) and a random effect model (RE). Since not all the institutional variables appear individually correlated with EIOp and since there are missing information for at least some countries, we only use those variables that show a correlation higher than +/- 0.6 and that have a lower number of missing observations.

Table 5. Pair-wise correlations – 26 countries – income inequality measured in 2005 and 2011 – institutions measured by average of previous five years

Institutional variables	IOp for tertiary education
Per capita GDP	-0.000157** (6.71e-05)
Gross enrolment rate in tertiary education	-0.182*** (0.05)
Share of individuals aged 25 and older with at least upper secondary education	-0.142*** (0.0521)
Share of individuals aged 15-25 enrolled in vocational studies	0.0747 (0.133)
Government expenditure on education (% GDP)	-3.120*** (0.799)
Government expenditure on tertiary education (% GDP)	-9.107*** (1.986)
Government expenditure on education (% of total government expenditure)	-1.270*** (0.364)
Government expenditure on tertiary education (% of total government expenditure)	-4.819*** (0.987)
Inbound mobility, tertiary	-0.0457 (0.124)
Outbound mobility, tertiary	0.0305 (0.0186)
Students—teachers ratio, tertiary	0.302*** (0.173)
Employment rate tertiary/secondary	46.39*** (15.83)
Unemployment rate tertiary/secondary	-8.859 (6.312)
Relative earnings: tertiary/upper secondary	0.173*** (0.0432)

Source: Authors' estimates using EU_SILC.

Figure 2. EIOp and development
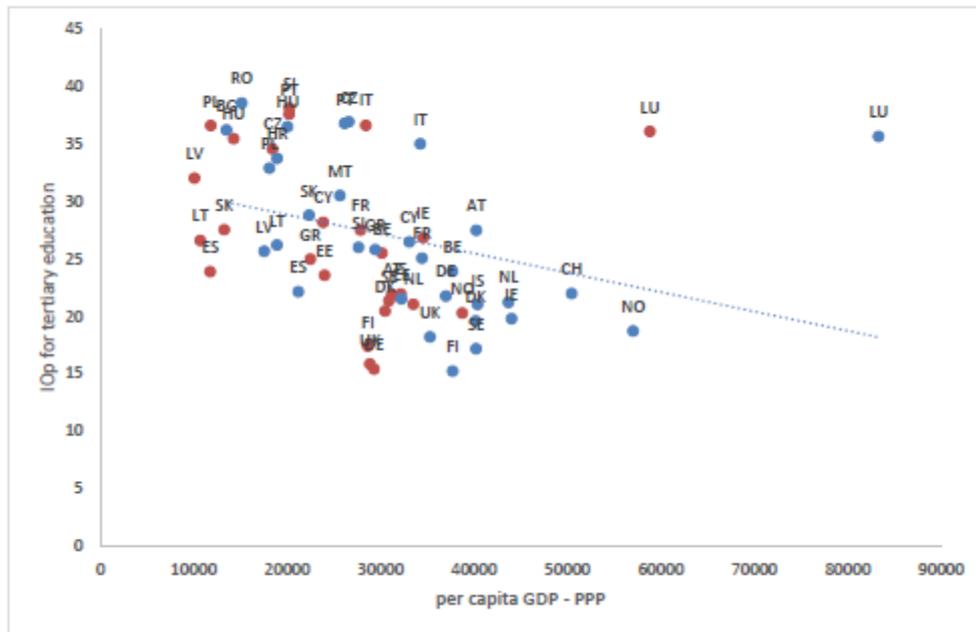
Source: Authors' estimates using EU_SILC.

Note: Red bullets refer to the observation in 2005, blue bullets in 2011.

It is important to bear in mind that our analysis does not try to estimate causal impacts (and reverse causation could also be an issue). Therefore, the coefficients that are presented below must be interpreted as simple correlations. Nevertheless, the availability of two observations for most of the countries allows us to increase the precision of our estimates. The results of our estimation are reported in Table 6. It is evident that only few correlations that are significant in the pair-wise correlation test are robust to the regression analysis. Surprisingly, the negative impact of the share of individuals aged 25 or older with at least secondary education is not robust, as it is only weakly significant in two model specifications, namely OLS and RE. Interestingly, the positive relationship between EIOp and the share of individuals aged 15-25 enrolled in vocational studies is weakly significant and only for pooled OLS and RE model specification. Similarly, the extent of public resources for tertiary education is negatively correlated with EIOp but significant only in the OLS and RE specification. Our estimates confirm the independence between internationalization and EIOp. Students-teachers ratio is the only variable that retains statistical significance in all the models tested, in addition to per capita GDP. Other things constant, a reduction of the number of students per teacher (i.e. and increase in the quality of education) reduces EIOp. By contrast, the variable used to proxy the incentives to achieve tertiary education (i.e. the relative employment rate) shows a varying pattern: it is positive and weakly significant if the correlation with EIOP is estimated via OLS or RE; it becomes negative, although not significantly, if this correlation is estimated via FE.

Table 6. Pooled OLS, FE and RE estimates

Variables	Pooled OLS EIOp	FE EIOp	RE EIOp
Per capita GDP	-0.000332*** (0.000106)	-0.000315* (0.000132)	-0.000286*** (8.62e-05)
Government expenditures on tertiary education (% of GDP)	-5.933** (2.421)	-3.843 (4.328)	-3.524* (2.027)
Outbound mobility	0.0107 (0.0361)	-0.155 (0.186)	0.0248 (0.0420)
Students-teachers ratio, tertiary	0.297** (0.133)	0.590** (0.182)	0.478*** (0.125)
Share of individuals aged 25 or older with at least secondary education	-0.105** (0.0413)	0.0421 (0.0875)	-0.0737* (0.0431)
Share of individuals aged 15-25 enrolled in vocational studies.	0.339*** (0.116)	0.264 (0.139)	0.315*** (0.108)
Employment rate tertiary/secondary	17.90** (7.576)	-5.041 (9.811)	11.09* (6.255)
Constant	30.17*** (5.347)	29.16** (9.490)	25.49*** (4.438)
Observations	36	36	36
R-squared	0.698	0.913	0.721
Number of countries	25	25	25

Source: Authors' estimates using EU_SILC.

Note: Standard errors in parentheses. Significance: *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

6 EIOp vs. IOp

As a last step, Figure 3 plots for each country the combination of inequality of opportunity for tertiary education (EIOp) and inequality of opportunity for income (IOp). There is a clear direct and positive relation between the two dimensions, with a correlation coefficient of 0.634. Countries with higher inequality of opportunity for tertiary education are also characterized by higher inequality of opportunity for income. In particular, we can identify three clusters. The first is composed by countries with high level of both types of inequality, mostly Eastern-European countries, but it includes also Italy, Portugal and Luxembourg. The second cluster encompasses countries with average levels of both EIOp and income IOP, and it is made up of Mediterranean and Eastern countries. The third cluster is made of countries with low level of both EIOp and income IOp, a cluster encompassing only Northern-European countries. We argue that providing a fair system for tertiary education attainment also equalizes opportunities for income. Of course, there are other channels that operate and affect inequality of opportunity for income, but granting equity at the educational stage would increase the probability of facing more equality of opportunity in later stages of life.

Figure 3. Inequality of opportunity in tertiary education and inequality of opportunity in income, 2005 and 2011
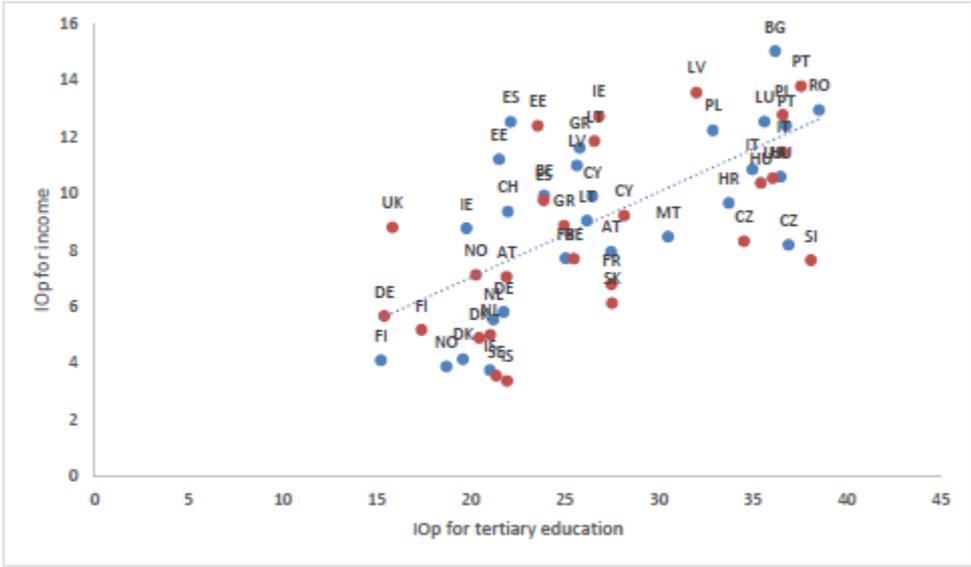
Source: Authors' estimates using EU_SILC.

Note: Red bullets refer to the observation in 2005, blue bullets in 2011.

7   Conclusions

A growing literature in the field of normative economics looks at the different factors generating inter-individual disparities, distinguishing between fair inequality, that is, inequality that is the result of differences in individuals' effort, and unfair inequality, that is, inequality caused by factors outside the sphere of the individual responsibility. According to the EOp paradigm, a society is to be considered equitable if "opportunities", rather than outcomes (as in the more traditional welfarist approach), are equally distributed. The opportunity egalitarian perspective is especially relevant when the focus is on education, which is an important determinant of future earning capacity of individuals and, thereby, of their future well-being.

In this report the EOp framework has been applied to the measurement of inequality of opportunity in tertiary education attainment (EIOp) in Europe, using the EU-SILC database for two survey years, 2005 and 2011. The results, robust to the time period considered, reveal that EIOp is lowest in Northern European countries and higher in Mediterranean and Eastern European countries. The disaggregation by circumstance shows that parental education and parental occupation are the most important factors contributing to EIOp. This points to socio-economic background as the most relevant driver of EIOp (we also note some relevant across-country variation). Policies directed at improving equality of opportunity in higher education should be focused on reducing the role of parental background. Examples of such policies are programs that inform students and their families of the benefits of tertiary education, recognition of non-traditional access routes to higher education, merit and need-based grants, and, more generally, policies directed at reducing the burden of tertiary education on the student or on her family of origin.

To better understand the sources of the estimated EIOp, the latter is regressed on a set of indicators that capture the country's level of economic and human capital development, public expenditures on education (and specifically on tertiary education), variables proxying the characteristics and the quality of education and indicators of the returns from completing   tertiary education.   The evidence shows that a higher students/teacher ratio is associated with higher EIOp, while the latter is negatively correlated with GDP per capita and with public expenditures on tertiary education. Countries with higher shares of individuals aged 25 or older with at least secondary education tend to have lower values of EIOp, which indicates that policies favouring access to and completion of secondary education also tend to reduce the impact of circumstances – parental background in the first place- on the likelihood of completing tertiary education. On the other hand, the share of individuals aged 15-25 enrolled in vocational training is positively associated with EIOp, possibly as a result of the fact that dual systems of education, and early tracking (Brunello and Checchi, 2007), tend to reinforce the importance of circumstances (and are generally associated with higher inequality in outcomes; Hanushek and Wößmann, 2006; Volante et al., 2019).

Interestingly, the benefits from completion of tertiary education, as captured by the ratio between the employment rate of individuals with tertiary education and the employment rate of individuals with secondary education, is positively associated to EIOp. A possible interpretation of this positive correlation is that the higher returns to tertiary education signal that relevant shares of the population are not completing higher education, due to lack of equality of opportunity.

Interventions aimed at reducing EIOp are desirable, as educational inequalities have an impact on future outcome achievements. Indeed, data show that there is a direct link between IOp in tertiary education and IOp in income. While guaranteeing a fair system for tertiary education is an important step towards the improvement of EOp in income, equality of opportunity should not limited to the later stages of education, and in fact, should be guaranteed at every stage of the educational career, from early childhood education to upper secondary schooling. At the same time, it is important to remember that other factors may also affect the transmission of the beneficial effects of tertiary education attainment to the labour market, and hence co-determine labour market outcomes.

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List of abbreviations and definitions

EIOp   Inequality of opportunity in tertiary education

IOp   Inequality of opportunity

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Annexes

Annex 1. Probit estimates for 2005

Table A.1. Reduced-Form Regression of tertiary education achievement on Circumstances

	AT	BE	CY	CZ	DE	DK	EE	ES
Male	0.237***	-0.0416***	0.0886***	0.120***	0.242***	-0.256***	-0.468***	-0.0206***
	(0.00146)	(0.00129)	(0.00478)	(0.00151)	(0.000416)	(0.00172)	(0.00357)	(0.000607)
Low parental education	-0.171***	0.0445***	-0.0178	-0.265***	-0.0697***	-0.197***	-0.105***	-0.210***
	(0.00194)	(0.00274)	(0.0352)	(0.00971)	(0.000824)	(0.00265)	(0.00896)	(0.00145)
Medium parental education	0.101***	0.637***	0.570***	-0.0759***	0.138***	-0.0285***	0.121***	0.344***
	(0.00183)	(0.00291)	(0.0357)	(0.00947)	(0.000579)	(0.00224)	(0.00908)	(0.00177)
High parental education	0.778***	1.340***	1.100***	0.729***	0.628***	0.473***	0.525***	0.768***
	(0.00342)	(0.00316)	(0.0364)	(0.00970)	(0.000630)	(0.00273)	(0.00976)	(0.00174)
Both blue collar	-0.250***	-0.252***	-0.422***	-0.961***	-0.338***	-0.247***	-0.380***	-0.567***
	(0.00238)	(0.00249)	(0.0111)	(0.00227)	(0.000637)	(0.00247)	(0.00771)	(0.00109)
F white collar M blue collar				-0.434***	-0.161***		-0.0427***	-0.242***
				(0.00208)	(0.000720)		(0.00748)	(0.00141)
F blue collar M white collar	-0.0535***	0.0964***	-0.0877***	-0.464***	0.0511***	0.143***		-0.139***
	(0.00277)	(0.00263)	(0.0117)	(0.00273)	(0.000668)	(0.00278)		(0.00117)
Both white collar	0.419***	0.213***	0.292***			0.394***	0.337***	
	(0.00260)	(0.00299)	(0.0132)			(0.00263)	(0.00814)	
Other EU	0.409***	0.0597***	0.0775***	0.420***	0.0717***	0.282***	0.256***	0.168***
	(0.00338)	(0.00290)	(0.0101)	(0.00442)	(0.000655)	(0.00714)	(0.00451)	(0.00243)
Outside EU	-0.146***	0.113***	0.0164**	0.0814***		0.213***	-0.322***	-0.0904***
	(0.00253)	(0.00296)	(0.00786)	(0.00633)		(0.00450)	(0.00915)	(0.00139)
Bad/Very Bad		-0.262***	-0.814***	-0.126***		-0.437***	-0.150***	-0.492***
		(0.00327)	(0.0144)	(0.00367)		(0.00487)	(0.00605)	(0.00115)
Moderately bad		-0.206***	-0.744***	-0.0360***		0.0267***	-0.0810***	-0.384***
		(0.00282)	(0.0111)	(0.00289)		(0.00416)	(0.00476)	(0.00114)
Moderately good		-0.226***	-0.322***	0.00621***		0.0517***	0.000638	-0.282***
		(0.00206)	(0.00938)	(0.00200)		(0.00250)	(0.00529)	(0.000848)
Good		-0.129***	-0.237***	-0.00959***		0.0552***		-0.112***
		(0.00210)	(0.00942)	(0.00202)		(0.00234)		(0.000806)
R-squared	0.0792	0.1718	0.1764	0.1627	0.0637	0.0857	0.1186	0.1263
Sample size	6514	5523	5364	4980	14618	3762	5108	17176

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Table A.1. Reduced-Form Regression of tertiary education achievement on Circumstances (continued)

	FI	FR	GR	HU	IE	IS	IT	LT	LU
Male	-0.293***	-0.136***	0.00512***	-0.129***	0.118***	-0.173***	-0.0173***	-0.352***	0.176***
	(0.00168)	(0.000543)	(0.00125)	(0.00148)	(0.00212)	(0.00787)	(0.000637)	(0.00232)	(0.00660)
Low parental education	0.140***	-0.409***	-0.324***	-0.275***	-0.0544***	0.128***	-0.0883***	0.149***	-0.0663***
	(0.00450)	(0.00106)	(0.00324)	(0.00487)	(0.00421)	(0.0216)	(0.00448)	(0.00813)	(0.0131)
Medium parental education	0.384***	0.0466***	0.300***	0.166***	0.725***	0.573***	0.565***	0.445***	0.363***
	(0.00474)	(0.00115)	(0.00370)	(0.00482)	(0.00484)	(0.0211)	(0.00455)	(0.00828)	(0.0130)
High parental education	0.673***	0.745***	0.725***	0.894***	1.043***	1.057***	1.161***	1.088***	1.251***
	(0.00504)	(0.00136)	(0.00397)	(0.00527)	(0.00534)	(0.0229)	(0.00466)	(0.00873)	(0.0151)
Both blue collar	-0.460***	-0.401***	-0.238***	-0.757***	-0.624***	-0.503***	-0.185***	-0.588***	-0.587***
	(0.00280)	(0.000890)	(0.00318)	(0.00241)	(0.00378)	(0.0116)	(0.00123)	(0.00437)	(0.00921)
F white collar M blue collar	-0.188***	-0.114***		-0.372***	-0.230***	-0.268***		-0.364***	-0.186***
	(0.00292)	(0.00100)		(0.00236)	(0.00491)	(0.0130)		(0.00401)	(0.0113)
F blue collar M white collar	-0.0596***		0.215***	-0.364***	-0.305***	-0.325***	0.238***	-0.233***	
	(0.00326)		(0.00326)	(0.00307)	(0.00366)	(0.0119)	(0.00129)	(0.00552)	
Both white collar		0.325***	0.304***				0.350***		0.275***
		(0.000983)	(0.00371)				(0.00141)		(0.00993)
Other EU	0.166***	-0.0109***	0.0234***	-0.238***	0.215***	0.138***	0.0280***	-0.366***	0.356***
	(0.00922)	(0.00157)	(0.00449)	(0.00900)	(0.00340)	(0.0226)	(0.00268)	(0.0211)	(0.00725)
Outside EU	0.344***	-0.0517***	-0.0568***	0.231***	0.689***	0.149***	-0.170***	0.0884***	0.440***
	(0.00837)	(0.000957)	(0.00250)	(0.00489)	(0.00571)	(0.0262)	(0.00143)	(0.00486)	(0.0125)
Bad/Very Bad	-0.333***			-0.172***	-0.508***	-0.173***	-0.514***	-0.191***	-0.576***
	(0.00340)			(0.00269)	(0.00433)	(0.0219)	(0.00125)	(0.00450)	(0.0157)
Moderately bad	-0.164***			-0.226***	-0.349***	0.00488	-0.383***	-0.220***	-0.480***
	(0.00294)			(0.00247)	(0.00395)	(0.0180)	(0.00109)	(0.00374)	(0.0125)
Moderately good	0.00684***			-0.106***	-0.202***	-0.159***	-0.215***	0.0608***	-0.221***
	(0.00221)			(0.00242)	(0.00283)	(0.0117)	(0.000952)	(0.00320)	(0.00885)
Good	0.0491***			-0.101***	-0.134***	-0.00468	-0.0714***	0.0822***	-0.120***
	(0.00233)			(0.00198)	(0.00281)	(0.0111)	(0.000992)	(0.00356)	(0.00947)
R-squared	0.0764	0.1437	0.1084	0.1774	0.1718	0.0940	0.1688	0.1375	0.2488
Sample size	6742	11527	7125	8400	4541	1764	27757	5479	4747

Table A.1. Reduced-Form Regression of tertiary education achievement on Circumstances (continued)

	LV	NL	NO	PL	PT	SE	SI	SK	UK
Male	-0.517***	0.252***	-0.100**	-0.248***	-0.318***	-0.331***	-0.195***	-0.0226***	-0.0657***
	(0.00320)	(0.00101)	(0.0442)	(0.000773)	(0.00153)	(0.00178)	(0.00353)	(0.00191)	(0.000556)
Low parental education	-0.302***	0.101***	-0.180**	-0.0975***	-0.253***	0.0924***	-0.158***	-0.266***	-0.0486***
	(0.00856)	(0.00141)	(0.0849)	(0.00188)	(0.00278)	(0.00369)	(0.00999)	(0.00557)	(0.000649)
Medium parental education	0.0783***	0.419***	0.158**	0.413***	0.623***	0.706***	0.346***	0.0486***	0.290***
	(0.00861)	(0.00169)	(0.0738)	(0.00185)	(0.00438)	(0.00407)	(0.0101)	(0.00543)	(0.000875)
High parental education	0.796***	1.095***	0.606***	1.302***	0.738***	1.051***	0.666***	0.691***	0.802***
	(0.00934)	(0.00178)	(0.0781)	(0.00225)	(0.00409)	(0.00402)	(0.0120)	(0.00610)	(0.000953)
Both blue collar	-0.545***	-0.289***	-0.252***	-0.284***	-0.585***	-0.374***	-0.629***	-0.333***	-0.489***
	(0.00563)	(0.00187)	(0.0628)	(0.00148)	(0.00259)	(0.00447)	(0.00551)	(0.00336)	(0.000862)
F white collar M blue collar	-0.167***			0.142***		-0.326***	-0.329***	-0.0862***	-0.134***
	(0.00493)			(0.00156)		(0.00507)	(0.00561)	(0.00351)	(0.000976)
F blue collar M white collar	-0.179***	0.0907***	0.199***	0.411***	0.215***	-0.304***	-0.348***		-0.244***
	(0.00760)	(0.00186)	(0.0697)	(0.00167)	(0.00289)	(0.00582)	(0.00658)		(0.000987)
Both white collar		0.200***	0.378***	-0.218***	0.409***			0.278***	
		(0.00219)	(0.0663)	(0.00925)	(0.00309)			(0.00354)	
Other EU	0.130***	-0.326***	0.379***	0.251***	0.721***	0.128***	-0.160***	0.246***	0.0106***
	(0.00430)	(0.00419)	(0.134)	(0.00597)	(0.00471)	(0.00418)	(0.00666)	(0.00735)	(0.00288)
Outside EU	-0.0723***	-0.190***	-0.00343	-0.345***	-0.0724***	0.145***	-0.522***	0.412***	0.214***
	(0.00625)	(0.00229)	(0.117)	(0.00159)	(0.00454)	(0.00356)	(0.00754)	(0.0143)	(0.000890)
Bad/Very Bad	-0.0379***	-0.245***	-0.0564	-0.274***		-0.239***	-0.330***	0.159***	-0.159***
	(0.00488)	(0.00251)	(0.134)	(0.00129)		(0.00435)	(0.00600)	(0.00557)	(0.000987)
Moderately bad	0.0971***	-0.202***	0.0421	-0.140***		-0.0849***	-0.238***	0.110***	-0.130***
	(0.00415)	(0.00193)	(0.103)	(0.000995)		(0.00365)	(0.00516)	(0.00548)	(0.000955)
Moderately good	0.0738***	0.0375***	0.0348	-0.0544***		-0.236***	0.0210***	0.0503***	-0.0934***
	(0.00464)	(0.00142)	(0.0679)	(0.00116)		(0.00280)	(0.00539)	(0.00542)	(0.000752)
Good		-0.0551***	0.0267			-0.0524***		0.00395	-0.0305***
		(0.00138)	(0.0530)			(0.00233)		(0.00571)	(0.000780)
R-squared	0.1582	0.1144	0.0969	0.1934	0.1804	0.0974	0.1549	0.1149	0.0753
Sample size	4106	5680	3711	21748	5804	3389	4888	7701	9674

Source: Authors' estimates using EU_SILC

Table A.2. Inequality of opportunity for tertiary education and contribution of each circumstance, 2005

Country	Iop	Gender	Parental education	Parental occupation	Birth place	Finantial problems
AT	21,90	13,13	27,71	51,1	8,06	n.a.
BE	25,48	1,7	52,61	33,74	0,37	11,57
BG	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
CH	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
CY	28,15	0,35	40,71	34,86	5,49	18,59
CZ	34,53	3,64	30,97	53,04	1,77	10,57
DE	15,4	13,01	48,51	38,25	0,24	n.a.
DK	20,44	13,5	31,83	47,45	2,06	5,17
EE	23,56	21,03	31,19	33,66	3,91	10,21
ES	23,87	0,98	37,05	40,91	1,05	19,99
FI	17,38	12,81	35,16	39,24	0,85	11,95
FR	27,48	4,02	51,33	43,35	1,2	n.a.
GR	24,96	0,17	49,76	48,18	1,86	n.a.
HR	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
HU	35,43	2,28	36,46	46,24	0,65	14,36
IE	26,81	3,49	45,01	26,79	8,83	15,88
IS	21,93	7,67	48,34	34,44	2,31	7,25
IT	36,59	0,67	41,16	36,62	0,96	20,59
LT	26,57	11,04	37,9	34,52	0,86	15,68
LU	36,06	1,95	35,74	40,94	7,89	13,49
LV	32	19,72	37,16	33,63	1,49	8
MT	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
NL	21,03	9,77	46,71	34,27	1,54	7,71
NO	20,27	2,66	45,5	43,31	2	6,52
PL	36,58	5,96	38,33	38,52	0,22	16,97
PT	37,56	9,67	27,81	59,03	3,5	n.a.
RO	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
SE	21,35	14,34	68,96	6,86	1,83	8,01
SI	38,09	5,77	36,14	34,54	2,65	20,9
SK	27,51	0,58	33,38	49,08	0,97	15,98
UK	15,83	1,36	40,73	39,74	5,34	12,82

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