The geography of tertiary education inequalities over time

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Executive summary

In recent years, there has been a growing interest in understanding the intricate relationship between social inequality and the geographic context in Europe. This executive summary provides an overview of a comprehensive study that delves into the geography of social inequality and intergenerational mobility in tertiary education across European regions. We study inequalities of educational opportunities 1) by comparing individuals' probability of attaining a tertiary education degree conditional on whether their parents attained a tertiary education or not, and 2) focusing on differences across countries, across (sub)regions and over time.

1. Persistence of inequality of educational opportunities

Our study shows that individuals from families without tertiary education face greater obstacles compared to individuals from highly educated families in achieving a tertiary education degree. Consistently observed across European countries, regions, and time periods is the tendency for individuals whose parents didn't achieve a tertiary education to be less likely to attain that level themselves compared to those whose at least one parent obtained a tertiary degree. Additionally, there's another stable trend over time: on average, approximately one-third of individuals from highly educated families fail to achieve a tertiary education degree.

2. The importance of within country difference and the sub-regional level

This study reveals substantial within-country disparities in educational attainment, emphasising the potential role of the local context in shaping individuals' opportunities. Regions or sub-regions explain 5,4% of the variability in the individual probability of attaining tertiary educational degree, compared to 3,4% explained by the country clustering. When inequalities in educational opportunities are measured at the (sub)regional level, country clustering explains only 22% in the variation. This points towards the intuition that the local environment, that may be characterised by variables such as crime rates, air quality, access to green spaces and public amenities, amplifies or mitigates these disparities. This result underscores the vital role of the local environment in shaping educational opportunities, which can be overlooked if only focusing on between country differences.

3. The general decline but not convergency in tertiary education inequalities

Our analyses demonstrate an average decline in inequalities of educational opportunities in Europe over cohorts of about 10 percentage points. This trend suggests a more equitable distribution of educational opportunities over the past decades across cohorts. However, the levels of educational inequalities across different European countries are not converging. That is, differences in inequalities across countries have remained on average the same over time, and single-country analysis show very different trends: even if most countries show a decline of IEOs, for some European countries, IEOs have stabilized or even increased over time.

Abbreviations

UTU University of Turku

UNED National Distance Education University

ESS European Social Survey

TED Tertiary education degree

IEO Inequality in Educational Opportunities

NUTS Nomenclature of Territorial Units for Statistics

ICC Intra-class correlation

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The geography of tertiary education inequalities over time

This study explores the geography of social inequality and intergenerational mobility in European tertiary education attainment. Analysing data from the European Social Survey (waves 1-10), this study aims to describe the potential role of national as well as regional and sub-regional contexts in shaping individual tertiary education opportunities. Results show substantial cross-country disparities, as well as a sharp divide in inequalities in tertiary education attainment within European countries. In parallel, we observe a general decline in educational inequalities over time, even if this decline is not followed by a convergence in the levels of Inequalities in Educational Opportunities (IEOs) across countries: the differences in educational inequalities between countries remain stable over time, and European countries show great variation in their trends of inequalities in tertiary education attainment over time.

Persistence of IEO.
Across countries, within regions, and over time, individuals whose parents did not obtain a tertiary education degree are less likely to obtain a tertiary education degree compared to individuals whose parents obtained at least one tertiary education degree. We uncover an interesting common pattern: 1 in 3 individuals whose parents obtained a tertiary education degree are not able to attain the same educational level.

Overall decline of IEO across cohorts.
Over time, there is an average notable decrease in educational disparities concerning tertiary educational attainment across European countries, indicating a trend toward a more equitable distribution of educational inequalities. However, this average decline of IEO is not followed by a convergence between countries, and this is explained by a great variation in IEOs trends across European countries.

The importance of local context.
The findings underscore the importance of considering (sub)regional and local environment for explaining intergenerational mobility and social inequality, especially considering tertiary education attainment. This result highlights the need for targeted policies that address also (sub)regional disparities in education, rather than focusing mainly on country differences.

1. Introduction

Over the last few years, there has been a growing interest in the geography of social inequality and intergenerational mobility (Acciari et al., 2022; Chetty et al., 2014, 2018; Corak, 2020; Eriksen & Munk, 2020; Granström & Engzell, 2023; Heidrich, 2017).

The core tenant of this line of research is that the place where people are born or live is a crucial moderator of the effect of their social origins on different life-course outcomes. For instance, coming from a family where no progenitor attained a tertiary education degree is a well-known disadvantage in the educational system. However, such a penalty can be amplified or mitigated by the local context, creating very granular geographical patterns of inequality of opportunity. Put in other terms, there is relevant heterogeneity in the intergenerational transmission of advantage that is commonly masked by the country mean.

These studies on the geography of social inequality are strongly linked to research on the neighbourhood effect, where different aspects of the local context have been proven relevant for individuals' life chances (Harding et al., 2011). Variables defining the neighbourhood environment such as crime (Manduca & Sampson, 2019), air pollution (Shier et al., 2019), greenery (Claesen et al., 2021), traffic noise (Foraster et al., 2022), libraries, public transport (Stein & Grigg, 2019) are related to the individual's academic performance and, through this channel, to later life-course outcomes. Of course, the social origin of individuals greatly influences the kind of local environment that they are exposed to, but also interact with it. As a result, the effect of social origin on academic success strongly depends on the characteristics of the place where people are born and raised.

Overall, what this line of research brings to the table is the idea that there is substantial variation hidden within countries, which are oftentimes wrongly assumed to be much more homogeneous than they are. In this work, we aimed to unveil such internal heterogeneity and examine the cross-regional variation in inequality in educational attainment in Europe. For this reason, the first aim of this work is to assess the potential variation across Europe in the effect of having tertiary-educated parents on the probability of attaining tertiary education, not only comparing European countries but descending to the regional level.

This is not the first study that attempts to explore this within-country heterogeneity in inequality patterns. However, most previous works on the geography of social inequality and mobility consisted of single-country studies (Acciari et al., 2022; Chetty et al., 2014, 2018; Corak, 2020; Eriksen & Munk, 2020; Heidrich, 2017). Instead, we adopt a comparative perspective and exploit waves 1-10 of the European Social Survey (ESS) to assess inequalities in tertiary degree attainment between and within countries and across regions.

The ESS has already been employed to examine regional patterns of intergenerational social mobility (Granström & Engzell, 2023). Our second aim is to go beyond cross-regional analysis and examine the variation over time. The hypothesis of persistent educational inequalities has been quite present in sociological studies since the 1990s (Blossfeld & Shavit, 1993; Raftery & Hout, 1993), although more recent works point towards a generalized, although modest, decrease in inequality levels over time (Ballarino et al.,

2009; Barone & Ruggera, 2018; Breen et al., 2009). Therefore, we will explore whether there has been a generalized downward trend in inequality over the last decades across European regions and whether it led to an increasing degree of convergence in inequality levels.

The results of our study, which will be presented in the subsequent sections, shed light on these critical questions. We unveil the intricate patterns of within-country and cross-regional educational inequalities, demonstrating the potential role of the geographic context in interacting with social origins to shape individuals' educational opportunities.

Our results reveal substantial within and between-country disparities in educational attainment across Europe. Notably, individuals from families without tertiary education have lower chances of achieving a tertiary education degree. This points towards the intuition that these individuals face greater obstacles, defined both by the national and regional environment, which in turn shape their educational opportunities. This pattern is consistent not only across regions and countries but also over time. In contrast, we find a stylised fact: consistently, 1 in 3 individuals from families with a tertiary degree do not manage to attain a tertiary education degree over time.

Importantly, we identify another very noteworthy trend: there is a general decline in educational inequalities across European regions over time, hinting at a potential more equitable distribution of educational opportunities. However, not all countries have experienced this decline in IEO. We find that countries such as Austria, Switzerland, Greece, and Belgium display higher levels of IEOs in their younger cohorts, while Ireland's IEO levels remain equal across cohorts. Countries such as Denmark, Spain, Finland, and Iceland show the steepest decline in IEOs over time.

Beyond this overall decline, we also test whether there has been a convergence in IEO across countries, that is, whether countries are converging to a similar level of IEO across time. Comparing older and younger cohorts' results shows that there is still great variation across countries which does not seem to be converging over time.

Finally, we ask whether it matters more to be born in a given region rather than in a given country. In other words, whether the regional context explains more IEO than the national context. Surprisingly, results from multilevel analysis show how both the national and the regional countries explain somehow similar levels of variation in individual probability of attaining TED in Europe: 5,4% of the variability is explained by regions and 3,4% is explained by countries. From this analysis, we cannot assert which environment, the regional or the national, is more important in explaining IEO. However, when focusing on IEOs as the outcome measured at the regional level, only 22% of the variation is explained by country clustering, suggesting a strong role played by the regional level. In other words, when we do not consider the individual variation explaining IEO, results show how the regional environment matters more for IEOs. These analyses show how the regional environment is at least as equally important as the national context for our understanding of IEO in Europe.

The remaining of this work is organized as follows. We begin with our data and methods section, where we provide an overview of our sample selection, the definition of our key variables as well and our analytical strategy. The following section presents our main

results. We start by mapping trends in the reproduction of Inequality of Educational Opportunities across regions in Europe, followed by some trends in the reproduction of IEO between countries over time. We end our results section by providing some results on inequalities in tertiary educational degree attainment in Europe across time, We end this report with a concluding section.

2. Data and Method

2.1.   Data and Sample

This analysis leverages the extensive territorial data made available through the European Social Survey (ESS). The ESS is a transnational survey initiative which began in 2001 and has since been conducted in over 30 countries. Biennially, ESS researchers conduct face-to-face interviews with freshly selected cross-sectional samples. The objective of the ESS is to assess individuals' attitudes, behaviours, and beliefs, thereby facilitating cross-population comparisons.

Our dataset consists of a merge of ESS survey rounds from round 1 (administered in 2002) to round 10 (administered in 2020). The Nomenclature of Territorial Units for Statistics (NUTS) level information varies across countries and survey rounds within our dataset. Consequently, our combined dataset necessitates the harmonization of NUTS-level information across years and countries, with the primary goal of obtaining the most granular NUTS-level data for each country within the final dataset.

Additionally, the selection of countries for inclusion in our analysis was based on two criteria:

— Inclusion of countries with observations available for at least four out of the ten survey waves. This criterion ensures an adequate sample size for descriptive statistics both at the national and NUTS levels.

— Inclusion of countries exhibiting sufficient variability in participants' cohort of birth ensures the dataset's representativeness of diverse age groups.

This methodical approach underpins the robustness and comprehensiveness of our analysis, allowing us to draw meaningful insights from the ESS data.

Concerning the individual-level selection of cases, we opted to include individuals aged 27 years and older in our analysis, as this age threshold ensures that most individuals have completed their educational journey. Moreover, we chose individuals for whom we have information on their education, parental education, and cohort (derived from the year of birth) information.

The resultant selection encompasses data from a total of 25 European countries, covering 298 distinct regions, and includes a substantial sample size of 285,506 individuals. This rigorous selection process not only enhances the reliability of our analysis but also ensures the representativeness of our dataset across a wide range of European countries and regions.

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Table 1 below describes the countries included in our analytical sample, the number of observations pooled across each ESS waves for each country, the level of geographical information, and the number of ESS waves present in our sample.

Table 1. Description of countries, regions, and number of observations

Country	N of observations pooled	NUTS 2016 (region)	Waves
AT – Austria	10,748	NUTS 2 (9)	1,2,3,7,8,9,10
BE – Belgium	12,124	NUTS 2 (11)	1,2,3,4,5,6,7,9
BG – Bulgaria	11,441	NUTS 3 (28)	3,4,5,6,9,10
CH – Switzerland	13,893	NUTS 2 (7)	1,2,3,4,5,6,7,8,9,10
CZ – Czech Republic	16,563	NUTS 2 (8)	1,2,4,5,6,7,8,9,10
DE – Germany	20,409	NUTS 1 (16)	1,2,3,4,5,6,7,8,9,10
DK – Denmark	6,496	NUTS 2 (5)	1,2,3,4,5,6,7,9
EE – Estonia	13,541	NUTS 3 (7)	2,3,4,5,6,7,8,9,10
EL – Greece	10,568	NUTS 2 (13)	1,2,4,5,10
ES – Spain	13,718	NUTS 2 (17)	1,2,3,4,5,6,7,8,9,10
FI – Finland	14,486	NUTS 2 (4)	1,2,3,4,5,6,7,8,9,10
FR – France	9,340	NUTS 1 (8)	1,2,3,4,5,6,7,8,9,10
HU – Hungary	7,147	NUTS 3 (22)	1,2,3,4,5,6,7,8,9,10
IE – Ireland	10,082	NUTS 3 (16)	1,2,3,4,5,6,7,8,9
IS – Island	3,156	NUTS 3 (2)	2,6,9,10
IT – Italy	9,389	NUTS 1 (6)	1,2,6,8,9,10
LT – Lithuania	9,200	NUTS 3 (20)	5,6,7,8,9,10
NL – Netherlands	15,217	NUTS 2 (12)	1,2,3,4,5,6,7,8,9,10
NO – Norway	7,131	NUTS 2 (10)	1,2,3,4,5,6,7,8,9,10
PL – Poland	11,522	NUTS 2 (22)	1,2,3,4,5,6,7,8,9,10
PT – Portugal	15,056	NUTS 2 (5)	1,2,3,4,5,6,7,8,9,10
SE – Sweden	9,435	NUTS 2 (8)	1,2,3,4,5,6,7,8,9,10
SI – Slovenia	10,636	NUTS 3 (24)	1,2,3,4,5,6,7,8,9,10
SK – Slovakia	9,152	NUTS 3 (8)	2,3,4,5,6,9,10
UK – United Kingdom	15,056	NUTS 1 (12)	1,2,3,4,5,6,7,8,9
Total	285,506	298 (sub)regions	

2.2.   Variables

Table 2 describes the individual-level data that has been selected for our analysis. Our primary research objective focuses on explaining the conditional probability of an individual attaining a tertiary educational degree based on two distinct parental education scenarios:

— Having at least one parent or both parents with a tertiary educational degree.

— Having parents without a tertiary educational degree.

Our very basic analysis aims to discern how these parental education backgrounds influence the likelihood of an individual achieving a tertiary education degree. To explain possible changes over time in the reproduction of inequalities in tertiary education, we selected six cohorts: individuals born before 1940 (1); individuals born between 1940 and 1949 (2); individuals born between 1950 and 1959 (3); individuals born between 1960 and 1969 (4); individuals born between 1970 and 1979 (5); and finally, individuals born between 1980 and 1993 (6). To account for possible fluctuations across waves, we also include the ESS wave (from 1 to 10) as a control variable.

Table 2. Variables description

Variables	Coding	Descriptives
Outcome variable		
Respondents' tertiary educational degree attainment	0 = No tertiary educational degree attained 1 = Yes tertiary educational degree attained	76% 24%
Independent variables		
Parents' tertiary educational degree attainment	0 = None of the parents have a tertiary educational degree 1 = At least one parent or both have a tertiary educational degree	87% 13%
Respondents' cohort	1 = Born before 1940 2 = Born between 1940 and 1949 3 = Born between 1950 and 1959 4 = Born between 1960 and 1969 5 = Born between 1970 and 1979 6 = Born between 1980 and 1994	14% 17% 20% 21% 18% 10%
ESS Wave	Continuous variable from 1 to 10	Mean = 5,76 St. dev = 2,72

2.3. Analytical strategy

The analytical strategy is threefold. The first step is describing trends in the reproduction of educational inequalities across the 25 European countries selected, both within countries (comparing the information at the smallest NUTS level), as well as between countries and over time. The second step is assessing the average European probability of TED attainment, as describing the trend of reproduction of educational inequalities over time. The final step is assessing country-specific trends of educational inequalities over time.

2.3.1. Maps and Descriptive Analysis

To describe trends of reproduction of educational inequalities **within and between countries**, we make use of maps as a descriptive tool, taking advantage of the smallest geographical unit. We show:

1. The percentage of individuals with tertiary education degree (TED) whose parents attained TED (at least one of them).

$$P_1 = (Ind_{TED}/Par_{TED}) * 100$$

2. The percentage of individuals with TED whose parents did not attain TED.

$$P_2 = (Ind_{TED}/Par_{NO\ TED}) * 100$$

3. The difference in the percentage of individuals with TED whose parents attained TED (at least one of them), and the percentage of individuals with TED whose parents did not attain TED.

$$D_1 = P_1 - P_2$$

To describe trends of reproduction of educational inequalities **between countries over time**, we make use of maps at the country level, to describe:

1. The difference in the percentage of individuals with TED whose parents attained TED (at least one of them), and the percentage of individuals with TED whose parents did not attain TED, only for individuals born *before 1950* (cohort 1940-1950).

$$D_{1(<1950)} = P_{1(<1950)} - P_{2(<1950)}$$

2. The rate of individuals with TED whose parents attained TED (at least one of them), minus the rate of individuals with TED whose parents did not attain TED, only for individuals born *after 1980* (cohort 1980-1994).

$$D_{1(>1980)} = P_{1(>1980)} - P_{2(>1980)}$$

3. The difference between the two.

$$D_2 = D_{1(>1980)} - D_{1(<1950)}$$

2.3.2. Multilevel Linear Regression Analysis

The second step of the analysis is assessing the overall European trend in the reproduction of educational inequalities over time, analysing how much variation in the probability of attaining a TED is explained both at the country level and at the regional/NUTS level. To do so, we perform a multilevel regression analysis, with individuals nested in regions nested in European countries. We introduce a random slope at the regional level and wave-fixed effects. To capture the trends over time, we introduce an interaction term at the first level between parental tertiary degree attainment and the respondents' cohort. The equation predicting the individual probability of attaining a TED is:

$$Y_{ijk} = \beta_0 + \beta_1 X_{ijk} + \beta_2 Z_{ijk} + \beta_1 X_{ijk}\mu_{1jk} + \beta_3 X_{ijk} * Z_{ijk} + \alpha_{1_w} + \mu_{0j} + \mu_{0jk} + \varepsilon_{ijk}$$

Where:

Y is the individual probability of having a TED;

X is parental education (having at least one parent with TED);

Z is an individual cohort;

α_1 is the fixed effect for ESS wave;

μ_1 is the random slope at the regional level;

ε is the error term.

2.3.3. Country-specific Linear Regression Analysis

The third and final step of the analysis is assessing trends in educational inequalities over time for each selected country. We do so by relying on Linear probability models for each country. The outcome is the individual probability of obtaining a tertiary degree, controlling for parental educational level, as having at least one parent or both with a tertiary degree versus having parents without any tertiary degree. Each model includes an interaction term

between the individual's parental education and cohort. We also introduce ESS wave fixed effects and region fixed effects. The equation predicting one's probability of attaining a TED is:

$$Y_{ic} = \beta_0 + \beta_1 X_{ic} + \beta_2 Z_{ic} + \beta_3 X_{ic} * Z_{ic} + \alpha_{1_r} + \alpha_{2_w} + \varepsilon_{ic}$$

Where:

Y is the individual probability of having a tertiary education degree

X is parental education (having at least one parent with tertiary education degree)

Z is individual cohort

α_1 is the fixed effect for region (NUTS level)

α_2 is the fixed effect for ESS wave

ε is the error term.

3. Results

3.1.   Mapping trends of reproduction of IEOs

In this initial section of our results, we delve into the dynamics of educational inequality reproduction, focusing on the percentages of individuals who attained a tertiary educational degree in relation to their parental educational backgrounds. Specifically, we aim to shed light to the geographical variations in the percentage of individuals holding a tertiary degree based on whether their parents have or not obtained a tertiary education degree.

Firstly, we examine these disparities at the finest geographical granularity attainable through the availability and volume of data in the European Social Survey (ESS). Consequently, our analysis encompasses variations both across countries and within individual countries. Secondly, we zoom out to a European-country level, investigating changes in disparities in educational opportunities at the tertiary level over time.

To facilitate the interpretation of the maps we present, it is crucial to note that lighter colors represent higher values, while darker colors indicate lower values. This color scheme aids in visualizing the magnitude of educational disparities across different regions and time periods.

3.1.1. Trends of reproduction of IEOs between and within countries

Figure 1. Within-and between-country reproduction of educational inequality in Europe
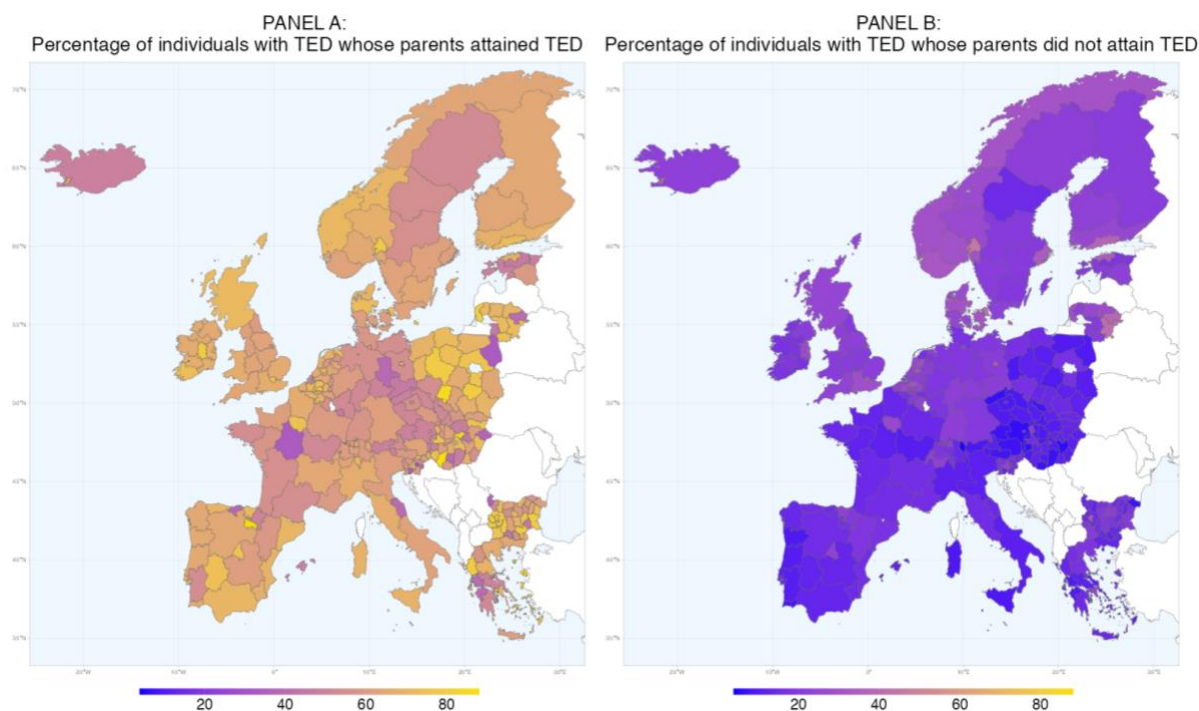
Note: Authors' own elaboration using pooled data from ESS waves (1-10). For each smallest geographical unit, we show the percentage of individuals with a tertiary education degree, conditional on having at least one parent with a tertiary educational degree (left) and conditional on having parents without any tertiary educational degree (right). Pooled waves. See Lahti et al. (2017) for the Eurostat package for R.

Figure 1 presents the percentages of tertiary educational attainment across various NUTS levels within our dataset. Panel A illustrates these percentages for individuals for whom at least one parent holds a tertiary educational degree, while Panel B showcases the same percentages for individuals whose parents lack a tertiary education degree.

A striking observation is the stark contrast in darkness between the two maps. Specifically, Panel B exhibits considerably darker shades across the entire geographic region. This disparity signifies a well-known pattern trend: individuals whose parents do not possess a tertiary education degree are significantly less likely to attain a tertiary degree themselves. This pattern is consistently evident across Europe.

In a more detailed examination, the percentage of individuals with a tertiary educational degree among those whose parents lack one ranges from a minimum of 5 per cent in Western Austria (Vorarlberg) to a maximum of 50 per cent in Southern Norway (Telemark). In contrast, among individuals with at least one parent holding a tertiary degree, the corresponding percentage ranges from 25% to 87.5%. This substantial discrepancy highlights the considerable advantage conferred by parental tertiary education attainment.

Furthermore, the maps also reveal disparities in these percentages both between countries across Europe and within the same country. While within-country differences are relatively subdued in Northern European nations, they become more conspicuous in Southern and Eastern European countries.

To comprehensively capture the extent of tertiary education inequalities across Europe, encompassing both inter-country and intra-country variations, Figure 2 portrays the disparity in percentages between the previously illustrated maps.

Figure 2. Variation in IEOs across EU regions
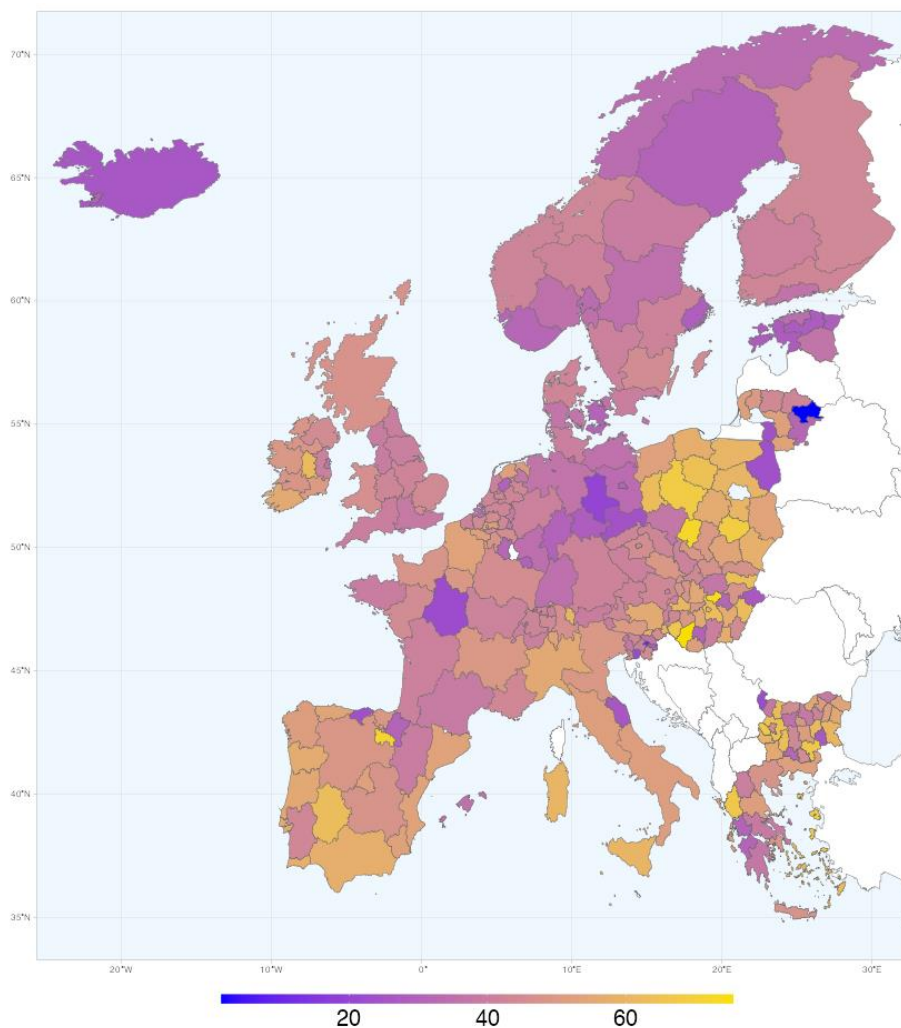
Note: Authors' elaboration using pooled data from ESS (waves 1-10). For each smallest geographical unit, we show IEOs calculated as the difference in the percentages of individuals with a tertiary education degree, conditional on having at least one parent with a tertiary educational degree, *minus* the percentages of individuals with a tertiary education degree, conditional of having parents without any tertiary educational degree. Pooled waves. See Lahti et al. (2017) for Eurostat package for R.

In essence, we highlight the differences in the percentages of individuals holding a tertiary educational degree, contingent upon whether their parents possess a tertiary educational

degree or not. This is calculated as the percentage of individuals with a tertiary education degree when parents lack such credentials, subtracted from the percentage when at least one parent holds a tertiary degree. The greater the discrepancy between these two percentages, the lighter the colours on the map, signifying a more pronounced degree of educational inequalities within a specific European region.

Figure 2 shows clear patterns of IEOs across Europe. We detect higher level of IEOs in Eastern and Southern Europe, where also inequalities within countries are more pronounced. For example, Spain, France, and Greece show a high degree of within-variability compared to Sweden and Norway. Indeed, IEOs slightly reduce in Centre Europe, and they become even smaller in Northern Europe.

The disparities in percentages span a wide range, from a modest 1.6% observed in Utena County (Lithuania) to a substantial 75.4% in Somogy (Hungary). Notably, the variability in these percentage differences is remarkably extensive across Europe, with the visual representation underscoring even more pronounced differences within individual countries.

Overall, this first section suggests that there are considerable geographical differences in inequalities in tertiary educational attainment, and that accounting for variations both between and within countries may hold substantial research interest.

3.1.2. Trends of reproduction of IEOs between countries over time

In this section, we aim to provide comprehensive insights into the evolving patterns of educational inequality reproduction in tertiary education across European countries. To do so, we perform the same analysis presented in the previous section, but distinguishing between our oldest cohorts, those born before 1950 and our youngest cohorts, those born after 1980.

Figure 3 shows two European maps, following the same methodology as presented in Figure 2, to illustrate and calculate inequalities in tertiary education opportunities within our oldest and youngest cohorts.

Panel A of Figure 3 spotlights Inequalities in Educational Opportunities (IEOs) among individuals born before 1950, while Panel B on the right side focuses on IEOs among individuals born after 1980. The colour intensity on each map continues to signify the magnitude of educational inequalities, with lighter colours indicating higher disparities, and the comparison of between the two maps provides valuable insight into the shifting of IEOs across cohorts and over time.

A discernible pattern emerges from the two maps displayed in Figure 3. Firstly, we observe evident disparities in IEOs between countries which seem to remain over time. Specifically, for both the oldest and youngest cohorts of our sample, the northern countries exhibit a narrower percentage point difference, indicating lower IEOs, when compared to their counterparts in eastern and southern regions.

Figure 3. Between-country differences in IEOs for different cohorts
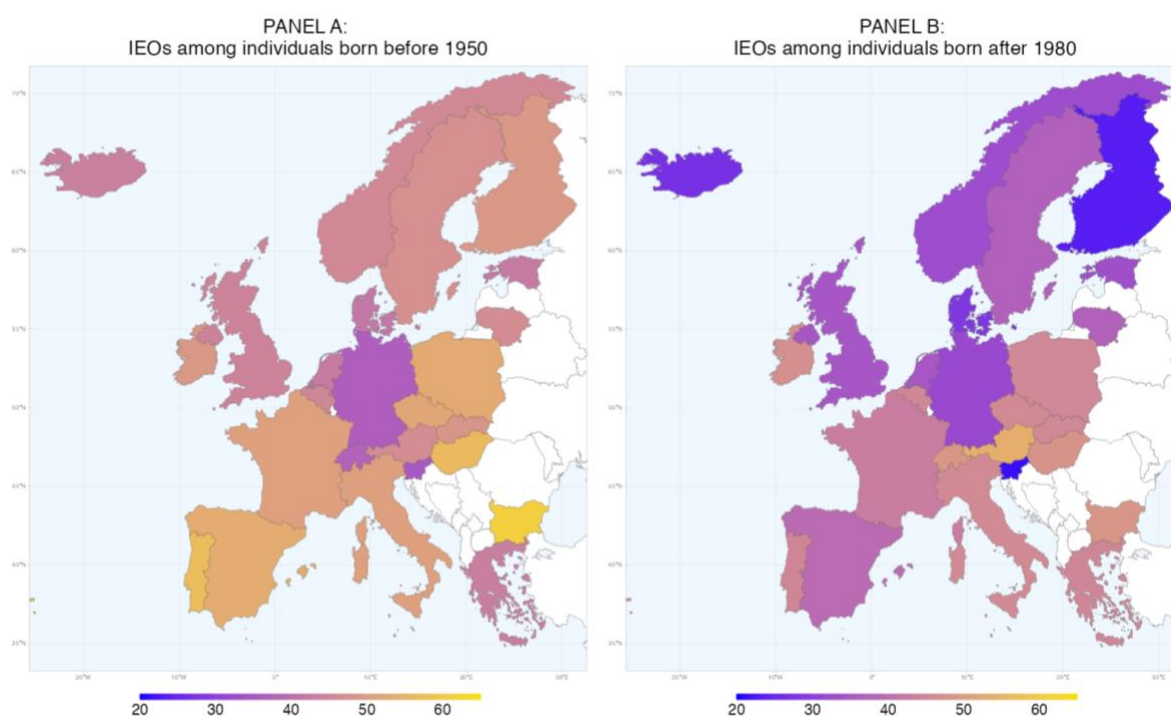
Note: Authors' elaboration using pooled data from ESS (waves 1-10). We show IEOs calculated as the differences in the percentages of individuals with a tertiary education degree, conditional on having at least one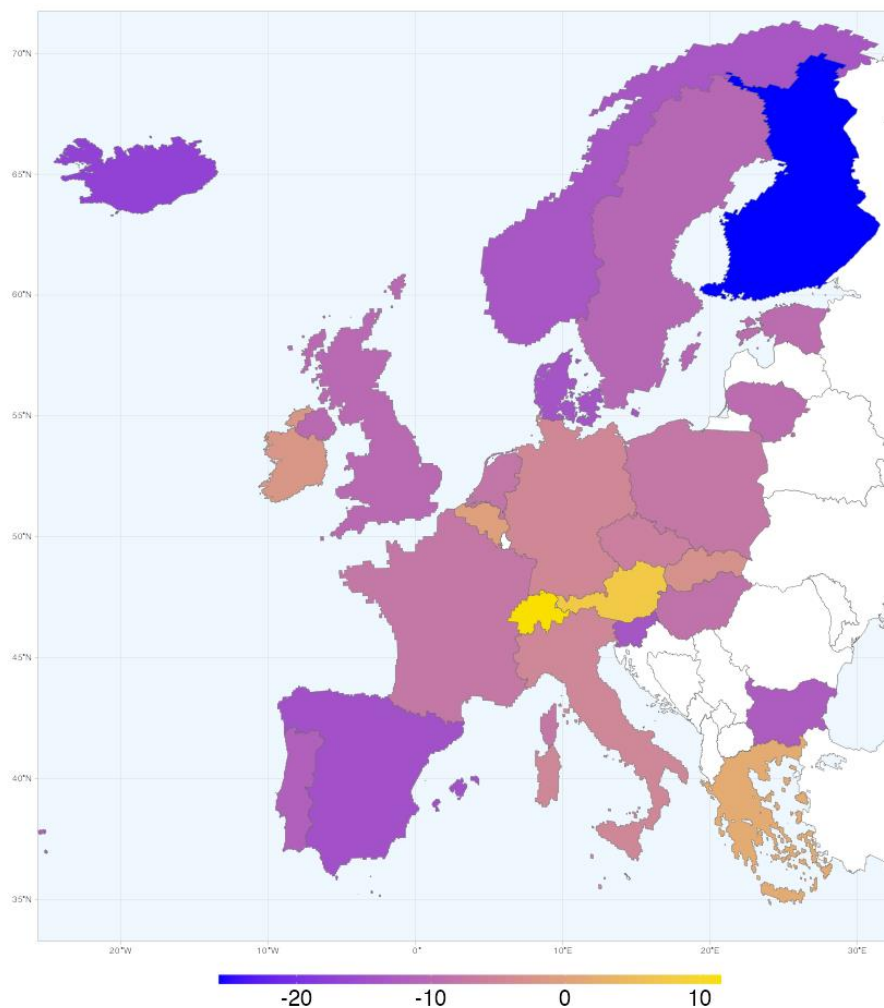 parent with a tertiary educational degree parents without any tertiary educational degree, *minus* the percentages of individuals with a tertiary education degree, conditional on having parents without any tertiary educational degree. See Lahti et al. (2017) for Eurostat package for R.

When focusing on individuals born before 1950 (Panel A in Figure 3), we find that countries with lower levels of IEOs include Slovenia, Germany, Denmark, and the Netherlands. Conversely, countries with higher levels of IEOs in this cohort encompass Bulgaria, Portugal, Hungary, and Spain. In contrast, for individuals born after 1980, representing more recent cohorts, we note that countries with lower levels of IEOs comprise Slovenia, Finland, Iceland, and Denmark. Meanwhile, countries characterized by higher levels of IEOs in this younger cohort encompass Austria, Switzerland, Bulgaria, and Hungary.

A noteworthy trend emerges as well: there is an overall decline in inequalities in tertiary education attainment as we shift our focus from Panel A to Panel B. What we observe is that conditional on having a parent without tertiary education, the probability that their children would instead attain a tertiary degree is higher for younger cohorts. This decline in inequalities in tertiary educational attainment seems to hold for nearly every European country, indicating a general improvement in educational opportunities and reduced disparities (smaller IEOs) across generations in the European context.

In our quest to comprehend these variations in the decline of IEOs across different countries and cohorts, we turn our attention to Figure 4. This figure captures the change over time in the levels of IEOs by country, by presenting the difference between IEOs calculated among individuals born after 1980 and those born before 1950.

Figure 4. Trends of between-country differences in IEOs over time

Note: Authors' calculations using pooled ESS data (wave 1-10). We restrict the sample to those individuals born before 1950 and after 1980. We show IEOs over time calculated as the odd ratios of individuals with a tertiary education degree, conditional on having at least one parent with a tertiary educational degree and parents without any tertiary educational degree, *minus* the percentages of individuals with a tertiary education degree, conditional on having parents without any tertiary educational degree for the two cohorts. See Lahti et al. (2017) for Eurostat package for R.

The colour representation on the map serves as a key indicator: darker colours signify a more pronounced and steeper decline in IEOs, indicating a significant reduction in educational disparities. When the difference equals 0, it implies that no substantial alterations in the levels of disparities in IEOs have occurred over time. Conversely, lighter colours signal an increase in IEOs, indicating a rise in educational disparities within a particular country.

Among the countries exhibiting a steeper decline in IEOs over time, we identify Finland, Iceland, Spain, and Denmark. In contrast, some countries have not witnessed a decline but rather an increase in IEOs over the years. These countries include Switzerland, Austria, Greece, and Belgium.

This visual representation shows the evolving trends in educational inequalities and offers a comparative perspective, allowing us to discern the varying degrees of change in IEOs across countries and cohorts. Indeed, this map provides valuable insights into the shifting dynamics of tertiary education attainment probabilities conditioned on parental education across different countries over time. What makes this analysis interesting is its ability to uncover unexpected patterns, shedding light on a distinct phenomenon compared to a singular snapshot of Inequalities in Educational Opportunities (IEOs) differences between countries.

To understand whether there has been a convergency of IEOs across countries, in Figure 5 we show IEOs calculated for each country and cohort on the left, and the European average for each cohort and 95% confidence intervals on the right. Results suggest that IEOs are clearly declining over time, but this trend has not been accompanied by a convergency in the level of IEOs in European countries. In other words, differences in IEOs across countries are not shrinking over time, even if IEOs are gradually declining over the considered cohorts. This decrease in inequality is about 10 percentage points. Results are corroborated also in Figure 6, where we show the standard deviations of the average level of inequalities in tertiary education opportunities in our sample.

Figure 5. Convergency trends of IEOs across countries over time

PANEL A   PANEL B
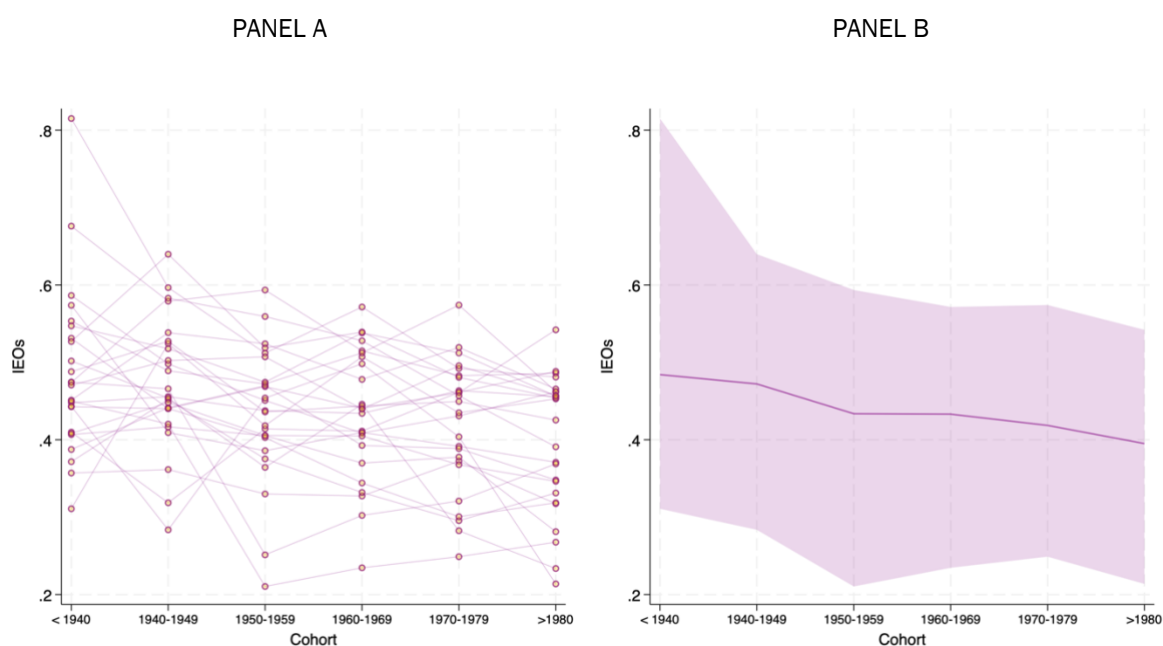
Note: Authors' calculations using pooled ESS data (wave 1-10). On the left, we show IEOs calculated for each country and cohort, as the differences between the percentage of individuals with a tertiary education degree, conditional of having at least one parent with a tertiary educational degree, *minus* the percentages of individuals with a tertiary education degree, conditional of having parents without any tertiary educational degree. On the right, we show the average IEOs for each cohort and 95% C.I.

Figure 6. Standard deviations of average IEOs over time

Note: Authors' calculations using pooled ESS data (wave 1-10).

These descriptive findings serve as a compelling starting point for further analysis, as they prompt exploration into the complex interplay of time and space. Specifically, they invite deeper investigation into the mechanisms underlying the reproduction of educational inequalities in tertiary education degree attainment. By dissecting the roles of time and geographic context, we may gain a more nuanced understanding of the dynamics at play within this important educational landscape.

3.2. Predicting the probability of TED attainment in Europe by parental educational background and cohorts

The second part of the analysis concerns the assessment of the average European trend of reproduction of inequalities in tertiary education, analysing through a multilevel regression analysis how much variation in the probability of attaining a tertiary educational degree is explained at the country and regional levels.

To understand so, the first step is calculating the intraclass correlation for the null model. Results show that 3,4% of the variability in individual probability of attaining a tertiary education degree is explained by the country clustering, while 5,4% of the variability is explained by the regional clustering. This points to the importance of also considering the regional context to unpack patterns of reproduction of educational inequalities.

Figure 10 (appendix section) shows the residuals calculated from the null model of the multilevel linear regression analysis. Residual plots suggest that there are no potential problems with the model assumptions.

To understand how much of the variability in IEOs is explained at the country or at the regional level, we also exploited a multilevel model in which regions as the unit of analysis

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are nested in countries. In this model, the outcome variable is IEOs measured as the difference for each region in the average probability of attaining tertiary education if parents attained TED minus the average probability of attaining tertiary education if parents did not attain TED. The ICC from this null multilevel model shows that 22% of the variation in IEOs is explained at the country level, meaning that the rest of the variation (78%) is explained at the regional level. Previous studies considering geographical disparities in inequality in tertiary educational attainment across Europe focused mainly on cross-country comparisons, therefore ignoring a substantial share of heterogeneity within countries. However, our results suggest that on average European variation in educational inequalities is more intense within countries rather than across countries.

Table 3 presents the coefficients derived from a linear multilevel regression model aimed at predicting the likelihood of individuals obtaining a tertiary degree. In Model 1, the explanatory variables encompass parental educational levels and cohorts. Model 2 extends this by introducing an interaction term between parental education and cohort, in addition to a random slope at the regional level.

Analysis of Model 1 reveals that, on average, individuals with at least one parent holding a tertiary educational degree exhibit a notably higher likelihood of attaining a tertiary educational degree themselves. This likelihood experiences an increment of nearly 40 percentage points in comparison to individuals whose parents lack tertiary degrees. Furthermore, the cohort exhibits a positive association with the likelihood of achieving a tertiary educational degree, with a stronger effect observed in more recent cohorts.

Upon the introduction of the random slope and the interaction term in Model 2, the relationship between parental education and an individual's probability of attaining a tertiary educational degree intensifies further for the first cohort. Individuals with at least one educated parent witness a 44 percentage points increase in the probability of attaining a tertiary educational degree compared to their counterparts with less educated parents (for individuals born before 1940). However, this probability becomes smaller through cohorts.

To gain insights into the interaction effect and comprehend how the reproduction of educational inequalities has evolved among the selected European countries over time, we turn our attention to Figure 6 (below). This figure illustrates the predicted probability associated with the interaction term between parental tertiary education and individual cohorts. As educational expansions have happened over time, we observe a concurrent rise in the likelihood of attaining a tertiary educational degree for all individuals, irrespective of their educational backgrounds.

Table 3. Multilevel linear regression models predicting the individual probability of attaining a tertiary educational degree; standard errors in parentheses

Tertiary educational degree	Null Model	Model 1	(S.E.)	Model 2	(S.E.)
Parental TED (Ref. None)					
At least one with TED		0.395***	(0.002)	0.443***	(0.010)
Individual cohort (Ref. <1940)					
1940-1949		0.053***	(0.003)	0.051***	(0.003)
1950-1959		0.080***	(0.003)	0.080***	(0.003)
1960-1969		0.106***	(0.003)	0.107***	(0.003)
1970-1979		0.151***	(0.003)	0.156***	(0.003)
1980-1994		0.185***	(0.003)	0.198***	(0.004)
At least one with TED#1940-1949				0.019*	(0.011)
At least one with TED#1950-1959				-0.010	(0.010)
At least one with TED#1960-1969				-0.022**	(0.010)
At least one with TED#1970-1979				-0.041***	(0.010)
At least one with TED#1980-1993				-0.072***	(0.010)
ESS round FE				YES	YES
Observations	285,506	285,506		285,506	
Number of regions	298	298		298	
Number of countries	25	25		25	
Intercept	0.238	0.105		0.104	
Individual Variance (level 1)	0.175	0.153		0.152	
Region Variance (level 2)	0.004	0.002		0.002	
Country Variance (level 3)	0.006	0.004		0.004	
Variance slope (parent edu)				0.006	
Covariance intercept-slope				-0.001	

*** p<0.01, ** p<0.05, * p<0.1

When we plot the random slopes at the country and at the regional level (see Figure 11 appendix), disregarding the lack of significance, probably driven by the small sample size at the (sub)regional level, the range of variation in the region slopes is very similar to the range of variation in the country slopes, underlying the importance of accounting for regional variation in individual probability of attaining a tertiary education degree conditional on parental level of education.

To gain insights into the interaction effect and comprehend how the reproduction of educational inequalities has evolved among the selected European countries over time, we turn our attention to Figure 6 (below). This figure illustrates the predicted probability associated with the interaction term between parental tertiary education and individual cohorts. As educational expansions have happened over time, we observe a concurrent rise in the likelihood of attaining a tertiary educational degree for all individuals, irrespective of their educational backgrounds.

Figure 7 further reveals distinctive patterns between two groups: individuals whose parents lack a tertiary degree and those with educated parents. For the former group, the

probability of obtaining a tertiary educational degree exhibits a consistent and nearly linear ascent over cohort periods. In contrast, individuals with educated parents display a distinct trend where the likelihood of attaining a tertiary degree appears to stabilize across different cohort periods. This trend serves to diminish the disparities in tertiary education attainment over time.

Examining the average gap in tertiary educational attainment, we see an average reduction over time. For individuals born before 1940, the gap stands at approximately 44 percentage points. Specifically, those without educated parents have 10 percentage points likelihood of obtaining a tertiary degree, while those with educated parents have a probability of 54 percentage points. In contrast, for individuals born after 1980, the gap diminishes to 34 percentage points. In this cohort, those without educated parents exhibit a probability of 30 percentage points, while individuals with educated parents demonstrate a probability of 66 percentage points of obtaining a tertiary degree.

Figure 7. Multilevel linear regression analysis predicting the probability of attaining tertiary education degree by parental education (2 categories): predicted probabilities for the interaction term between parental education and individual cohort
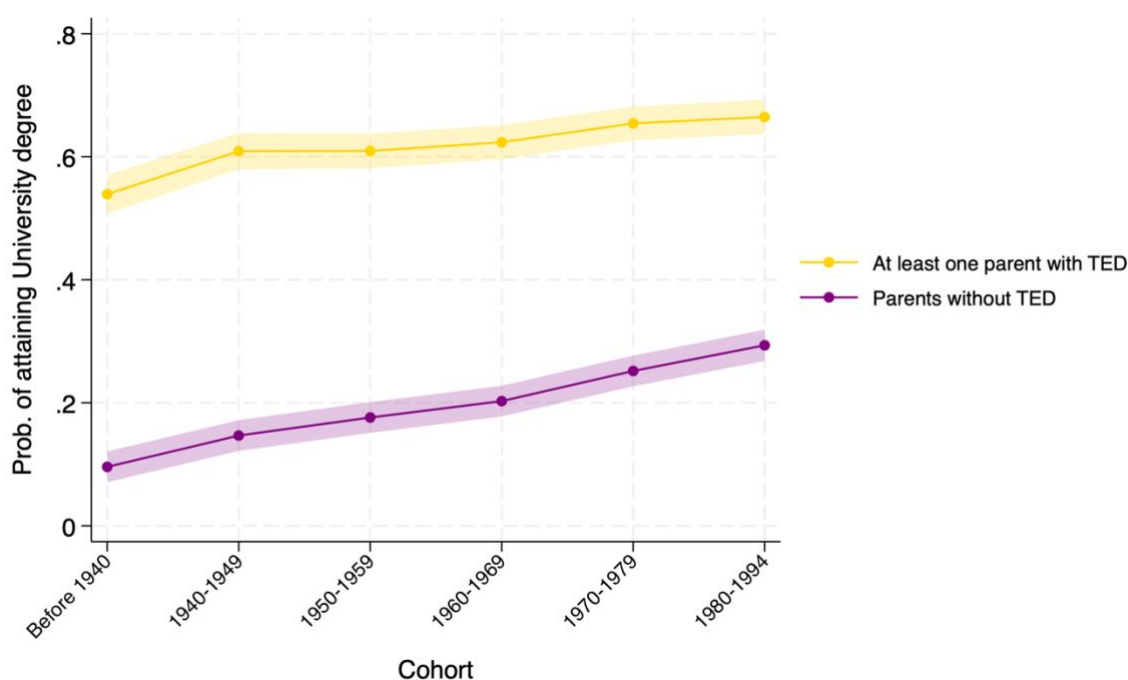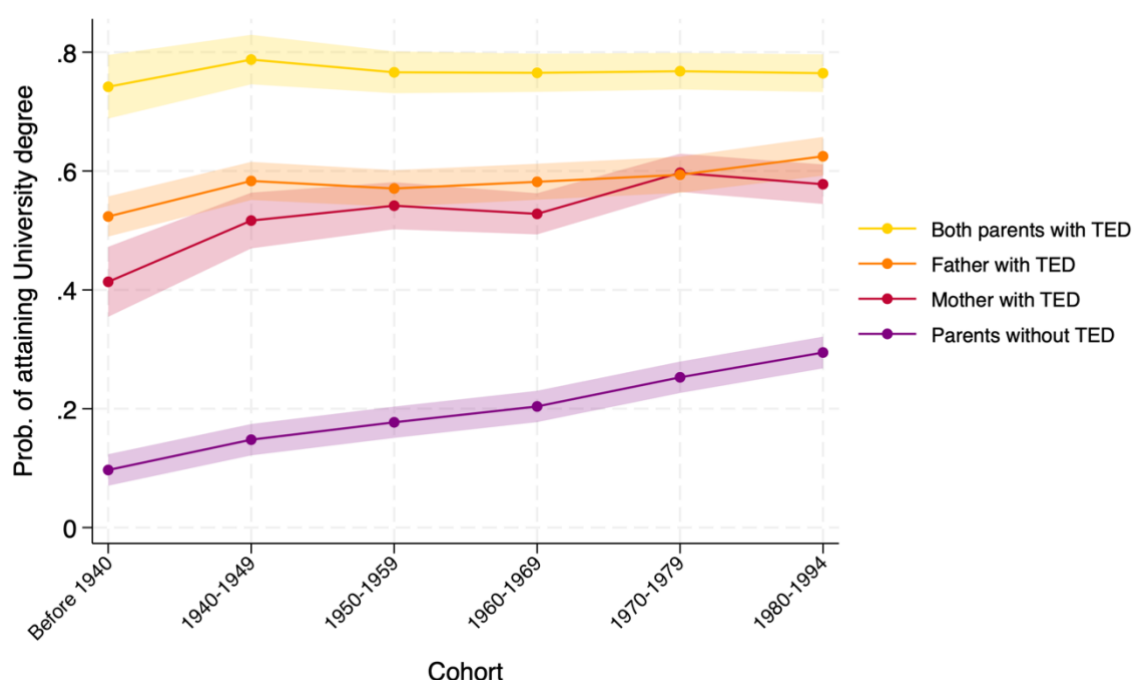

Note: Author's own calculations using pooled ESS data (1-10).

However, if we differentiate parental education by considering parents with both a tertiary education degree, only the mother with a tertiary education degree, only the father with a tertiary education degree, and finally both parents without any tertiary degree, the picture is different (Figure 8). Clearly, the probability of attaining a tertiary degree for individuals whose parents did not attain a tertiary degree increases over time (cohorts). The same happens, even if to a lesser extent, for those individuals with only one parent with a tertiary education degree - regardless of whether it is the father or the mother.

However, the probability of attaining a tertiary education degree for individuals whose both parents attained a tertiary degree is consistent over time. From both Figures 7 and 8, we conclude that approximately one-third of individuals with at least one parent holding a tertiary education degree does not attain the same educational level. In other words, the share of individuals attaining a TED whose parents attained a TED is not consistently increasing over time, on the contrary, it remains stable.

This finding bears significance in the realm of social mobility literature, prompting exploration into the subsequent section, which delves into country-specific trends of reproduction of inequalities in tertiary education over time.

Figure 8. Multilevel linear regression model predicting the probability of attaining tertiary education degree by parental education (4 categories): predicted probabilities for the interaction term between parental education and individual cohort

Note: Author's own elaboration using pooled ESS data (1-10).

3.3.   Country-specific Trends in the Probability of TED Attainment

In this concluding section of our results, we direct our focus towards showing country-specific trends regarding the replication of inequalities in tertiary education attainment across various cohorts, thus spanning different periods. Our objective is to ascertain whether the observed relative stability over cohort periods in the probability of obtaining a tertiary degree among individuals with at least one parent possessing a tertiary degree remains consistent across diverse European contexts, or if variations exist in this trend across countries.

By delving into these country-specific trends, we seek to unveil any nuanced patterns or disparities that may shed light on the broader dynamics of educational attainment and its

intergenerational transmission within the European landscape. This examination underlines the significance of considering the unique socio-cultural, economic, and educational contexts of individual countries when assessing the evolution of educational inequalities over time.

Figure 9 illustrates predicted probabilities derived from an interaction term between parental education and cohort, as determined through linear regression analyses for each country, predicting the likelihood of achieving a tertiary education degree.

An interesting initial observation is that the trend in the likelihood of attaining a tertiary degree among individuals from lower educational backgrounds (indicated by the purple line) displays remarkable similarity across the 25 European countries under consideration. Specifically, the probability of obtaining a tertiary educational degree exhibits a consistent and stable increase over cohorts in nearly every European country, with only a few exceptions: Bulgaria, the Czech Republic, and Estonia. Nevertheless, there are relatively higher probabilities are observed even among the oldest cohorts.

Conversely, when we shift our focus to the likelihood of attaining a tertiary degree among individuals from higher educational backgrounds (indicated by the yellow line), trends are less uniform across countries. For certain nations, we distinctly observe a stabilization in the probability of attaining a tertiary educational degree over cohorts, exemplified by Denmark, Spain, Germany, the United Kingdom, and Portugal. In contrast, in other countries, a reduction in this probability is apparent, as evidenced in Hungary and Bulgaria. Meanwhile, countries such as Greece, Poland, and Austria exhibit a consistent upward trajectory in the probability of attaining a tertiary educational degree for those with a higher educational background.

This analysis suggests a compelling insight: while, on average, inequalities in tertiary educational attainment based on parental educational backgrounds seem to diminish over time in the European context, country-specific patterns emerge. These discrepancies in trends are notably related to the probability of obtaining a tertiary degree for individuals with educated parents.

Potential explanations for these country-specific variations may lie in differences in the perceived value of educational credentials and the returns on educational degrees. However, these results suggest a need for deeper investigation in the country and even regional specificities in explaining trends of educational mobility and the reproduction of inequalities.

Figure 9. Linear regression analysis for each country predicting the probability of attaining tertiary education degree by parental education and cohort
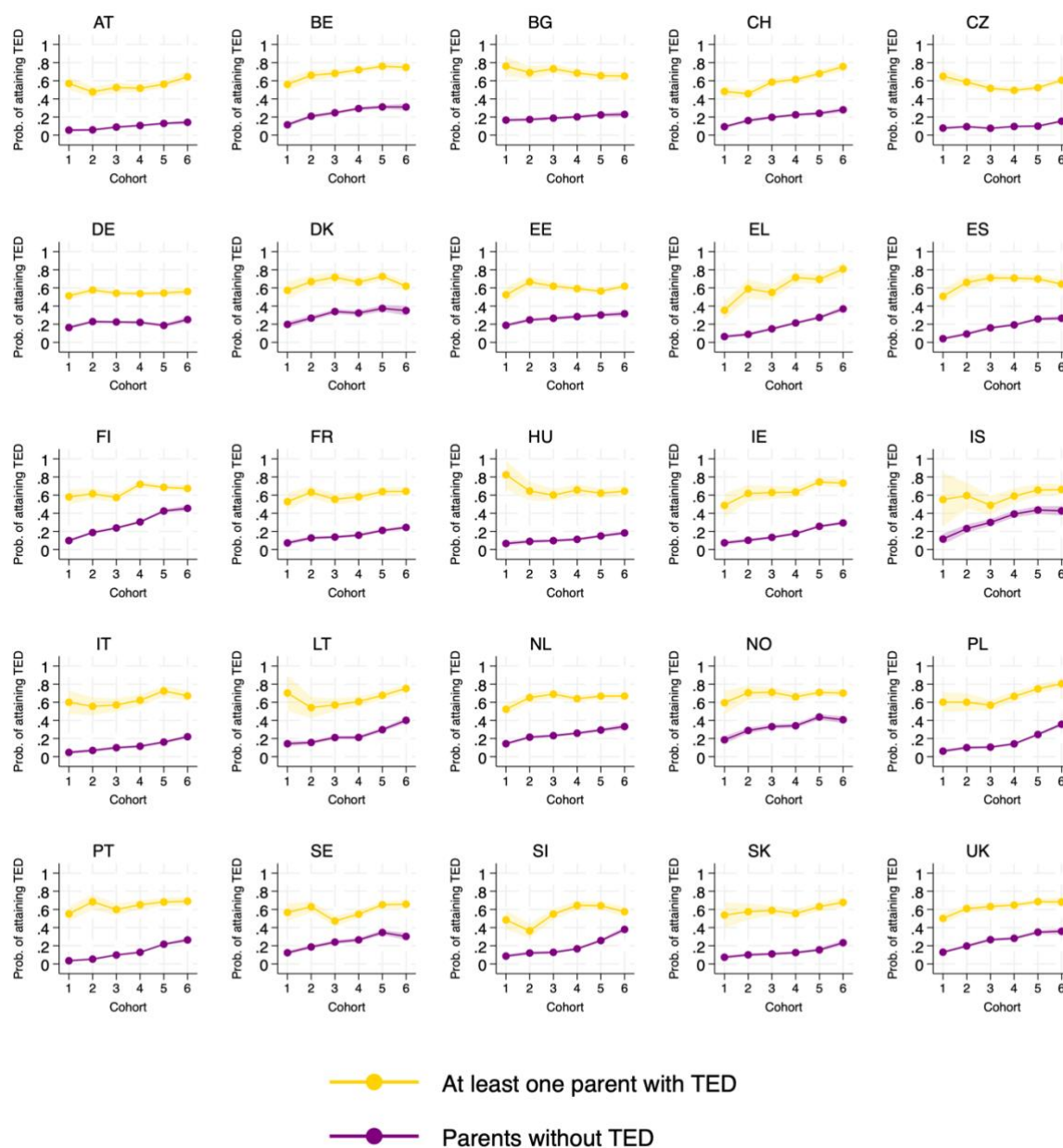
Note: Author's own elaboration using pooled ESS data (1-10).

4. Conclusions

Our comprehensive study on Inequalities in Educational Opportunities (IEOs) within the European context has provided nuanced insights into the dynamics of tertiary educational attainment linked to parental educational background, especially focusing on the difference in the individual probability of obtaining a tertiary educational degree conditional on whether parents did not attain a tertiary educational degree versus at least one parent attained a tertiary educational degree. These findings carry profound implications for policy formulation and future research endeavours within the realm of education.

One of the main aims of this study is to unveil variations across countries and regions in IEOs in Europe. After having established that there is indeed a consistent trend of persistent inequalities in tertiary educational attainment based on parental educational background across countries, between (sub)regions and over time, our study reveals substantial differences observed not only between countries, as already underlined by previous research, but also within countries across various (sub)regions. These regional and local disparities in IEOs, in which only 22% of the variability is attributable to country-level distinctions, where the remaining is attributable to regional clustering, underscore the pivotal role played by regional and local disparities in shaping educational opportunities. When including individual variability and focusing on the individual probability of obtaining a TED, the (sub)regional clustering seems to hold at least the same importance as the country level (5,4% versus 3,4%). Understanding these nuances at both country and lower levels is imperative for the development of targeted interventions to address educational disparities effectively.

Our temporal analysis showcases an evolution of diverse trajectories of IEOs in Europe. Our exploration of the temporal evolution of IEOs has shown intricate country-specific trends. While the overarching trend reveals an average decline in IEOs in Europe, the diversity of these trajectories across countries stands out prominently. Some nations have experienced a commendable reduction in educational disparities, while others have faced persistent or even escalating challenges. There is no convergency between European countries in their level of IEOs: differences between countries are not shrinking over time. The lack of convergence in the levels of IEOs between European countries is largely explained by the heterogeneity of trends in tertiary educational opportunities across Europe.

The average decrease in European inequalities in educational opportunities is about 10 percentage points. This decline is mostly explained by the increase in the probability of attaining TED for individuals without tertiary-educated parents. This reflect another notable finding, which is the persistent trend over time showing 1/3 of individuals whose parents attained TED that did not manage to attain the same educational level.

A limitation of this study derives from the impossibility of gaining a more accurate understanding of how social origin shape inequality in access to most prestigious universities and to higher degree of tertiary education. This is because of two reasons. First, our final dataset do not contain enough observations for individuals who obtained

higher degree of tertiary education, such for example a Ph.D. Second, ESS data do not contain information that can be harmonized across countries concerning the type of university degree, to be able to differentiate most prestigious vs less prestigious university degree.

Moving forward, it becomes imperative to focus on understanding the regional intricacies influencing IEOs comprehensively. Furthermore, policymakers should shift their gaze from average trends to understanding differences between countries over time. Introducing country or regional-level indicators will be pivotal in gaining deeper insights and devising targeted strategies to combat educational inequalities effectively. This paper offers some important insights that can be exploit as starting points for future research with a focus on differences within countries. Future research should also account for regional and country indicators for deepening the understanding of this important topic.

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Appendix

Figure 10. Multilevel regression null model residuals calculated at the country level and at the regional level
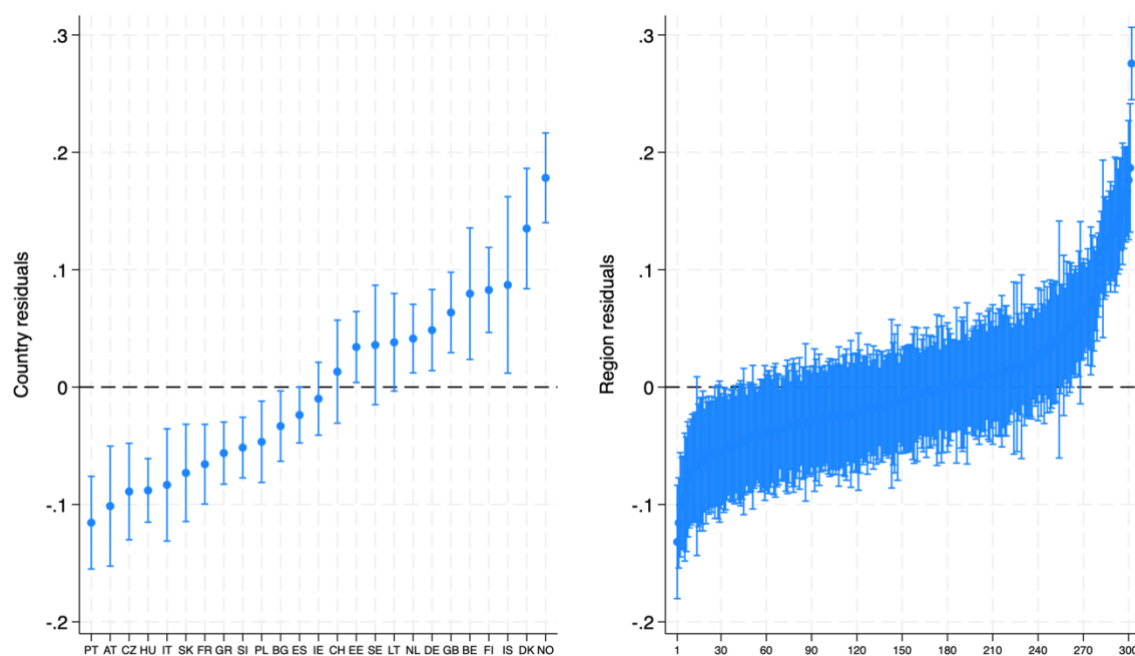
Note: Author's own elaboration using pooled ESS data (1-10).

Figure 11. Regional and country slopes from multilevel model predicting the individual probability of attaining a tertiary educational degree.   i.e., the average slope across all regions/countries, sorted in ascending order from left to right
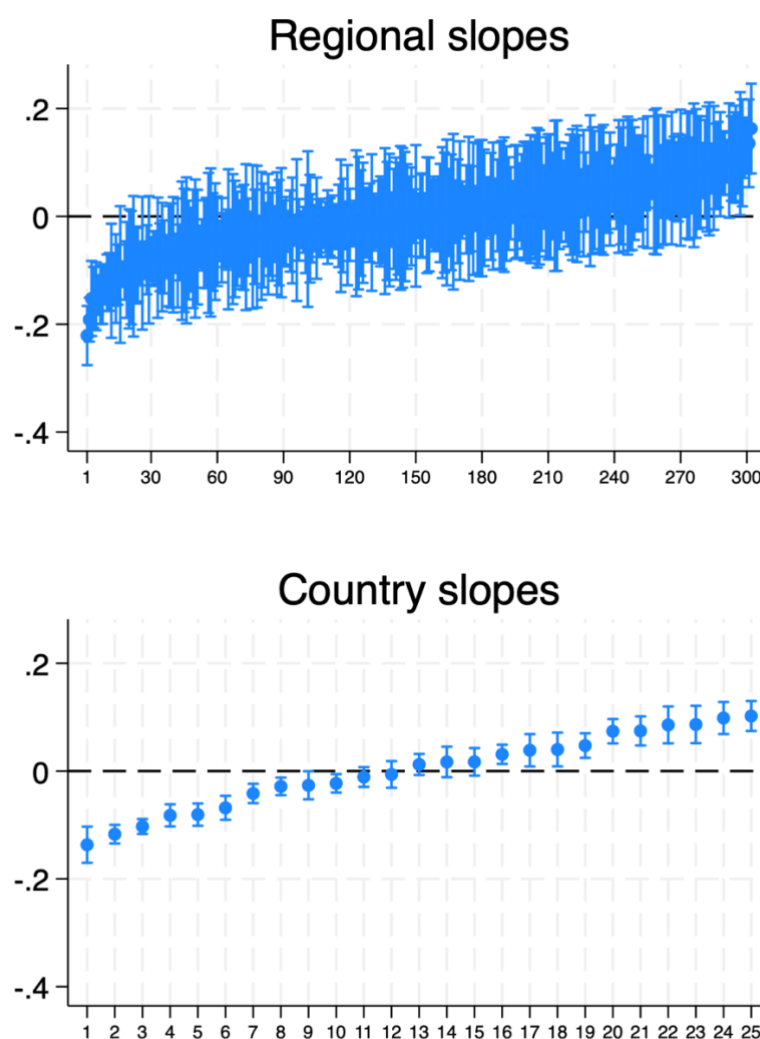
Note: Author's own elaboration using pooled ESS data (1-10). The graph shows: 1) above, the deviations of the regional random slopes (for parental level of education) from the slope fixed effect, as the average slope across all regions, sorted in ascending order from left to right; and 2) below, the deviations of the country random slopes (for parental level of education) from the slope fixed effects, as the average slope across all countries, sorted in ascending order from left to right.