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Stratification of education systems and social mobility.

Empirical analyses of the moderating role of the stratification of education systems on the associations of the mobility triangle

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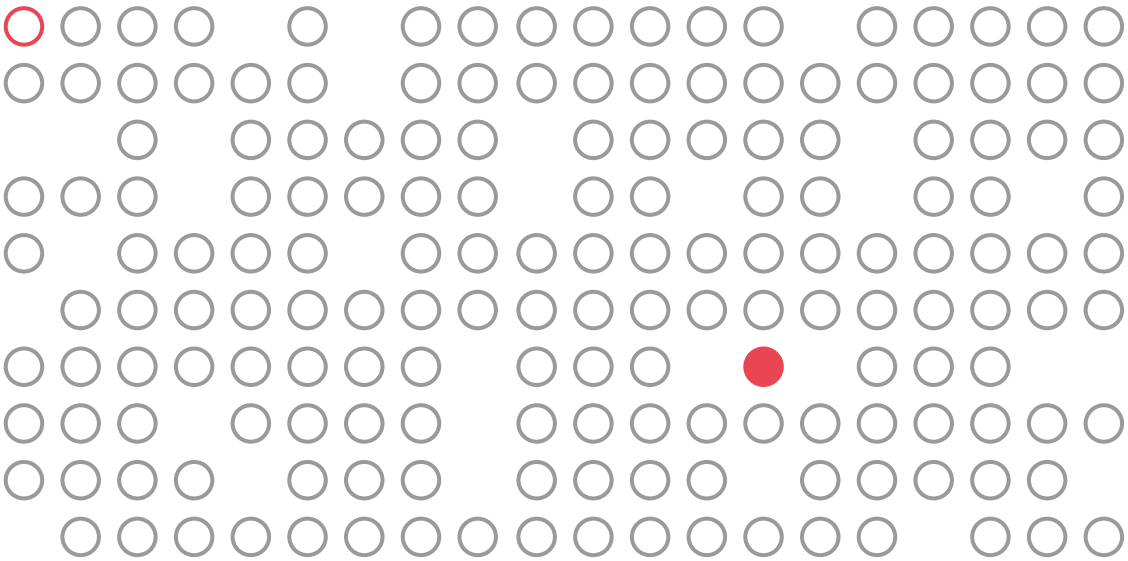

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Chapter 1 Framework paper

1.1 Introduction

The comparison of an individual's social background[1] with the labour market destination achieved over the life course is of fundamental interest for sociologists but not only. When a person's social background is different from his/her destination, mobility (or fluidity) occurs. On the contrary, the more parental background and adult's destination are associated, the less mobility (or fluidity) there is (Breen and Luijkx, 2004).

Besides social background and destination, another factor affects social fluidity namely, educational attainment. Together, these three factors constitute what in social stratification research is called the mobility triangle.[2] This triangle, shown in Figure 1.1 easily depicts the relationships between social backgrounds (O), education (E), and destinations (D). The first arrow connects social background with education. This association is also known as the OE link and informs about the extent of social background inequalities in educational attainment. In turn, education is linked to occupational attainment and this association (the ED link) gives us information about the occupational returns to education. The third arrow shows a direct association between social background and destination (net of education). This path is also known as the OD|E link and encompasses the impact of ascriptive factors[3] among people with the same educational level.

By looking at Figure 1.1 we can see that social fluidity depends on an indirect path from social background to destination through education (OE and ED link), and a direct path (OD|E). Social fluidity is thus affected by changes in any of the OE, ED, and OD|E links (Breen and Müller, 2020; Breen and Luijkx, 2004).

[1] Social background is used here as a synonym for social origin.
[2] Throughout this thesis, I also employ the term OED triangle to refer to the mobility triangle.
[3] Ascribed factors are beyond an individual's control. They are not earned and usually refer to something people are born with. Race, ethnicity, and social background are examples of ascribed statuses.

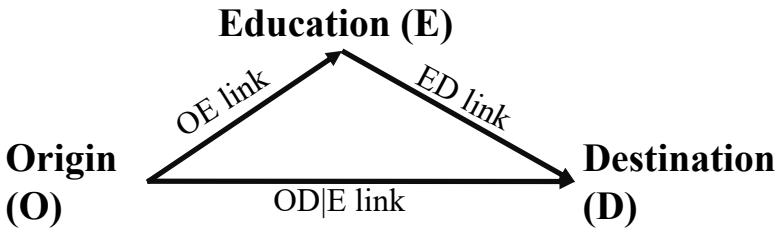

Figure 1.1: The mobility triangle

Since social fluidity reveals the openness or rigidity of a given society, its research outputs feed into political debates about which institutions affect social mobility (Breen and Müller, 2020). Identifying which institutions promote fairer societies is thus of key concern to social sciences.

A wide-ranging social science literature has documented extensive cross-national differences in the stratification of education systems that shape social stratification and labour market opportunities (e.g., Allmendinger, 1989; Bol and Van de Werfhorst, 2013; Blossfeld et al., 2019; Hadjar and Gross, 2016; Jackson and Jonsson, 2013; Kerckhoff, 2001; Müller and Gangl, 2003; Shavit and Müller, 1998). Following this research tradition, this thesis seeks to determine whether and to what extent educational system's differentiation practices moderate the associations of the OED triangle. With this thesis I thus ask *does the stratification of education systems moderate social mobility?*

Despite the merits of the previous literature, three weaknesses can be identified. First, the majority has focused on only one or two of the three associations (see Table 1.2 in section 1.2). Most have indeed analysed only the OE or ED link completely disregarding the remaining path of the mobility triangle. Since institutions may impact social mobility differently, overlooking the OD|E path may lead to wrong conclusions in terms of social mobility. For instance, wealthy families could react to the introduction of reforms directed at weakening their influence on their children's educational attainment

by strengthening their influence on their children's occupational attainment. As a result, a weaker OE link may be counterbalanced by a stronger social background gradient in occupational attainment.

Second, the mechanisms that strengthen or weaken the OED associations remain unclear (Erola and Kilpi-Jakonen, 2017; Jackson, 2007; Marks, 2014; Torche, 2014). Some scholars have indeed argued that we still do not know which specific dimensions of the stratification of education systems are responsible for conveying the macro-level effect to the individual or micro-level (Gross, Meyer and Hadjar, 2016; Zapfe and Gross, 2021). This is especially the case for the ED and OD|E links. The effect of the stratification of education systems is often grounded upon broad theoretical expectations that are related to other dimensions of education systems. For example, the effect of the stratification of education systems is often explained by the extent to which education systems provide occupational specific skills that is more a reflection of the linkages between education systems and labour market than of the stratification of education systems.

Third, from an empirical point of view, the evidence suggests that the stratification of education systems leads to more rigid societies (Bol and Van de Werfhorst, 2013; Van de Werfhorst and Mijs, 2010; Hadjar and Becker, 2016). On the other hand, more recent analyses suggest that the stratification of education systems explains the same amount of intergenerational inheritance in different countries (Schindler et al., 2021). All in all, drawing conclusions of what promotes equality of opportunities based on existing research is rather difficult. The main reason is that previous measurements of the stratification of education systems are limited in their scope, sometimes incomplete and, most importantly, not theoretically grounded. For example, the replication study that constitutes the first empirical article of this thesis

shows that the most used empirical measure of the stratification of education systems (i.e., the index of tracking created by Bol and Van de Werfhorst (2013))[4] fails its predictive validity test.

This thesis seeks to overcome the drawbacks of the previous studies in two ways. First it provides a deep explanation from the macro to the micro-level making clear which dimensions of the stratification of education systems play a role in strengthening or weakening the OED associations. This means that from a theoretical point of view it will be clear which micro-level mechanisms should be affected and which dimensions of the stratification of education systems should exert such effects. Second, building on the previous theoretical contribution and the replication study, the three theory-guided empirical articles employ new data on the stratification of education systems that have been collected by means of an expert survey in which more than 200 experts participated.

Before describing the structure of this cumulative thesis, for definitional purposes, I define what I mean by stratification of education systems as over the years several definitions have been provided and different terms have been used interchangeably.[5] In this thesis, stratification of education systems refers to the allocation of students into different school types or different curricula within schools for the first time in the educational career. The reason for focusing on the first moment in which students are allocated into different educational pathways is that it has long-lasting consequences in terms of future opportunity (Blossfeld et al., 2016; Jackson and Jonsson, 2013). One important caveat is that the differentiation practice has to last for the entire school day and cover all the subjects. This means that temporary forms of differentiation are disregarded because student's location may change over time and across discipline.

[4] This indicator has been used in 1/3 of the comparative studies reviewed in this chapter (see Table 1.2). Besides, it has also been employed to investigate other outcomes (see for example, Lavrijsen and Nicaise (2017) and Levels, van der Velden and Di Stasio (2014)).
[5] For more information see LeTendre, Hofer and Shimizu (2003), Gamoran (2009) and Veselý (2012).

For example, a student can be in the lower achieving group at the beginning of the year and improve toward the end of the academic year and/or he/she can be in the lower achieving group in math and in the higher achieving group in reading. As a consequence, their impact on social mobility is expected to be smaller than those of permanent forms.

1.1.1 Thesis outline

The first empirical article of this cumulative thesis is a replication study that investigates the indirect paths testing the predictive validity of the most-famous indicator of the stratification of education system i.e., the index of tracking (Bol and Van de Werfhorst, 2013). Under different empirical checks, the index of tracking shows to be statistically insignificantly associated with social inequality of educational opportunity. Stratification scholars are thus in need of new empirically and theoretically grounded indicators to measure the stratification of education systems.

In the next three articles, I test the predictive validity of the theoretically grounded indicators I collected through the expert survey. Specifically, to analyse changes in social fluidity, this thesis also includes three theory-guided empirical articles each one dealing with one of the OED associations. These three theory-guided empirical articles seek to answer the following research questions *does the stratification of education systems moderate:*

- *social inequality of educational opportunity?*
- *educational gradient in occupational attainment?*
- *the direct effect of social background on occupational attainment?*

To sum up, this cumulative thesis consists of this framework paper (chapter 1), a replication study (article 1 or chapter 2) and three single-authored papers (article 2 or chapter 3, article 3 or chapter 4 and article 4 or chapter 5). The latter consist of theory-

guided empirical articles that I have either published or submitted in international peer-reviewed journals. Table 1.1 provides an overview of the articles.

Table 1.1 Status of this thesis's articles

Chapter	Article	*Title*	*Journal/Status*
2	1	The Trade-off between Labour Market Allocation and Equality of Educational opportunity. A replication of Bol and Van de Werfhorst's (2013) analyses	Not submitted
3	2	The stratification of education systems and social background inequality of educational opportunity	Published in *International Journal of Comparative Sociology* doi: 10.1177/00207152211033015
4	3	The association between educational and occupational attainment. Does the stratification of education systems really matter?	1st revise and resubmit at *Comparative Education Review*
5	4	Like parents, like children. Does the stratification of education systems moderate the direct effect of social backgrounds on destinations?	Published in *Contemporary Social Science*, 16 (3), pp 344-358 doi: 10.1080/21582041.2020.1821908

The remainder of this framework paper proceeds as follows: section 1.2 reviews the previous literature highlighting its shortcomings. Section 1.3 addresses the question why stratification moderates the OED associations underlying which dimensions of the stratification of education systems should play a role and which micro-level mechanisms should be affected. The next section on research design is divided into three subsections. The first one focuses on the macro data on education systems' characteristics describing the expert survey and the indicators I obtained from it. The second sub-section describes the micro data by presenting the European Social Survey (ESS) and the analytical samples used in this thesis. The third and last part of the research design section discusses

the methods used in the empirical papers. Section 1.5 summarizes findings and limitations of the four articles and offers some concluding remarks and ideas for future research.

1.2 Previous comparative literature

This section presents an overview of the cross-country studies that have investigated the moderating effect of the stratification of education systems on the associations of the mobility triangle (until spring 2021).[6] To emphasize the research gaps this thesis seeks to fill, the literature review is organized according to the drawbacks that characterize the previous research. After describing the theoretical pitfall, I discuss the empirical limitations of the previous literature.

From a theoretical point of view, the existing literature does not clearly identify the paths through which specific dimensions of the stratification of education systems moderate the OED associations (Gross, Meyer and Hadjar, 2016; Zapfe and Gross, 2021). As a consequence, it is not exactly clear why previous studies have focused on specific dimensions and not on others (like why on the age of first selection and not on the number of tracks available) and which effects these dimensions exert on the individual or micro-level (why do the associations get stronger or weaker? Which are the mechanisms through which such macro-level effects come about at the micro-level?).

If we consider the literature focusing on each single path, we have to acknowledge that this theoretical link has been already identified for the OE link. It is indeed theoretically grounded that to understand how the stratification of education systems affects the OE link, the focus has to be on two dimensions: the timing and the extent to which the first selection is based on students' ability. In this case, the existing literature

[6] Note that this review is limited to the comparative research that has directly measured the stratification of education system.

has also already identified the micro-level mechanisms through which these dimensions amplify or weaken social background gradient in educational attainment. In contrast, when we focus on the other 2 associations (i.e., ED and OD|E), the theoretical link has not been identified. For example, the comparative literature on the ED link relies on the following hypothesis: the higher the stratification of education systems the stronger is the association between educational and occupational attainment (Allmendinger, 1989; Müller and Shavit, 1998; Bol and Van de Werfhorst, 2013; Hadjar and Becker, 2016; Reichelt, Collischon and Eberl, 2019). The explanation is that "different tracks prepare students for specific places in the occupational structure, which increases the strength of the [ED] link" (Bol and Van de Werfhorst, 2013: 291). At the same time, scholars also claim that the endowment of general versus (occupationally specific) vocational skills affects the transition into the labour market because of the linkage between education system and labour market. As stated, the distinction between the stratification of education systems and linkages between education system and labour market becomes quite elusive and often times the effect of the former is expected without grounding it theoretically. The stratification of education systems thus seems to matter just because it is highly correlated with the linkages between education systems and labour market, not because of its independent effect on the ED link. This means that from a theoretical point of view, we still need to identify the specific dimension of the stratification of education systems that strengthens the ED link and the micro-level mechanisms. The same consideration holds for the subsequent path namely, the direct effect of social background on destination.

Despite these theoretical research gaps, the previous studies also present four empirical limitations. First, as shown in Table 1.2, only two studies among the previous

literature have investigated all the three associations (Reichelt, Collischon and Eberl, 2019; Hadjar and Becker, 2016).

Table 1.2 Conclusions of the previous literature on the effects of the stratification of education systems on social mobility

	Stratification of education systems strengthens the specific link[1]	*Stratification of education systems is not statistically significantly associated with the specific link*
OE	Bol and Van de Werfhorst (2013); Braga, Checchi and Meschi (2013); Brunello and Checchi (2007)*; Hadjar and Becker (2016); Heisig, Elbers and Solga (2019); Horn (2009); Marks (2005); Österman (2018); Parker et al. (2016); Pfeffer (2008); Reichelt, Collischon and Eberl (2019); Van de Werfhorst (2019)	Ballarino, Bernardi and Panichella (2016); Brunello and Checchi (2007)*; Horn (2009)*; Parker et al. (2016)*; Jackson and Jonsson (2013); Vogtenhuber (2018)
ED	Allmendinger (1989); Andersen and Van de Werfhorst (2010); Bol and Van de Werfhorst (2011); Bol and Van de Werfhorst (2013)	Hadjar and Becker (2016); Müller and Shavit (1998); Reichelt, Collischon and Eberl (2019); Vogtenhuber (2018)
OD|E		Hadjar and Becker (2016); Reichelt, Collischon and Eberl (2019)

Notes: *depending on the specific indicator used (Horn, 2009; Parker et al., 2016) or the outcome considered (Brunello and Checchi, 2007), these authors reach different conclusions (see Table A1 in appendix).
[1] Positive or negative effects depends on the operationalization of the stratification of education systems (for more information, see Table A1 in appendix).
OE stands for the association between social background and education, ED for the association between education and destination, OD|E for the association between social background and destination net of education.

Others two studies have examined the OE and ED links (Vogtenhuber, 2018; Bol and Van de Werfhorst, 2013) while the vast majority has focused on only one of the three associations. Of the total 19 studies here considered, the latter is the case for 15 studies that have only focused on inequality of educational opportunity and four contributions that have investigated only the educational gradient in occupational attainment.

Second, the previous studies have reached quite different conclusions. Of the 19 articles considered, twelve have concluded that the stratification of education systems moderates social mobility through the OE link (see Table 1.2). Three other studies have shown that this conclusion is highly sensitive to either the outcome (Brunello and Checchi, 2007) or the specific dimension of stratification of education systems considered (Parker et al., 2016; Horn, 2009). Besides, other three studies have found that the stratification of education systems does not moderate the OE link (Ballarino, Bernardi and Panichella, 2016; Jackson and Jonsson, 2013; Vogtenhuber, 2018). Turning to the ED link, the evidence is mixed. Four studies have concluded that the stratification of education systems does moderate the ED link (Allmendinger, 1989; Andersen and Van de Werfhorst, 2010; Bol and Van de Werfhorst, 2011; Bol and Van de Werfhorst, 2013) while the remaining four have shown no statistically significant moderating effect (Hadjar and Becker, 2016; Müller and Shavit, 1998; Reichelt, Collischon and Eberl, 2019; Vogtenhuber, 2018). As for the last path of the mobility triangle, the only two available analyses have suggested that the OD|E link is not moderated by the stratification of education systems (Hadjar and Becker, 2016; Reichelt, Collischon and Eberl, 2019).

Third, the previous literature stems from very different research designs (especially measurement and analytical samples, see Table A1 in appendix). Diving into these differences, the most crucial is the operationalization of the stratification of education systems. Scholars have either used ideal-type dichotomies (Hadjar and Becker, 2016; Jackson and Jonsson, 2013; Müller and Shavit, 1998; Pfeffer, 2008) or empirically measured the concept. In the former case, as argued by Bol and Van de Werfhorst (2011), poorly documented classifications hamper the possibility to replicate findings and use the same classification for other purposes. Apart from incomplete classifications, these

theoretically driven operationalizations may also be limited in the sense that they are likely to be available only for the specific countries involved in the study.

In the latter case, two main approaches can then be distinguished. First, some researchers have employed single indicator(s). They have either used one single indicator like the age of first selection or a related measure (Braga, Checchi and Meschi, 2013; Brunello and Checchi, 2007; Heisig, Elbers and Solga, 2019; Österman, 2018; Van de Werfhorst, 2019; Vogtenhuber, 2018), or, in addition to the age of first selection, they have employed indicators of ability-based selection (Horn, 2009; Marks, 2005; Parker et al., 2016). Second, other researchers have employed a concise index comprising different indicators like the index of skill transparency (Andersen and Van de Werfhorst, 2010), external differentiation (Bol and Van de Werfhorst, 2011), and the well-known index of tracking (Ballarino, Bernardi and Panichella, 2016, Bol and Van de Werfhorst, 2013, Reichelt, Collischon and Eberl, 2019, Parker et al., 2016).

The general drawback of empirically measured institutional indicators is connected to their theoretical foundation. If it is clear upon which dimensions of the stratification of education systems is relevant to focus on, the presence of multiple indicators provides further evidence for supporting or rejecting the (theoretically derived) hypotheses. In contrast, when it is not clear which are the relevant dimensions to focus on and/or the empirical indicators do not exactly mirror the theoretical concepts but are a mix of different phenomena not always related with the stratification of education systems, the presence of multiple indicators harms more than helps. For instance, the ready-to-use country-level indicators provided by international statistical agencies like the Organisation for Economic Co-operation and Development (OECD) or international surveys like the Program for International Student Assessment (PISA) have not been conceptualized to measure the specific concepts researchers are employing them for.

Since these ready-to-use indicators suffer from measurement errors, the empirical studies that use them do not provide the necessary evidence for either supports or rejects the intial hypotheses. For example, to evaluate the extent to which education systems select their students upon their abilities during the first selection, Horn (2009) has employed the proportion of school principals who considered academic performance as a prerequisite for attendance. Coming from PISA, this indicator refers to a specific point within the educational career that does not necessarily coincide with the timing of the first selection. Because PISA surveys 15-year-old students, depending on the specific country this indicator is measured:

a) before the first selection takes place (e.g., in Denmark, Finland, Ireland, Latvia, Norway, Russia, Spain, and Sweden);
b) right after the first selection takes place (e.g., in Croatia, Cyprus, Estonia, Greece, Iceland, Lithuania, Poland, Portugal, Slovenia, Ukraine);
c) up to five years after the first selection takes place (e.g., Austria, Belgium, Bulgaria, Germany, Israel, Italy, Luxembourg, the Netherlands, Romania, Slovakia, Switzerland, Turkey, and the UK).

Another relevant downside of Horn's measure is that it provides a good measure of the extent to which the first selection is based on students' ability when educational systems are centralized and school autonomy is low.

As an alternative, other researchers have used the school Intra-Class Correlation (ICC) that measures the proportion of the total variance in student performance that is due to between-school differences (Marks, 2005; Parker et al., 2016). Since the ICC is computed on PISA data, this indicator suffers from the above-mentioned critiques. In addition, the ICC confounds all the possible sources of between-school variance in student performance as related with the first selection.

The indicators used to measure the other dimension of the stratification of education system i.e., the timing of the first selection, has also been criticized. The age at which pupils are separated into different types of school -collected by Brunello and Checchi (2007) and the OECD- registers when students are grouped into different formally recognized educational programmes provided in separate schools. Stratification scholars have recently pointed out that this operationalization lacks flexibility in capturing hidden forms of differentiation taking place within school (Blossfeld et al., 2016).

Finally, the indicators derived from OECD and PISA data have been collected for the first time in early 2000. This means that they reflect the recent situation of education systems that do not necessarily mirror how the systems looked like when the respondents under scrutiny were studying.

Another research design difference that makes it hard to compare the previous studies concerns sample selections (see Table A1 in appendix). At the macro level, some studies restrict the number of countries analysed and some others, at the individual level, select their respondents on the basis of specific characteristics like sex. These not theoretically derived decisions may explain part of the large variation in findings across studies.

The fourth and last pitfall of the previous literature involves the reliability of some of its findings. The data source of this evidence often consists of repeated cross-sectional surveys (see for instance, how many studies in Table A1 in appendix use multiple rounds of the European Social Survey ESS). This means that the samples are drawn within the same countries in different time points. As a result, the assumption of independence is violated as individuals from the same time point are more similar than individuals from different time points. If disregarded, the violation of this assumption generates too narrow

confidence intervals and p-values leading to the over-rejection of the null hypothesis (Heisig, Schaeffer and Giesecke, 2017; Schmidt-Catran and Fairbrother, 2016). Another critical point of especially multilevel analyses is that the estimation of robust country effects depends on the number of countries (Bryan and Jenkins, 2016; Maas and Hox, 2005; Schmidt-Catran and Fairbrother, 2016). As Table A1 in appendix shows, the number of units at the second level is often quite small. Finally, the majority of the studies has failed to condition on the confounders of the OED associations. This is also known in the literature as omitted variable bias (Wooldridge, 2014). For instance, if we want to analyse the ED link, we need to acknowledge that family characteristics are positively correlated with both educational and occupational attainment. If a proxy for social background is not included in our model specification, this is likely to result in an overstated educational gradient in occupational attainment. The same logic also applies to the country-level (Jæger, 2013). If we want to investigate the moderating effect of the stratification of education systems on the ED link, we need to acknowledge that other country-level variables are correlated with both, like vocational orientation and educational expansion (see Hadjar and Becker, 2016). To obtain unbiased moderating effects, we also need to account for these country-level confounders (Brunello and Checchi, 2007; Giesselmann and Schmidt-Catran, 2018, 2020; Österman, 2018).

To summarise, this review highlights that a complete explanation of how the stratification of education systems affects social mobility is missing. Besides this theoretical research gap, several empirical gaps can be identified. The previous literature is fragmented because it has mostly analyzed only a single path of the mobility triangle. Studies do not converge towards a common conclusion and are based on very different research designs. This means that it is not clear if these methodological choices are the only explanation behind the mixed results. Moreover, the empirical strategy of some

articles casts doubts on their findings. Specifically, some articles fail to fully account for the nesting of the data structure, focus on a low number of countries and suffer from omitted variable biased at micro and macro level. As a result, some of the previous literature has not been able to properly quantify the moderating role of the stratification of education systems on social mobility.

Overall, these previous studies prevent readers from drawing general conclusions. This means that we still do not know whether a) the stratification of education systems moderates the associations of the OED triangle and the mixed findings are simply the results of the too different research designs and/or the not always appropriate analytical strategies; or b) the stratification of education systems does not moderate social fluidity.

1.3 Theory and hypotheses

In this section, I present a theoretical model to understand how the stratification of education systems moderates the OED associations describing the specific mechanisms at work in each association of the mobility triangle. Figure 1.2 shows the theoretical model displaying the micro-level mechanisms through which the stratification of education systems moderates the OED links. Along with the micro-level mechanisms, Figure 1.2 also reports the theoretically-driven expectations.

We have already seen that previous research on the mobility triangle has been criticized for not being able to theoretically identify the specific mechanisms responsible for tightening or loosening the strength of the OED associations (Erola and Kilpi-Jakonen, 2017; Jackson, 2007; Marks, 2014; Torche, 2014). In addition, other scholars have added that this stream of research has failed to identify the specific institutional characteristics influencing individual-level mechanisms (Gross, Meyer and Hadjar, 2016; Zapfe and Gross, 2021).

Drawing on the OE, ED, and OD|E theories, I develop a theoretical model which identifies the mechanisms through which the stratification of education systems affects the mobility triangle. By doing so it becomes clear that one overlooked dimension of the stratification of education systems (the extent to which the first selection is based on students' ability) needs to be brought into the picture.

Although the number of tracks available has been identified as another dimension of the stratification of education systems in the past, there are no studies that have analysed the effect of this specific dimension alone on educational or occupational attainment[7] (see Table A1 in appendix). The majority of the previous literature that has investigated educational or occupational attainment, has measured stratification using the index of tracking. This composite measure includes the number of tracks together with other two dimensions i.e., the age of first selection and the length of the differentiated curriculum. Hence, it rests unclear if the number of tracks statistically significantly affects social mobility independently from the other dimensions of the stratification of education systems. Interesting in this respect are the explorative analyses of Reichelt and colleagues (2019). The authors provide correlation coefficients between the OE, ED and OD|E links (which account for the micro-level confounders) and the three different components of the index of tracking showing that the number of tracks is statistically significantly associated only with the OD|E link. Also in this case, however, we do not know if this association remains statistically significant when other dimensions of the stratification of education systems are considered. Additionally, it is quite challenging to

[7] Even when education is measured through achievement, the relevance of the number of tracks is debatable. Analyzing PISA data, Horn (2009) and Marks (2005) show that this dimension of stratification of education systems is statistically associated with the OE link. However, in both studies, the other indicators of stratification suffer from the measurement errors discussed in the previous section (paragraph 1.2). Because of the latter, we cannot exclude the possibility that the coefficient measuring the number of tracks captures the unobserved effects of the other not adequately measured indicators of the stratification of education systems.

find theoretically sound arguments linking the number of tracks to a stronger/weaker OD|E link. Since the existing studies do not provide evidence for considering the numbers of tracks available as an additional indicator explaining the moderating effects of the stratification of education systems on social mobility, this thesis disregards this dimension.

As it will be explained in much more detail later, when focusing on the OE link, the effect of the stratification of education systems is expected to come about through two dimensions: the age of first selection and the extent to which the first selection is based on students' ability. From a theoretical point of view, the introduction of the extent to which the first selection is based on students' ability is not new in the study of social background inequality in educational opportunity whereas this is the case for the other two paths. In the ED and OD|E links, the stratification of education systems is expected to affect social mobility only through the extent to which the first selection is based on students' ability. This means that I do not expect the age of first selection to affect the strength of the ED or OD|E associations once the extent to which the first selection is based on students' ability is factored in. This decision resonates with the difficulty in finding theoretical reasons to expect a direct impact of the timing of the first selection on respectively, the educational gradient in occupational attainment and the direct effect of social background on destination. The focus on the extent to which the first selection is based on students' ability can be considered the theoretical contribution of this thesis for the ED and OD|E paths. In the following, each section centres on one of the OED associations.

1.3.1 The OE link

In the third chapter (article 2) of this thesis, I examine the OE link (see Figure 1.2). Specifically, I investigate two dimensions of the stratification of education systems

namely, the extent to which the first selection is based on students' ability and the age of first selection, formulating separate hypotheses. I ground my expectations on Boudon's (1974) distinction between primary and secondary effects. The former corresponds to social background achievement differentials while the latter to social background differences in educational choices net of achievement.

Following Jackson and Jonsson (2013), secondary effects are expected to be much more influenced by the structure of education systems than primary effects. One of the reasons is that primary effects also comprise the genetic transmission from parents to children that by definition is least influenced by institutional settings. Moreover, since educational systems do not provide different educational paths in primary education, a high degree of between country homogeneity can be expected with respect to the content of the curriculum and the types of cognitive skills rewarded by primary schools. Socialization processes within the family seem thus to be the only way through which primary effects may be affected by the stratification of education systems. Moreover, when dealing with educational choices, it is reasonable to assume that the stratification of education systems impacts secondary effects more than primary effects.

Since the first dimension of the stratification of education systems measures to what extent students' ability guides the allocation into tracks rather than the free choice of parents and children, we could then expect that when scholastic performances drive the selection into tracks, the size of secondary effects shrinks because there is less room for parents to influence the allocation of their children. This means that the total effect of social background is entirely due to primary effects (Contini and Scagni, 2011; Dollmann, 2016; Erikson and Jonsson, 1996; Esser, 2016; Jackson and Jonsson, 2013; Maaz et al., 2008; Parker et al., 2016; Tieben et al., 2010). In contrast, when the selection

into tracks also relies on teachers' recommendations[8] and/or parental/student preferences, the size of secondary effects increases because parents have more room to influence their children's allocation. In this case, to compute the total effect of social background on educational outcomes, along with primary effects the role played by secondary effects also has to be taken into account.

Accordingly, the first hypothesis of the third chapter (article 1) expects *a negative moderating effect of ability-based first selection on the social background gradient in educational attainment (H3.1)*. In other words, I expect that the more the first selection is based on students' ability the weaker is the association between social background and education. This means that the extent to which the first selection is based on students' ability moderates the OE link by *reducing/enlarging the size of secondary effects* (Contini and Scagni, 2011; Dollmann, 2016; Erikson and Jonsson, 1996; Esser, 2016; Jackson and Jonsson, 2013; Maaz et al., 2008; Parker et al., 2016; Tieben et al., 2010). Specifically, on the one extreme, when the first selection is the least bounded to academic achievement, the OE link becomes stronger because the size of the secondary effects increases. On the other extreme, when the first selection is completely based on students' ability, the OE link becomes weaker because the size of the secondary effects decreases.

[8] Even when teachers ground their advices on grades and scholastic achievement, the evidence shows that recommendations are socially biased (Boone and Van Houtte, 2013; De Boer et al., 2010; Timmermans et al., 2015). In this respect I thus follow Esser's (2016) lead in considering teachers' recommendation (or what he defines tertiary effects) as belonging to the secondary effects.

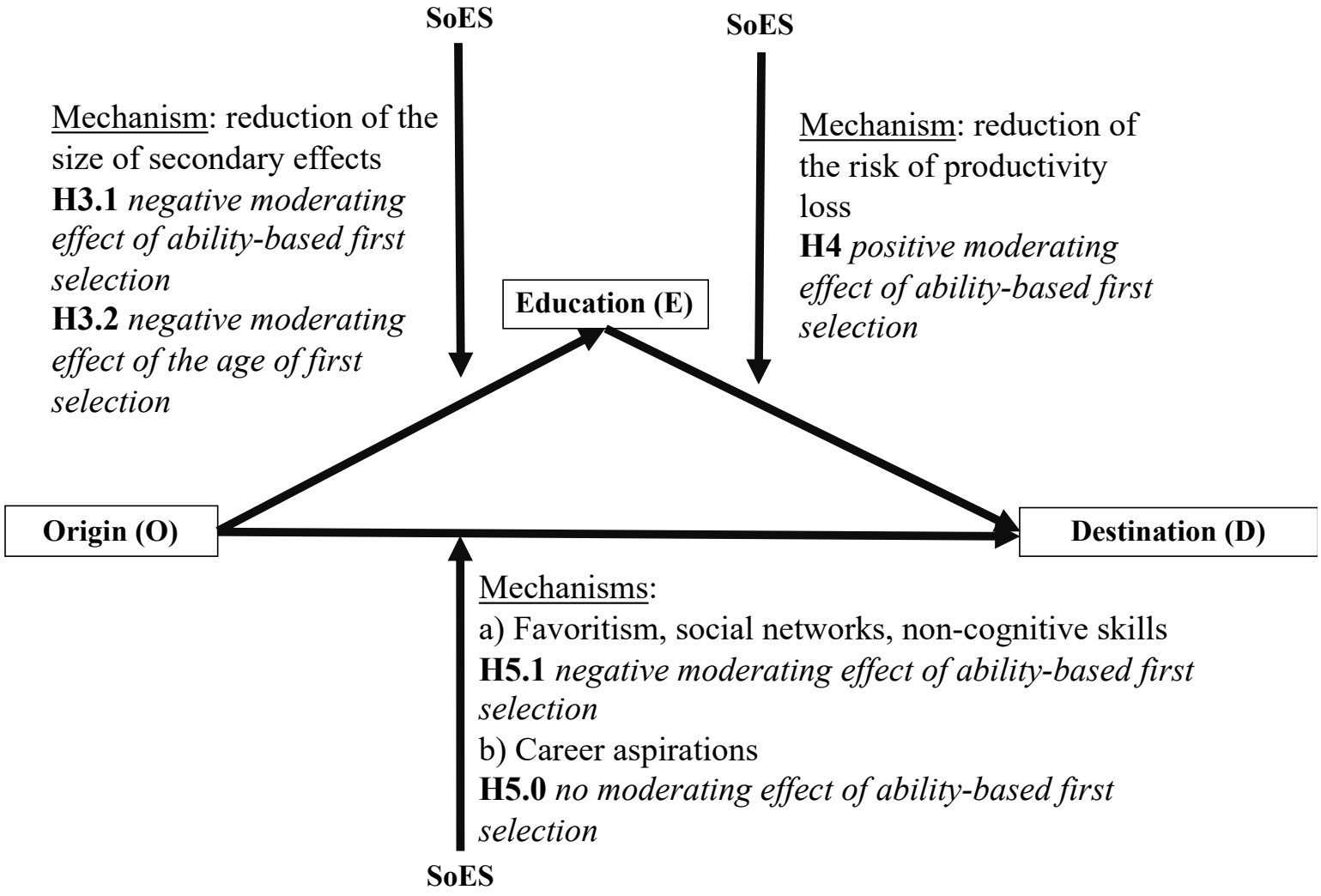

Figure 1.2: Theoretical mechanisms and hypotheses

Notes: the ED article does not explicitly state the hypothesis listed here as it is taken for granted. SoES stands for stratification of education systems.

Turning to the second dimension of the stratification of education systems, the life course hypothesis argues that one's social background has a greater effect on one's educational success at a younger age and that the size of this effect decreases with age (Blossfeld and Shavit, 1993; Müller and Karle, 1993). This hypothesis, however, does not explicate why younger students are more dependent on their parents' resources than older students. Besides, as stated, this hypothesis is supposed to affect both higher and lower social background groups equally. In the following I explain first why social background has a greater effect on educational success at a younger age and second, why heterogeneous effects by social backgrounds are to be expected.

The rational choice theory assumes that educational choices are made by rational individuals based on expected costs and benefits as well as probability of success (Boudon, 1974; Breen and Goldthorpe, 1997; Breen, Van de Werfhorst and Jæger, 2014). However, it is difficult for families to form their expectations when they do not have enough information about their children's cognitive resources (Breen and Goldthorpe, 1997; Breen, Van de Werfhorst and Jæger, 2014). This performance uncertainty is linked to the timing of the first selection: the earlier the selection is the less information there is on student achievement (Berger and Combet, 2017).

Empirical findings have, however, shown that regardless of the timing of the first selection, students from higher social backgrounds are overrepresented in the academic track (Blossfeld and Shavit, 1993; Dupriez et al., 2012). This suggest that the age of the first selection does not affect social backgrounds equally. Berger and Combet (2017) explain these heterogeneous social background effects by claiming that lower social background students place more weight on performance uncertainty compared with higher social background students. This mechanism allows to explain why in case of early selection, only disadvantaged students are negatively affected. Accordingly, since

lower social background parents tend to underestimate their children's academic abilities (Erikson, 2013), to send them to the academic track, parents require evidence of their children's academic abilities. Additionally, parents from high social backgrounds are also less responsive to information about their offspring's scholastic performance compared with those from low social backgrounds because they derive more utility from pursuing the academic track. Indeed, to minimize the risk of downward social mobility, students from high social backgrounds need to continue studying in the academic track (Breen and Goldthorpe, 1997; Breen and Yaish, 2006; Breen, Van de Werfhorst and Jæger, 2014). Lastly, because information about educational sorting processes is distributed unequally across social backgrounds, children from low social background families also have lower access to information about the timing, requirements, and logistics of such processes, as well as access to resources that improve their chances of attaining the academic track (Lareau, 2011; Lucas, 2001; Pfeffer, 2008; Erikson and Jonsson, 1996).

Pulling all these arguments together, the second hypothesis of the third chapter (article 1) expects *a negative moderating effect of age of first selection on the social background gradient in educational attainment (H3.2).* In other words, with H3.2 I expect that the earlier the first selection takes place the stronger is the association between social background and education. It must be noted that the age of first selection and the stratification of education systems are negatively related. The more education systems are stratified the earlier the selection takes place. This means that the impression of the two hypotheses going in the same direction is a direct consequence of the measurement of the timing of the first selection.

Similarly to the other dimension of the stratification of education systems, the age of first selection moderates social background inequality in educational opportunity by *changing the size of the secondary effects*.

Although it could be argued that these two dimensions of the stratification of education systems (time and ability-based selection) interact with each other, I refrain from formulating theoretical hypotheses on the direction of these hypothetical multiplicative effects. On the one hand, considering what said before, it could be suggested that the negative moderating effect of ability-based first selection on the OE link is stronger the earlier the first selection takes place. On the other side, considering the "skills beget skills" argument, it can be argued that the social background achievement differential grows with time (Cunha et al., 2006). As shown in the OE article (i.e., chapter 3), I empirically test the existence of a three-way interaction between these two dimensions of the stratification of education systems and social background. The evidence provides support only for the existence of independent additive effects of the two dimensions of the stratification of education systems on the OE link.

1.3.2 The ED link

To explain how stratification of education systems moderates the ED link, in the fourth chapter of this thesis (article 3), I rely on the training cost model (Glebbeek, Nieuwenhuysen and Schakelaar, 1989). This theoretical model claims that graduates having the same educational qualification but different skill levels constitute a threat for employers (the so-called risk of productivity loss) which has not been discussed by previous micro-level theories explaining the labour market pay off of educational credentials.

Previous theories on educational returns can be grouped in three broad groups. According to the human capital theory (Becker, 1964), labour market entrants are

expected to be immediately productive because education is supposed to provide school-leavers with work-relevant skills that increase individuals' labour market pay off by enhancing their future productivity. The second group of theories is formed by signalling and filter theories. Accordingly, education works as a signal (Spence, 1973) on whose basis employers screen candidates (Stiglitz, 1975). Education thus helps employers in sorting individuals according to their training costs (Thurow, 1975). The third group includes the theories that conceive education as a credential unrelated to productive ability. Social closure theories (Weber, 1978; Parkin, 1979) do not attach any value to schooling and claim that the ED link is due to the possession of educational credentials (Collins, 1979). Education sorts individuals but it does so by relying on neither their expected levels of productivity (human capital theory) nor trainability (signalling and filter theories). Those with high credentials, obtain access to more prestigious positions in the occupational structure as entry to the latter is restricted by institutional barriers.

All these theories lack to account for the risk of productivity loss faced by employers. Indeed, graduates holding the same educational credential may be endowed with different skill levels (Levels, Van der Velden and Allen, 2014; Vogtenhuber, 2018). This heterogeneity translates into workers being more or less productive. The latter represents a clear disadvantage for employers. In this context, selecting applicants upon educational credentials alone does not guarantee that expected productivity levels and costs are met.

I argued that this risk of productivity loss is reduced the more the skill variance among school leavers having the same qualification diminishes and, at the same time, the more the skill gap between educational qualifications increases. These outcomes can be realised by influencing the skills' homogeneity that, in turn, depends on the criterion upon which the selection takes place (Sørensen, 1970). When the input of the educational

process is characterized by less within school/track variance, because of specialization effects, the initial homogenization allows teachers to perform tailored instructions (Rosenbaum, 1999; Eccles and Roeser, 2011), ultimately fostering a uniform skill development (Brunello and Checchi, 2007). This results in an even lower dispersion of skills (among those with the same qualification), coupled with broadening skill gaps between educational qualifications (Marsh, 1987; Epple, Newlon and Romano, 2002; Zimmer, 2003) once students leave the education system and enter the labour market.

The theoretical contribution of this fourth chapter (article 3) is therefore the identification of the dimension of the stratification of education system and the mechanism through which the latter moderates the ED link that is *the risk of productivity loss* (see Figure 1.2). Indeed, since the extent to which the first selection is based on students' ability is expected to positively moderate the ED link, the hypothesis of this chapter expects that *the moderating effect of the stratification of education systems on the ED link is mediated by the extent to which the first selection is based on students' ability (H4).* Specifically, in this article, I use the index of tracking and test its association with the ED link. In a second step, I test whether the moderation exerted by the index of tracking is mediated (i.e., explained) by the extent to which the first selection is based on students' ability.

Scholars may argue that the reduction of the risk of productivity loss is influenced by the centralization of education systems rather than their stratification. However, centralization guarantees that the same standards are applied nationwide but it does not impact the homogeneity of the skills learnt by students. Put differently, when the allocation into tracks is not bounded to students' ability, the fact that this selection procedure is implemented homogenously within a country does not reduce the risk of productivity loss as applicants having the same educational credential are still endowed

with different skill levels. I argue that school-leavers with the same educational credential are more likely to have homogeneous skill levels when the first selection is based on their achievement.

1.3.3 The OD|E link

Lastly, the fifth and last theory-guided empirical study (article 4) focuses on the OD|E link (Figure 1.2). According to previous research, the direct effect of social origin on destination partly results from three demand-side mechanisms: favouritism, social connections, and non-cognitive skills (Bernardi and Ballarino, 2016; Erikson and Jonsson, 1998; Hällsten, 2013; Mastekaasa, 2011; Reichelt, Collischon and Eberl, 2019). Favouritism refers to the practice of recruiting and hiring people who are similar or have an analogous lifestyle. Since employers are more likely to belong to the higher social background, they may favour and hire job seekers belonging to the same strata. Social networks provide information about vacancies but their quality and prestige depend on the status of the members of the circle. The more high-status the members of the network are the more prestigious job offers are. Non-cognitive skills refer to productivity differences unrelated to education but positively associated with productivity on the job such as social skills which are not equally distributed and developed across social backgrounds (Jackson, Goldthorpe and Mills, 2005). School-to-work transition research complements this picture adding that employers' use of educational qualifications depends on the amount of information they convey (Rosenbaum et al., 1996; Gangl, 2003). The more educational qualifications are informative, the more employers will use them to reliably evaluate: expected levels of productivity (Becker, 1964), training costs (Thurow, 1975), and risk of productivity loss (Glebbeek, Nieuwenhuysen and Schakelaar, 1989).

I argue that when education systems select according to students' ability, employers may feel more reassured that graduates holding the same qualification have homogeneous productivity levels. Put differently, the more the education system selects its students based on their abilities, the more likely employers are to trust qualifications, as they convey the information needed for a successful match. Accordingly, the role of the first three demand-side mechanisms becomes weaker when employers can sort applicants just by relying on their educational qualifications. In other words, when the first selection is based on student ability, social networks, non-cognitive skills, and favouritism may lose their importance compared with education. On the contrary, when students self-select themselves into educational paths, educational qualifications convey less accurate information. In this case employers may rely more on ascriptive characteristics and, by making use of the three demand-side mechanisms, favour respondents from affluent social origins (Goldthorpe, 1996). Consequently, the first hypothesis of this fifth chapter (article 4) states that *the more student ability matters during the first selection, the weaker is the direct effect of social origins on labour market attainment (H5.1).*

Apart from the demand-side mechanisms, the remaining avenue through which social background affects occupational attainment is career aspirations (Bernardi and Ballarino, 2016; Erikson and Jonsson, 1998; Hällsten, 2013; Mastekaasa, 2011; Reichelt, Collischon and Eberl, 2019). In keeping with the rational action theory, I assume that aspirations are partly determined by social background and that people want to avoid the risk of downward mobility (Breen and Goldthorpe, 1997). By combining these two assumptions, stratification scholars argue that people from high social background need to obtain more prestigious occupations than those from low social background, even whit the same education (Erikson and Jonsson, 1998). This implies that, regardless of the

stratification of the education systems, families from higher social background will exploit their resources to ensure that their offspring get ahead in the occupational structure (Lucas, 2001). As a result, when the supply-side mechanism (career aspiration) dominates over the demand-side mechanisms, another hypothesis can be formulated. Specifically, the null hypothesis of chapter fifth states that *the extent to which student ability matters during the first selection does not moderate the direct effect of social background on labour market attainment* (H5.0). As shown in Figure 1.2, this moderating effect is supposed to come about through *one group of micro-mechanism(s) prevailing over the other group*.

1.4 Research design

Before focusing on the micro data and the analytical strategies implemented to reply to this thesis research questions, I describe how I collected the macro data to measure the stratification of education systems and the linkages between education system and labour market. In the next section, I discuss the replication study and the three theory-guided articles by describing their data sources, analytical samples and methods.

1.4.1 Macro data

The discussion of the previous comparative literature in session 1.2 highlights that the existing indicators to measure the timing and extent to which the first selection is based on students' ability are affected by measurement errors. Specifically, the age of first selection overlooks differentiation practices taking place within school. As for the extent to which the first selection is based on students' ability, the existing indicators are not collected right after the first selection takes place and are likely to misclassify the observed between school differences as due to the stratification of education systems. Furthermore, the results of the replication study severely question the use of the most

famous composite indicator of the stratification of education systems i.e., the index of tracking built by Bol and Van de Werfhorst (2013). As a consequence, to properly measure the two theoretically identified dimensions of the stratification of education systems, I collected primary data. Since expert surveys are especially useful for measuring complex concepts that require expert knowledge and for measuring phenomena for which alternative sources of information are scarce (Meyer and Booker, 2001), I collected data on education systems through an online expert survey. In the following, I describe the data collection process and how I selected the sample of experts. The final indicators obtained from the expert survey are presented in the last part of section 1.4.1.

Data collection

I conducted the online survey in the web-based survey tool Unipark in 2016. To identify the questions that respondents have difficulty in understanding, the online questionnaire had been pre-tested with a small number of experts that did not participate in the final survey (Krosnick, 1999). I contacted experts via email and set up reminder emails ten days before the final deadline. Data were collected in two different rounds. The first round had lasted from 20/06/2016 to 29/10/2016. In case of contrasting responses within a country, between 19/09/2016 and 29/10/2016, experts had been contacted again to clarify their answers. Because the minimum required number of experts within a country (set at five (Ray, 1999)) had not been reached, I activated an additional round. The second round started on 17/10/2016 and included a new group of experts (never contacted before) as well as those experts that had been selected for the first round who had not completed the survey. Unfortunately, among the latter group only two experts completed the online questionnaire (one for Iceland and one for Norway).

Sampling

Since the quality of expert survey data is directly influenced by the quality of the respondents, identifying the population of experts represented a major challenge (Benoit and Laver, 2006). In this survey, I define as experts scholars specialized in the education system of his/her country. The contacted experts were scientists and academics belonging to a variety of disciplines (sociology, economics, demography and educational science), as well as professionals outside academia (for example, school principals and former or current staff of the ministry of education). For more details see Table A1 in appendix A.

As usually done in convenient sampling, the starting sample was identified via personal connections. Following networking sampling procedures, the initial starting seeds were asked to name as many additional experts as possible. As shown in Traini (2019), 61% of the respondents who finished the questionnaire[9] suggested other experts (this percentage ranges from 14% in Ireland to 100% in Finland, Italy, Russia, and Slovenia). Thanks to this chain, I reached non-academic experts that otherwise would have been excluded. To limit the bias of a not random sample of experts in the initial sample of convenience and the probability of having network connections to the earlier convenience sample (Krosnick, 1999; Baker et al., 2013), I followed Vehovar and colleagues' (2016) suggestion of increasing the sample by combining different recruitment channels. To this end, I considered two additional criteria: scientific publications and membership of scientific associations or research centres.

Table 1.3 shows that the response rate (i.e., the percentage of persons participating among those invited) was 54%. Among active respondents, 206 completed the survey. Compared to political science, where this methodology is extensively used, this expert survey had a high participation rate. The remaining 205 started the

[9] By construction this question was asked at the end of the questionnaire.

questionnaire but never finished it.[10] The completion rate (i.e., the ratio between the number of finished surveys and the total number of surveys sent to participating experts) was 27%.

Table 1.3 Expert survey's participation rates

	Obs	*%*
Total sample	757	
Net participation	411	54.35
Completed	206	50.24
Suspended	205	49.76
Completion rate		27.31

The final sample size of 206 experts provided information on 34 countries: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Latvia, Lithuania, Luxembourg, the Netherlands, Norway, Poland, Portugal, Romania, Russia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine and the United Kingdom. The countries included in this survey are those that took part in international surveys, as the final aim of this data collection was to integrate this macro information into individual-level data.

Twelve countries failed to reach the minimum threshold of five experts (Ray, 1999). Nevertheless, in 11 countries, four experts replied (Czech Republic, Estonia, Finland, Hungary, Iceland, Luxembourg, Poland, Spain, Sweden, Switzerland and Turkey) and three experts completed the survey in Ukraine. Hence, in all these countries, it was still possible to aggregate multiple experts' opinions. A practice that has better

[10] Since 94% of the dropouts left the survey after reading the first task (they had to compare their educational system with those of other countries (see Traini, 2019)), these respondents did not provide valid responses that I could exploit.

chances than single expert's judgement in getting closer to the true value (Meyer and Booker, 2001; Benoit and Laver, 2006).

Measurements of education system's characteristics

To overcome the drawback related to the between-school focus of the previous conceptualizations of stratification of education systems, the definition used in this thesis and in the online questionnaire focuses not only on different school types but also on different curricula within schools where groups of students are taught separately all day long and in all subjects. To make sure that while responding the experts had in mind the abovementioned definition of stratification of education system, this definition was explicitly cited in the online questionnaire. Additionally, to adequately associate the indicators of the stratification of education systems to the micro level data used to test the hypotheses, I explicitly reminded the experts to refer to the structure their education system had in the time window between 1980 and 2000. Together with a sample selection in the ESS data explained later, this time restriction makes sure that the education system described by the experts matches the institutional arrangement the ESS respondents where subjected to while studying.

To capture the differential timing of selection across countries, the indicator of the expert survey identifies the age at which the first within- and/or between-school differentiation occurred. Since for each country at least three experts responded, the final indicator is computed as the within country mode. Since the presence of multiple experts allows to evaluate expert agreement, each empirical article presents measures of experts' reliability (for more information see chapters 3, 4, and 5). Besides reliability, expert judgement has also been validated by comparing it with previous indicators. For additional information on this validity checks, please refer to the three theory-guided

empirical articles (i.e., chapters 3, 4, and 5). Table 1.4 shows the country values of the timing of the first selection. For more information on the questionnaire see appendix A.

The second dimension of the stratification of education systems focuses on students' scholastic abilities. To overcome the drawback of previous indicators and make sure that this information refers to the first selection, I collected this information asking the experts to refer to the moment in which the first selection took place. Specifically, the question in the questionnaire stated: 'to what extent was the first selection associated with students' scholastic abilities?' and the provided answer was a continuum ranging from 'not at all' (=0) to 'completely' (=100). Before computing the mean within each country, each respondent's value was centred on his/her average response. The final indicator is also reported in Table 1.3. Although the theoretical range is 0 to 100, the observed values range from 31 (Turkey) to 90 (Bulgaria).

Table 1.4 Indicators of the stratification of education systems

	Age of first selection	Ability-based selection
Austria (AT)	10	60.07
Belgium (BE)	14 (1988: 12)	79.46
Bulgaria (BG)	14	89.63
Croatia (HR)	15	68.92
Cyprus (CY)	15	41.35
Czech Republic (CZ)	14 (1990: 11)	82.08
Denmark (DK)	16	67.07
Estonia (EE)	15	83.34
Finland (FI)	16	73.63
France (FR)	13 (1994: 15)	80.70
Germany (DE)	10	61.59
Greece (GR)	15	50.43
Hungary (HU)	14 (1989: 10)	63.53
Iceland (IS)	15	62.04
Ireland (IE)	16	55.07
Israel (IL)	12	71.38
Italy (IT)	14	53.90
Latvia (LV)	15 (1991: 16)	68.22
Lithuania (LT)	15	52.13
Luxembourg (LU)	12	66.71
the Netherlands (NL)	12	75.46
Norway (NO)	16	61.09
Poland (PL)	15	84.28
Portugal (PT)	15	51.75
Romania (RO)	14	73.25
Russia (RU)	16	80.15
Slovakia (SK)	10	68.48
Slovenia (SL)	15	66.03
Spain (ES)	14 (1990: 16)	49.39
Sweden (SE)	16	75.36
Switzerland (CH)	12	47.00
Turkey (TR)	11 (1997: 14)	30.79
Ukraine (UA)	15 (1989: 10)	78.89
the United Kingdom (UK)	11	48.28

1.4.2 Micro data

The micro-level data employed in this thesis come from repeated cross-sectional surveys that also collect retrospective information. In the replication study reported in chapter 2, I exploit the same data sources used by Bol and Van de Werfhorst (2013) namely, the cumulative dataset of the European Social Survey (ESS) which, at that time, consisted of the first four rounds and the International Social Survey Programme (ISSP) of 2008.[11]

The data of the remaining three chapters (i.e., the theory-guided 2, 3 and 4 articles) come from the ESS. The ESS is a comparative survey collected biannually and the majority of countries participate repeatedly. In each country and round, random probability samples are drawn from the population of interest that consists of persons older than 15 years of age living in private households. Since the ESS was explicitly created to provide comparable data across countries over time, all important aspects of survey methodology are standardized (Fitzgerald and Jowell, 2010).

The advantages of the ESS over alternative data mainly relates to the comparative aim of this thesis. ESS data provide information about the three main variables of interest (social background, educational and occupational attainment) and its quality has been recognized (Kohler, 2008).

The ESS has been complemented with time-constant macro-level data to measure the stratification of education systems that I collected through an online expert survey and the confounders of the latter's moderating effects on the OED associations.

Analytical samples

[11] Since I do not use the data of the ISSP directly but only employ the coefficients estimated by Bol and Van de Werfhorst (2013), I will not further describe the ISSP. More information can be found at http://w.issp.org/menu-top/home/

Since the version of the ESS dataset used by Bol and Van de Werfhorst (2013) is not available anymore, the set of replication analyses reported in article 1 draws on the same sample selections applied by the authors. Specifically, they applied the same selection on both datasets namely, men between 25 and 40 years of age.

The analytical samples ignore first-generation migrants and include individuals older than 24 years who completed their education. To integrate the ESS data with the information from the expert survey, the samples further exclude respondents born before 1973 and after 1995. Since the experts that participated provided information on how education systems were organized between 1980 and 2000 (see section 1.4.1), the respondents exposed to that specific arrangement were born between 1973 and 1995. I apply further restrictions in chapter 5 (article 4) that investigates the OD|E link. Specifically, the analytical sample disregards respondents working in family businesses and self-employed, because the theoretical expectations do not directly apply to these workers.

1.4.3 Methods

In this section, I discuss the analytical strategies applied in the replication and the three theory-guided articles.

The Replication study

Chapter 2 contains the replication of Bol and Van de Werfhorst's (2013) analyses. From a methodological point of view, the replication is composed of three types of analyses. First, I question the predictive validity of the index of tracking on social background inequality in educational attainment and educational gradient in occupational attainment. Specifically, I regress their country estimates of the OE and ED links on the index of tracking, vocational enrolment and vocational specificity. This corresponds to the kind of replication that Freese and Peterson (2017) define verifiability.

Second, I employ a weighting approach that adequately accounts for the two error components that characterized regression models whose dependent variables are based on estimates. Back to Freese and Peterson's (2017) terminology, I investigate finding generalizability. Bol and Van de Werfhorst used inverse-probability weights (also called Weighted Least Squared WLS i.e., the reverse of the dependent variable's standard errors) assuming that the total residual is only due to the sampling error (i.e., the difference between the true value of the dependent variable and its estimated value). In line with Lewis and Linzer (2005), I compute the sampling weights employing a procedure called Feasible Generalized Least Squares (FGLS).

Third, I add a country level indicator testing Bol and Van de Werfhorst's (2013) robustness of findings (Freese and Peterson, 2017). This addition to their model specification permits to estimate unbiased moderating effects of the index of tracking on OE and ED associations as it conditions the analyses to educational expansion (Schmidt-Catran and Giesselmann, 2018).[12]

The three theory-guided empirical articles

The ESS data structure is characterized by the nesting of individuals into countries and rounds. For statistical reasons, this multilevel structure needs to be taken into account (Bryan and Jenkins, 2016; Heisig, Schaeffer and Giesecke, 2017; Maas and Hox, 2005; Schmidt-Catran and Fairbrother, 2016). If ignored, the estimates obtained would be anticonservative as they would have downward-biased standard errors. This results from the violation of the independence of errors assumption as individuals from the same country/round/country*round will be more similar than individuals from different countries/rounds/countries*rounds.

[12] Another possible test is to account for the nesting of rounds into countries. Although the version of the micro-level data used by the authors is not available anymore, this test would quantify the bias of previous studies that fail to account for this additional level.

In addition to the above mentioned statistical reason, to choose the appropriate method, another consideration must be taken into account. The main interest of this thesis is to estimate the moderating effects of the stratification of education systems. These moderating effects can be estimated simultaneously by means of cross-level interactions or in separate steps by using the two-stage approach (Bryan and Jenkins, 2016). In the former case, researchers estimate multilevel models. Usually, this model is estimated by assuming random intercepts for the higher-level units and random slopes for the effect of the independent variable of interest. This approach is also characterized by the "invariant coefficients assumption" that constraints the effects of the control variables to be constant across the higher-level units (Heisig, Schaeffer and Giesecke, 2017: 797). In contrast, in the latter case (i.e., the two-stage approach), an individual-level model is estimated separately within each higher-level unit. The difference from the multilevel model is thus that all the individual parameters are here allowed to vary across the higher-level units. In the second stage, the estimated individual regression coefficients of each higher-level unit are then regressed on the higher-level variables of interest.

Finally, when deciding which method suits the data best, we need to consider that because of the different measurements of the independent and dependent variables across the ESS rounds, the theoretically driven articles use different rounds. Specifically, chapters 3 and 4 (articles 2 and 3) draw on ESS data from the first to the ninth round, while the last article uses the first five rounds.

Considering all the above mentioned arguments, in chapters 3 and 4 (article 2 and 3) where it is possible to maximize the number of country-rounds I apply multilevel models. On top of this, the analyses of these articles contain fewer micro-level covariates than the model specification of article 4 (chapter 5), making the violation of the invariant coefficients assumption less likely. In contrast, in article 4 (chapter 5) that uses only five

rounds, I implement the two-step approach with country as the unit of analysis. Here, to take further account of the nesting of rounds in countries, in the first step I cluster the standard errors by round. Another reason to lean towards this method is that after estimating the OD|E effect within each country, this technique allows to apply the sheaf coefficient to measure the combined effects of social background by combining the effects of parental social class and education (for more information on the sheaf coefficient see Buis, 2009; Heise, 1972; Meraviglia and Buis, 2015). Additionally, this step by step method makes it possible to directly test hypothesis H5.0 that predicts a null effect of the stratification of education systems on the OD|E link. As highlighted by Bryan and Jenkins (2016), another benefit of the two-stage approach is the possibility to produce quite simple and straightforward graphs by plotting the first-stage estimates against the higher-level variables of interest (see Figure 5.2 in Article 4).

One of the drawbacks of the two-stage approach is that only within-higher-level units' variation is used to estimate the effects of the micro-level variables (Heisig, Schaeffer and Giesecke, 2017). However, this issue is not problematic in Article 4 as the number of respondents per country (that is the higher-level unit in this case) is large (see Table 5.1 in Article 4).

The second pitfall of the two-stage approach is its computation. Indeed, the dependent variable used in the second stage is estimated. To account for this, in article 4 I employ the FGLS estimator.

1.5 Summary and conclusions

In the next section, I summarize the main findings of the articles and discuss their limitations. Based on this, the following section draws some general conclusions and ideas for future research.

1.5.1 Main findings of the articles

From the replication study (chapter 2, article 1), we can conclude that the three types of replication show that the index of tracking is not statistically significantly associated with the strength of the OE link while it is positively and statistically significantly associated with the ED link. This is a contribution to the field on its own as it shows that the most famous indicator of the stratification of education systems (i.e., index of tracking) fails its predictive validity test. It is important to note though that in this replication I rely on Bol and Van de Werfhorst's (2013) estimates of the dependent variables even though they are affected by omitted variable bias as the authors estimated total OE and ED effect. Because of that, I refrain from further speculating about these findings.

Building on the abovementioned results, the subsequent three chapters (articles 2, 3 and 4) investigate to what extent new indicators of the stratification of education systems moderates the OE, ED, and OD|E links. Specifically, in addition to the timing of the first selection, a new dimension is considered: the extent to which the first selection is based on students' ability. Readers may argue that the extent to which the first selection is based on students' ability is not new to OE literature. However, as explained in section 1.2, it is still new for comparative studies looking at educational attainment that is exactly what this thesis looks at in the OE analyses.

In chapter 3 (article 2) I find that the two dimensions of stratification of education systems moderate the OE link. Specifically, confirming earlier studies it is shown that the later the first selection takes place the weaker is the importance of social background on educational attainment with the influence being much greater for children from the lower social background. The H3.2 hypothesis finds thus support. In contrast, as students' ability becomes more important in the selection process, educational attainment becomes

more dependent on social background. Findings suggest that this is mostly due to the families at the extremes enlarging their gap in attained years of education. Consequently, the H3.1 hypothesis is rejected. Sensitivity analyses based on an alternative indicator of ability-based selection coming from PISA (2000, 2003, and 2006) confirm these results. I further show that the effect of ability-based first selection on social inequality in educational attainment does not depend on the timing of the first selection. Chapter 3 also shows that the moderating effects are not affected by the ideological orientation of policymakers (Furuta, 2020).

The rejection of hypothesis H3.1 puts into question the theoretical mechanism identified in section 1.3.1. There I hypothesized that the extent to which the first selection is based on students' ability should affect social background gradient in educational attainment by reducing the size of secondary effects. In turn, this argument is grounded in the original version of Boudon's (1974) theory that treats primary and secondary effects as independent from each other. In contrast, the findings of this chapter seem to suggest that primary and secondary effects are not additive but multiplicative. This means that to preserve the intergenerational transmission of advantages, parents from higher social backgrounds may anticipate their children's academic failure and boost their scholastic achievement (Bernardi, 2012; Boudon, 1988; Roth and Siegert, 2016). This hints to higher social background families finding alternative ways to maintain and pass their advantages on to their offspring (Lucas, 2001).

By showing that both dimensions of the stratification of education systems count in amplifying the OE link, this thesis makes a step further empirically showing that the extent to which the first selection is based on students' ability affects the OE link when long term educational outcomes are analysed. Therefore, article 2 improves our understanding of explanations for moderating effects of the stratification of education

systems by testing the effect of a new dimension never considered before in comparative studies on educational attainment.

With chapter 4 (article 3), I find a stronger ED link as the index of tracking increases (see M1 in table 4.5 article 2). Considering the review of the previous studies (section 1.2), these findings improve the current state of research because they overcome the omitted variable bias at the micro and macro level and properly account for the data structure of the ESS. Once the extent to which the first selection is based on students' ability is included in the analysis, the moderating effects of the index of tracking on the association between educational and occupational attainment turn insignificant and their effect sizes get close to zero (see M2 in table 4.5 article 3). Since the analyses also show that the more students' ability counts during the first selection the stronger is the ED link, I can conclude that the moderating effect of the index of tracking on the ED link is mediated by ability-based first selection.

This means that the empirical evidence of chapter four suggests that the effect of the stratification of education systems on the ED link may come about because of the reduction of the risk of productivity loss as suggested by hypothesis 4.1. However, the generalizability of these results is put into question as one of the sensitivity checks reveal that the findings are sensitive to different sets of countries. Specifically, when either the Netherlands or the United Kingdom is excluded, ability-based first selection does not moderate the association between educational and occupational attainment. Since the Netherlands or the United Kingdom are not outliers, this result speaks for the rejection of hypothesis 4.1. As a consequence, finding which characteristics of the stratification of education systems are responsible for the moderating effect of the stratification of education systems on the ED link still rests an open question for future study to investigate (Gross, Meyer and Hadjar, 2016; Zapfe and Gross, 2021).

In chapter 5 (article 4) I look at the direct effect of social background on occupational attainment and my results show that the OD|E link does not depend on the extent to which the first selection is based on students' ability. This conclusion holds despite restricting the analytical sample, changing the countries, altering the operationalizations, and modifying the model specification. Confirming former findings, I show that the strength of the direct effect of social background on destination is not affected by the stratification of education systems (Hadjar and Becker, 2016; Reichelt, Collischon and Eberl, 2019). For this last article, the theoretical and empirical contributions lie in accounting for the extent to which the first selection is based on students' ability.

Despite these contributions, there remain some limitations valid for all the theory-guided articles. First, with the ESS data, it is not possible to control for pre-tracking ability making it impossible to distinguish the self-selection process from the effect exerted by ability-based first selection (Esser, 2016; Morgan, 2001). Consequently, these analyses may overestimate the OED associations. Note that this endogeneity bias is less problematic in chapter 5 (article 4) as I rely on country averages.

The second limitation is connected with the nature of the (micro- and macro-level) data at hand. Because of their cross-sectional nature, I refrain from any causal interpretations of these results. While time-varying information on macro-level variables won't solve this issue completely, it would make it possible to observe the phenomena while controlling for constant country-level characteristics.

Third, the definition of stratification of education systems used in this thesis focuses on stable differentiation practices neglecting less visible forms of educational differentiation—such as placement in high-ability groups or specific course-taking patterns—which can be highly relevant in the social stratification of the student body

between and within schools. Temporary (in the sense of subject- or time-coverage) forms of differentiation, however, are hard to capture in cross-national research, and few scholars have attempted to do so. Additionally, the few comparative studies that focus on temporary differentiation practices are constrained to use PISA data as it is the only survey that has recently started to measure ability grouping, see for example Chmielewski (2014) and Chmielewski, Dumont and Trautwein (2013). However, since these forms of temporary/subject-related differentiation are known to affect educational attainment (Blossfeld et al., 2019), the current measurement of the stratification of education systems may underestimate its moderating effects.

Fourth, for what concerns the theoretical contribution of this thesis it must be said that its direct empirical test is still missing. Because of data constraints, with this thesis I cannot directly test the micro-level mechanisms explained in section 1.3 but only indirectly provide support (or do not provide support) of the theoretical model.

The fifth and last critical point concerns the measurement of education systems' characteristics by means of expert judgement. As presented in the theory-guided articles, in chapter 3, 4 and 5 I test the reliability and validity of these indicators. Specifically, to test the former I assess the extent to which experts of the same country agreed on their answer by computing average standard deviation. Robustness checks show that results are stable when the countries characterised by low expert agreement are excluded from the analyses. In chapter 4 I also implement another test where the country indicators are computed again from a different sample of experts. More in detail, from each original sample of size *n*, I randomly select all the possible samples of *n-1* experts. By restricting the analyses to those countries whose indicators are not dependent on the pool of experts interviewed, findings hold. To check the indicators' validity, I compare them with the indicators used in the previous literature and also replace them with the latter in the

empirical analyses. Results point towards foreseeable and anticipated differences that do not question the main conclusions.

Additionally, the use of indicators to measure the national education system may raise concerns especially for countries characterized by low levels of centralization. Since selecting experts for each lower level (the latter being regional, federal, cantonal, etc.) has not been possible, analyses have been repeated by disregarding the countries with decentralized education systems (i.e., Belgium, Cyprus, Germany, Switzerland, and the UK). Also in this case, findings are robust.

Unfortunately, what I cannot test empirically is whether the experts that participated in this online survey constitute a selective group of experts and whether the meaning they attached to the main theoretical concepts is different from mine. As for the former, the above mentioned checks (especially the content validity ones) should support the use of expert data. To minimize the risk of the latter, I always provided my specific definition of each term. Additionally, experts were also given the possibility to leave comments on each question by expressing their doubts and concerns. Since this option has been used on ancillary questions, I do not have reasons to question its non-use on the main questions of interest.

Finally, an additional critical point can be raised in connection with the countries included in the expert survey as I ground my selection on those countries participating in international surveys. In turn these countries never comprise a random sample of the universe of countries (Möhring, 2012). If the chosen countries are systematically different from the ones not participating in these international surveys, the generalizability of these findings are severely compromised.

1.5.2 Conclusions

This thesis updates the widely used term stratification of education systems to include within school differentiation. Additionally, it shows the value of new theoretical explanations for the moderating effect of the stratification of education systems on the OED associations, especially ED and OD|E. Differentiating between the timing and extent to which the first selection is based on students' ability, the results confirm the necessity to investigate the latter in addition to the former. The theoretical contributions of this thesis are partly achieved as the micro-level mechanisms are not directly tested. Given that the appropriate data to test them are not available yet, this represents a possible avenue for future projects. For example, to test the mechanisms theoretically identified for the ED and OD|E links, vignette studies may be carried out in similar contexts that differ only with respect to the extent to which the first selection is based on students' ability complemented with in-depth interviews. By means of the latter it would be possible to investigate whether the risk of productivity loss is something that really bothers employers and if its role is reduced in the presence of ability-based first selection.

Building on the findings of chapter 3, another plan for future research is to carry out qualitative studies investigating the actual strategies employed by higher social background parents to compensate for their children's potential academic failure. In this thesis, I have only speculated about these anticipatory mechanisms. It is important to test whether the conversion of primary effects into secondary effects is the micro-level mechanism that explains the (moderating) effect of ability-based first selection on social background inequality.

Findings show that social mobility is only weakly altered by the stratification of education systems and that the moderating effects only occurs through the indirect path affecting the OE link. If we define stratified education systems as those systems selecting

early and upon students' ability, these results show that the more education systems are stratified the stronger is the social background gradient in educational attainment. This means that families from higher social backgrounds seem to find strategies to exploit educational institutions to their benefit (Bernardi, 2012, 2014; Heath, Mills and Roberts, 1992). Interestingly, the two dimensions of the stratification of education systems increase social background gradient in educational attainment differently. Using Erola and Kilpi-Jakonen's (2017) words, the timing of the first selection seems to work through *compensation* (or what Esping-Andersen has called bottom-up equalization (2004)) while ability-based first selection resembles what the authors defined as *multiplication*. In the former case, anticipating the age of first selection is detrimental especially for individuals stemming from the lower social background. In the latter case, ability-based first selection multiplies the family resources by being more advantageous the more parents are affluent. In the previous literature, this process has been called Matthew effect (Merton, 1968), or cumulative advantage (Bernardi, 2012, 2014; DiPrete and Eirich, 2006).

Considering the next path of the indirect effect of social background on occupational attainment, i.e., the educational gradient in occupational attainment, this thesis shows that selecting students upon their ability may be the mechanism that strengthens the association between educational and occupational attainment for a limited number of countries. It is therefore relevant to further investigate this moderating effect and test its generalizability by employing different indicators and high-quality micro-level data.

Given the results of previous literature that by employing different indicators has reached opposite conclusions, it appears clear that additional indicators of the two dimensions of the stratification of education systems need to be collected and released.

A series of analyses employing different theoretically-driven indicators (given that the other methodological aspects of the strategy are held constant) may be an idea for future research. Furthermore, it could also be interesting to expand the current definition of stratification of education systems to include also temporary forms of differentiation.

Lastly, this thesis highlights that to provide sound policy advice, international agencies should offer macro-level longitudinal data on theoretically grounded indicators to be integrated into rich longitudinal micro-level data. In addition to these analyses of secondary data, rich qualitative studies supporting or rejecting the theoretically identified micro-level mechanisms are also of fundamental relevance.

Appendix.

Table A1: Previous studies on the effects of the stratification of education systems on social mobility

Source and results	*Description of data, sample selections, countries, operationalizations, and model specifications*
Allmendinger (1989) ED: educational credentials are rewarded differently in stratified and unstratified (higher and more diverse in the latter than in the former). Also, the importance of formal certificates against years of education is higher in the former	Data: national datasets (the USA: American Life History Study, Germany: West German Life History Study, and Norway: Norwegian Occupational Life History Study) Sample selection: males born between 1929 and 1931 truncated after age 40 Countries: 3 the USA, Germany and Norway Measurement of: a) stratification of education systems (↑): theoretical (stratified: Germany and Norway; unstratified: Norway) c) E: (categories: elementary, middle (High school, Mittelschule, and Realskole), and gymnasium (for the USA completed high school); but also years of education) d) D: SAS Method: comparisons of single case study (comparison of variance explained (R^2) M1 regresses SAS on years of education, M2 adds educational categories and statistically significance of the regression coefficient measuring educational categories) Model specification: not specified
Andersen and Van de Werfhorst (2010) ED: statistically significant moderating effect	Data: ESS (2004) Sample selection: 18 years and older Countries: 14 Belgium, Czech Republic, Denmark, France, Germany, Hungary, Ireland, the Netherlands, Norway, Poland, Slovakia, Spain, Sweden, and Switzerland Measurement of: a) stratification of education systems (↑): index of skill transparency (factor analysis over the percentage of the students at the secondary level studying in vocational courses, percentage of the students enrolled in dual track, the number of tracks available to students in the lower secondary level, the age of first selection, and percentage of students enrolled in tertiary education) c) E: (categories: less than a secondary school diploma, vocation or technical training at the upper secondary level, general upper secondary school, and tertiary degree) d) D: ISEI Method: linear multilevel models Model specification: at micro-level gender and age; at macro-level* no controls

Table A2: Continued

Source and results	*Description of data, sample selections, countries, operationalizations, and model specifications*
Ballarino, Bernardi and Panichella (2016) OE: not statistically significant moderating effect	Data: ESS (2002/10) and EU SILC (2005) Sample selection: birth cohorts born from 1931 to 1970 Countries: 20 Germany, Czech Republic, Estonia, Slovakia, Austria, Slovenia, Poland, Norway, Denmark, the United Kingdom, Hungary, France, the Netherlands, Luxembourg, Sweden, Lithuania, Italy, Iceland, Finland, Belgium, Portugal, Cyprus, Greece, and Spain Measurement of: a) stratification of education systems (↑): index of tracking b) O: education (dominance approach, dummy lower than secondary education) c) E: attaining at least an upper secondary diploma (ISCED 3) and achieving at least some post-secondary degree (ISCED 4-6) Method: Two-step model (first stage OLS models by country*cohort) Model specification: at micro-level gender; at macro-level vocational orientation and educational expansion
Bol and Van de Werfhorst (2011) ED: statistically significant moderating effect	Data: ESS (2006) Sample selection: individuals between the age of 24 and 65 Countries: 15 Belgium, Czech Republic, Denmark, France, Germany, Hungary, Ireland, the Netherlands, Norway, Poland, Russia, Slovenia, Spain, Sweden, and Switzerland Measurement of: a) stratification of education systems (↑): External differentiation (i.e., on a factor analysis over the age of first selection, the number of tracks at 14 years old, and the total number of tracks in secondary education c) E: (ES-ISCED categories: I + II, IIIa, IIIb, IV+V1, V2) d) D: ISEI Method: linear multilevel models Model specification: at micro-level gender and age; at macro-level no controls

Table A3: Continued

Source and results	*Description of data, sample selections, countries, operationalizations, and model specifications*
Bol and Van de Werfhorst (2013) OE: statistically significant moderating effect ED: statistically significant moderating effect	Data and sample selection: for OE = ESS (2002-2008, men 25-40 years of age), for ED = ISSP (2008, men 24-65 years of age) Countries: For OE = 19 Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Israel, Italy, Luxembourg, Norway, Poland, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, and the United Kingdom; for ED = 23 Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Finland, France, Germany, Ireland, Japan, Korea, the Netherlands, Norway, Poland, Slovakia, Slovenia, Spain, Sweden, Switzerland, the USA, and the United Kingdom Measurement of: a) stratification of education systems (↑): index of tracking b) O: education (father, categories ISCED: 0–1, 2, 3, 4, 5–6) c) E: (full-time equivalent) years of education d) D: ISEI Method: Two-step model (first stage they combined the effect of parental education on years of education by means of sheaf coefficient, second stage OLS) Model specification: at micro-level gender, age, country of birth; at macro-level vocational orientation
Braga, Checchi and Meschi (2013) OE: statistically significant moderating effect	Data: ESS (2002-2008), EUSILC (2005), IALS (survey year not reported), and ISSP (1991, 1992, 1993, and 1999) Sample selection: individuals aged at least 25, excluded those who reported more than 25 years of schooling and foreign-born people Countries: 23 Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Great Britain, Greece, Hungary, Ireland, Italy, Latvia, the Netherlands, Northern Ireland, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, and Sweden Measurement of: a) stratification of education systems (↓): age at first tracking (time-varying) b) O: education (approach not reported: at least one parent has tertiary education) c) E: (full-time equivalent) years of education completed Method: Two-step model (first stage they estimate the intergenerational correlation of educational attainment in each country*cohort, in the second stage they regress them on institutional variables with country and cohort fixed effects) Model specification: at micro-level, gender, age, country of birth; at macro-level, educational expansion

Table A4: Continued

Source and results	*Description of data, sample selections, countries, operationalizations, and model specifications*
Brunello and Checchi (2007) OE: statistically significant moderating effect	Data and sample selection: ISSP (1991 cohorts born in the periods 1967–73 and 1975–81; and 1999 those born in 1989–2000 and 1979–1990), IALS (1994 age groups 17–22 and 27–32; 1996 age groups 18–24 and 28–34; and 1998 the age groups 20–25 and 30–35) Countries: 24 Australia, Belgium, Canada, Chile, Czech Republic, Denmark, Finland, France, Germany, Hungary, Ireland, Italy, Japan, the Netherlands, New Zealand, Norway, Poland, Portugal, Russia, Spain, Sweden, Switzerland, United Kingdom, and United States Measurement of: a) stratification of education systems (↑): tracking length i.e., the percentage of primary + secondary education that is tracked (time-varying) b) O: education (dominance approach: coding 0 when no parent completed secondary education, 1 when at least one parent has a secondary education degree and 2 when at least one parent has a college degree) c) E: years of education, upper secondary completion, and college enrolment/attainment Method: OLS and probit models with country and year fixed effects Model specification: at micro-level, gender and age; at macro-level, vocational orientation
Hadjar and Becker (2016) OE: positive and statistically significant moderating effect ED: not statistically significant moderating effect OD|E: not statistically significant moderating effect	Data: ESS (2008-2012) Sample selection: birth cohorts born in 1933–77 Countries: 33 (list not reported) Measurement of: a) stratification of education systems (↑): country clusters (classification not complete) b) O: social class (dominance approach: service, middle and working-class) c) E: attainment of general upper secondary education (less than ISCED 3a vs. at least ISCED 3a) d) D: ISEI Method: logistic and linear multilevel models (2 levels) Model specification: at micro-level, gender, citizenship, period, birth cohort (education); at macro-level, educational expansion and vocational orientation

Table A5: Continued

Source and results	*Description of data, sample selections, countries, operationalizations, and model specifications*
Heisig, Elbers and Solga (2019) OE: statistically significant moderating effect	Data: PIAAC (2011, 2014) Sample selection: respondents aged 30–49 excluding who obtained the credential in another country Countries: 23 Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Finland, France, Germany, Great Britain, Greece, Ireland, Italy, Japan, Korea, the Netherlands, New Zealand, Norway, Poland, Spain, Sweden, Turkey, and the USA Measurement of: a) stratification of education systems (↑): tracking length (i.e., the share of the length of primary and secondary education that is tracked (time-varying)) b) O: education (dominance approach: 3 cat: below upper secondary, upper sec or non-tertiary post-secondary, tertiary; treated as continuous) c) E: years of education Method: mixed-effects (multilevel) models with random effects (O) at the country and country-cohort levels nested in cohorts, countries, and combinations of country*cohorts Model specification: at micro-level, sex, age, foreign birth, foreign language; at macro-level vocational orientation
Horn (2009) OE: moderating effects not always statistically significant	Data: PISA 2003 Countries: 29 Austria, Hungary, Turkey, Slovakia, Belgium, Ireland, Poland, Great Britain, New Zealand, Denmark, the USA, Australia, Sweden, Norway, Czech Republic, Germany, Mexico, the Netherlands, Luxembourg, Korea, Italy, Switzerland, Greece, Japan, Portugal, Finland, and Spain, Canada, Iceland. Measurement of: a) stratification of education systems: number of school types at age 15 (↑), age of selection (↓), ratio of vocational training (↑), academic selection (↑) i.e., ratio of school heads that reported that the school considers previous academic record or the results of an entrance exam as a prerequisite for attendance b) O: ESCS c) E: achievement in math and reading literacy Method: linear two-level hierarchical mixed model Model specification: at micro-level, grade, age, gender, and immigrant status

Table A6: Continued

Source and results	*Description of data, sample selections, countries, operationalizations, and model specifications*
Jackson and Jonsson (2013) OE: no clear pattern	Data: national datasets (for more info see table 11.2 page 314) Sample selection: risk set of students eligible for the transition under consideration Countries: 7 England, the United States, Germany, the Netherlands, Denmark, Italy, and Sweden Measurement of: a) stratification of education systems: country clusters for stratification and selectivity (see table 11.1 page 310) b) O: social class and education if both present (see table 11.2 page 314) c) E: educational transitions (the first either during or at the end of compulsory education, the second from secondary to university education, see table 11.3 page 316) Method: graphical inspection of the country values of log odds ratios between advantaged and disadvantaged social groups
Marks (2005) OE: statistically significant moderating effect	Data: PISA 2000 Countries: 30 Australia, Austria, Belgium, Brazil, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Korea, Latvia, Luxembourg, Mexico, the Netherlands, New Zealand, Norway, Poland, Portugal, Russia, Spain, Sweden, Switzerland, the UK, and the USA Measurement of: a) stratification of education systems: number of tracks at age 15 (↑), age of selection (↓), and school intra-class correlation (↑) i.e., the proportion of the total variation in student performance due to between-school differences b) O: social class (father's occupation and if missing, mother: upper service, lower service, routine white-collar, skilled and supervisory manual, semi- and unskilled manual, and farmers) c) E: achievement in reading literacy Method: Two-step model (first stage to estimate R^2 values of country-wise OLS models regressing reading on social class -clustering standard error within schools-, second stage correlation) Model specification: no controls at the micro level

Table A7: Continued

Source and results	*Description of data, sample selections, countries, operationalizations, and model specifications*
Müller and Shavit (1998) ED: not statistically significant moderating effect	Data: national datasets Countries: 12 Australia, the USA, Great Britain, France, Germany, Israel, Italy, Japan, the Netherlands, Sweden, Switzerland, and Taiwan Measurement of: a) stratification of education systems (↑): country clusters c) E: CASMIN (1ab, 1c, 2a, 2b, 2c, 3a, 3b) d) D (first job): prestige scores and social classes Method: Two-step model (OLS/logit at the first stage that gives the differences/log odds in D between the highest and the lowest educational qualification, OLS at the second stage) Model specification: at micro level (see national chapters) at macro-level vocational orientation
Österman (2018) OE: statistically significant moderating effect	Data: ESS (2002–2012) Sample selection. respondents aged between 22 and 40 years and excluded immigrants who immigrated after the typical age for starting school Countries: 20 Hungary, Portugal, Spain, Ireland, Greece, Latvia, Sweden, Denmark, Bulgaria, France, Norway, Poland, Switzerland, the United Kingdom, Slovakia, the Netherland, Belgium, Slovenia, Germany, and Czech Republic Measurement of: a) stratification of education systems (↑): tracking length b) O: parental education (dominance approach, 5 categories translated into years of education) c) E: general vs. vocational programme at the upper-secondary level Method: country-fixed and cohort-by-country effects with country-clustered robust standard errors Model specification: at micro-level sex, birth year and ESS-round dummies, at macro-level vocational orientation

Table A8: Continued

Source and results	*Description of data, sample selections, countries, operationalizations, and model specifications*
Parker et al. (2016) OE: moderating effects not always statistically significant	Data: PISA 2003 Countries: 30 Iceland, Finland, Norway, Sweden, Denmark, Poland, New Zeeland, Ireland, Canada, Australia, Spain, the USA, Great Britain, Luxembourg, Portugal, Switzerland, Greece, Korea, Mexico, Slovakia, Czech Republic, France, Belgium, Japan, Austria, Italy, Turkey, Germany, Hungary, and the Netherlands Measurement of: a) stratification of education systems (↑): index of tracking and school intra-class correlation b) O: ESCS c) E: students' expectations of receiving at least a university degree Method: Two-step model (first stage probit regression using path modelling, second stage correlations and partial correlations) Model specification: no controls at the micro level, at the macro the other dimension of tracking
Pfeffer (2008) OE: statistically significant moderating effect	Data: IALS (survey year not reported) Sample selection: respondents aged 26–65 excluded second-generation migrants Countries: 19 (Finland, Northern Ireland, Great Britain, New Zealand, Denmark, the USA, Canada, CZ, Sweden, Poland, Chile, Ireland, Italy, Norway, Hungary, Switzerland, Belgium, Germany, and Slovenia) Measurement of: a) stratification of education systems (↑): country cluster b) O: education (dominance approach, categories: ISCED 0-1, ISCED 2, ISCED 3, ISCED 5, ISCED 6-7) c) E: see above Method: Two-step model (first stage log-linear models to estimate UniDiff parameters, second stage OLS) Model specification: at macro-level educational expansion

Table A9: Continued

Source and results	*Description of data, sample selections, countries, operationalizations, and model specifications*
Reichelt, Collischon and Eberl (2019) Moderating effects not always statistically significant OE: statistically significant ED: not statistically significant OD|E: not statistically significant	Data: ESS (2012-2014) Sample selection: individuals younger than 35 years of age, employees Countries: 24 (Austria, Belgium, Bulgaria, Czech Republic, Denmark, Finland, France, Germany, Hungary, Iceland, Ireland; Israel, Italy, the Netherlands, Norway, Poland, Portugal, Russia, Slovenia, Slovakia, Spain, Sweden, Switzerland, and the United Kingdom Measurement of: a) stratification of education systems (↑): index of tracking b) O: education (dominance approach (ISCED): 1; 2; 3; 4; 5-6) c) E: ES-ISCED I+II; IIIa and b; IV; V1; V2 d) D: ISEI Method: Two-step model (first stage see Jerrim and Macmillan (2015), second stage correlation) Model specification: at micro-level, age, sex, household size, respondent's and partner's migration status, presence of partner, partner's (and respondent's) education (lower or equal vs. higher)
Van de Werfhorst (2019) OE: statistically significant moderating effect	Data: ESS (2002-2012) Sample selection: birth cohorts born in 1933–77 Countries: 21 Austria, Belgium, Czech Republic, Denmark, the United Kingdom, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, the Netherland, Norway, Poland, Portugal, Slovakia, Slovenia, and Sweden Measurement of: a) stratification of education systems (↓): age of first selection (time-varying) b) O: social class (dominance approach categories: routine working-class, semi/routine working-class, technicians/crafts, intermediate/middle management, senior management/administration, and Professionals) c) E: Completion of upper secondary, completion of bachelor, years of education d) D: ISEI Method: OLS with country*cohort*O (and lower order) fixed effects Model specification: sex and year of birth, at macro-level educational expansion,

Table A10: Continued

Source and results	*Description of data, sample selections, countries, operationalizations, and model specifications*
Vogtenhuber (2018) OE: not statistically insignificant moderating effect ED: not statistically insignificant moderating effect	Data: PIAAC (2011, 2014) Sample selection: respondents aged 30- to 49-year-olds and only individuals who had earned their educational credential in the country of their current residence Countries: 23 countries Czech Republic, Poland, Italy, Turkey, Chile, Great Britain, Germany, Greece, the USA, France, Spain, Ireland, Japan, Belgium, Canada, Austria, Norway, the Netherland, Denmark, New Zeeland, Finland, Sweden, and Korea Measurement of: a) stratification of education systems (↓): age of first selection b) O: education (dominance approach, categories: neither parent has an upper secondary education, at least one parent has upper secondary education, and at least one parent has obtained a tertiary degree) c) E: tertiary degree d) D: ISEI Method: two-level random coefficient models (random intercept and slope) Model specification: at micro-level, age, sex, foreign-born parents, at macro-level vocational orientation

Note: * Depending on the study, the term "macro-level" may refer to country, time periods, or the combination of the two. Within this macro-level, I only consider whether the analyses condition on two country-level confounders: educational expansion and vocational orientation.
Stratification of education systems: (↑) means that higher values correspond to highly stratified systems, (↓) means that lower values refer to weakly stratified education systems. ESS stands for European Social Survey, O for social background, E for education, D for occupational attainment, OE for the association between social background and education, ED for the association between education and occupation, OD|E for the association between social background and occupation net of education, ISEI for Socio-Economic Index of Occupational Status, ISCED for International Standard Classification of Education, ES-ISCED for the European Survey Version of ISCED, PISA for Programme for International Student Assessment, OLS for ordinary least square, ESCS for index of economic, social and cultural status, EUSILC for European Union Statistics on Income and Living Conditions, IALS for International Adult Literacy Survey, ISSP for International Social Survey Programme, ECHP for European Community Household Panel, CASMIN for Comparative Analysis of Social Mobility in Industrial Nations, PIAAC for the Programme for the International Assessment of Adult Competencies.

Chapter 2 (Article 1) The Trade-off between Labor Market Allocation and Equality of Educational opportunity. A replication of Bol and Van de Werfhorst's (2013) analyses

2.1 Introduction

Bol and Van de Werfhorst's article 'Educational systems and the trade-off between labour market allocation and equality of educational opportunity' represents a milestone for researchers studying the effect of educational institutions on micro-level outcomes. In this study, the stratification of education systems[13] and other concepts, like vocational enrolment and vocational specificity, have been empirically operationalized into numerical indicators and then used in regression models in order to establish their associations with individual outcomes.

The original article tests these new numerical indicators against several hypotheses. Because the first two theory-guided articles of this thesis focus on the moderating effect of the stratification of education systems on: a) the association between social background and educational attainment (OE link) and b) the association between educational and occupational attainment (ED link), these are the specific analyses among those carried out by Bol and Van de Werfhorst (2013) that will be replicated here. By focusing on the OE and ED links, we will be able to test the predictive validity of the index of tracking with respect to the efficient labor market allocation versus equality of educational opportunity trade-off (Bol and Van de Werfhorst, 2013; Österman, 2018; Van de Werfhorst and Mijs, 2010; Van de Werfhorst, 2014).

2.2 Analytical strategy

Before describing the analytical strategy, it is important to clarify which types of replication are performed in this chapter. Adopting Freese and Peterson's approach, in this first chapter I ask "whether the same results are obtained by doing the same analyses on the same data" (2017: 152). Besides verifiability, I also evaluate whether Bol and Van

[13] Another term often used to refer to the stratification of education systems is tracking.

de Werfhorst's (2013) findings are observed across different methods and, in addition, if their results hold against a different model specification.

Since the first kind of replication involves the same data and the same methodological choices applied by Bol and Van de Werfhorst (2013), what follows in the analytical strategy section is a description of their methodological choices.[14] To test whether there is an association between the stratification of education systems and a) inequality of educational opportunity and b) educational gradient in occupational attainment, Bol and Van de Werfhorst implemented the two-step approach. For each country, the authors ran regression models at the micro level to measure the OE link and ED link. In a second step, these country coefficients were used as dependent variables in OLS regression models with country as the unit of analysis.

To estimate the OE link, the first-step estimated each respondent's educational attainment as a function of his/her father's educational attainment. As a consequence, the country coefficients measured the total association between a father's and his offspring's educational attainment, running the risk of overestimating the OE link due to unobserved variables (Jæger, 2007; Marks, 2011). Note that the omitted variable bias is not addressed in this replication study but it is dealt with in the subsequent chapters. The country-wise regression models used to estimate the gross ED link regressed occupational attainment on educational attainment. Also in this case, no additional controls were included.

Regardless of the outcome analysed, in the second step Bol and Van de Werfhorst estimated OLS regression models including their indicator of the stratification of education systems (i.e., the index of tracking, described in section 2.4). As country-level control they also included two measures of the vocational orientation of education

[14] Note that to independently verify the results of previous studies it is essential that, as in this case, the authors make their data available to others.

systems (the index of vocational enrolment and vocational specificity, see section 2.4 for their operationalization). In the original article they also ran these OLS models with another model specification that included more controls like the GDP, government educational spending, and so on. Since these controls are not simultaneously affecting the dependent and independent variables, these more complex model specifications are disregarded here.

2.3 Individual level data and operationalization

Considering the OE link, Bol and Van de Werfhorst made use of the cumulative dataset of the European Social Survey (ESS) which, at that time, pooled together the first four rounds of the survey: 1 (2002), 2 (2004), 3 (2006) and 4 (2008). Each respondent's educational attainment was measured by means of years of education while social backgrounds were operationalized through the father's educational attainment. The latter variable included the following categories (to be consistent with Bol and Van de Werfhorst I kept the same terminology): less than lower secondary education (ISCED 0–1), lower secondary education completed (ISCED 2), upper secondary education completed (ISCED 3), postsecondary non-tertiary education completed (ISCED 4), and tertiary education completed (ISCED 5–6). They pooled together the regression coefficient of each dummy of father's education by means of the sheaf coefficient (Buis, 2009; Heise, 1972).

Turning to the ED link, the data used by Bol and Van de Werfhorst come from the International Social Survey Programme (ISSP) of 2008. Educational attainment was operationalized into years of education while occupational attainment was measured by the International Socio-Economic Index of Occupational Status (ISEI).

2.4 Country-level data

To measure the stratification of education systems, Bol and Van de Werfhorst used three different indicators: the age of first selection, the length of the stratified curriculum, and the number of tracks available to 15-year-old students. According to the authors, the data for the age of first selection and the number of distinct school types available for 15-year-old students are provided by the OECD (2005, 2006) while the data for the percentage of the total curriculum in primary and secondary tracks that is tracked come from Brunello and Checchi (2007). To combine the three indicators into one single measure called the index of tracking, they performed factor analysis and saved the factor loadings as regression coefficients.

Together with the index of tracking, they also measured vocational orientation by breaking it down into two different indicators: vocational enrolment and vocational specificity. The former was computed through factor analysis on enrolment data in upper secondary vocational programs collected by the Organisation for Economic Co-operation and Development (OECD) and the United Nations Educational, Scientific and Cultural Organization (UNESCO). The latter denoted the percentage of upper secondary vocational education taking place in a dual system as reported by the OECD in its annual publication 'Education at a glance'.

2.5 Results

While describing the findings of the three types of replication, in the current section, I will also briefly discussed the reasons why the second and third type of replication have been implemented. Note that the replications of Bol and Van de Werfhorst's (2013) analyses concern only the country-level regression models (i.e., the second step of the analyses) as the specific versions of the datasets employed by the authors are no longer available.

In detail, the first two columns of Table 2.1 (model 3 and 5) report the findings of Bol and Van de Werfhorst's (2013) article, while the subsequent columns show the results from the different types of replications: verifiability, generalization, and robustness. The third and fourth columns (model 3a and 5a) are dedicated to the reproduction of the original results using the same data and same empirical strategy.

The subsequent four columns (model 3b, 5b, 3c and 5c) adopt a different estimator: Feasible Generalized Least Squares (FGLS). This means that with these analyses, I question the generalizability of the original study investigating whether the same findings may be found across different methods (Freese and Peterson, 2017). Additionally, with the last two models (3c and 5c), I perform a robustness test by reanalyzing the original data using an alternative model specification. Specifically, I add a country-level confounder namely, educational expansion.

Starting with verifiability, Model 3a illustrates that even if the sign of the coefficient is in the expected direction of a positive effect, the positive association between the index of tracking and the OE link is not statistically significant. Thus the index of tracking is not associated with the strength of the OE link. In contrast, model 5a shows a positive and statistically significant association between the index of tracking and the ED link.

The procedure used for computing the sampling weights Bol and Van de Werfhorst adopted (2013) has been criticized by Lewis and Linzer (2005) because it underestimates the standard errors. Inverse-probability weights, also known as WLS, are computed as the reverse of the dependent variable's standard errors. By applying this weighting procedure, researchers assume that the total residual is only due to the sampling error. In line with Lewis and Linzer (2005), I compute the weights by employing a procedure called Feasible Generalized Least Squares (FGLS). Following

Lewis and Linzer's (2005) recommendation, model 3b and 5b in Table 2.1 reports the new estimates with the correct standard errors. Both regression coefficients are positive and statistically significant.

However, the model specifications of model 3b and 5b omit a country-level confounder. To satisfy Pearl's (2009) backdoor criterion we need to close off all the associations connecting the stratification of education systems to respectively the OE or ED link. Along with vocational orientation, educational expansion is also associated with stratification of education systems, OE and ED link. Educational expansion and the stratification of education systems are known to be positively correlated (Bol and Van de Werfhorst, 2013; Hadjar and Becker, 2016; Müller and Shavit, 1998), while a negative correlation between educational expansion and OE link is expected by the modernization theory (Treiman, 1970). In contrast, Maximally Maintained Inequality (Raftery and Hout, 1993) and Effectively Maintained Inequality (Lucas, 1999, 2001) theories claim that as educational expansion increases, the OE link becomes stronger. Turning to the association between educational expansions and ED link, an increase in the former is expected to negatively affect the latter (Boudon, 1974). At the individual level, it forces young people to obtain higher educational qualifications if they want a favourable position in the job queue (Thurow, 1975). At the macro level, it may lead to credential inflation (Collins, 1979; Jackson and Goldthorpe, 2007). If there are more highly educated school leavers than the labour market can absorb, the value of educational credentials will decline, forcing highly educated individuals to accept jobs for which they are overeducated.

Table 2.1 Replication of Bol and Van de Werfhorst's (2013) analyses

	Bol and Van de Werfhorst (2013)		*Replications*					
	WLS		WLS		FGLS			
	OE	ED	OE	ED	OE	ED	OE	ED
	Model 3 (Tab 4 p 303)	Model 5 (Tab 3 p 301)	Model 3a	Model 5a	Model 3b	Model 5b	Model 3c	Model 5c
Index of tracking	0.03**	0.39**	0.02	0.39*	0.03*	0.39*	0.02	0.42*
	(0.01)	(0.15)	(0.01)	(0.16)	(0.01)	(0.16)	(0.01)	(0.17)
Vocational enrollment	0.00	-0.04	0.01	-0.07	0.00	-0.05	-0.02	0.03
	(0.02)	(0.17)	(0.02)	(0.19)	(0.02)	(0.18)	(0.02)	(0.25)
Vocational specificity	0.00	-0.01	0.00	-0.01	0.00	-0.01	0.00	-0.01
	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)
Educational expansion							-0.01*	0.02
							(0.00)	(0.03)
Constant	0.38***	3.05***	0.42***	2.94***	0.40***	3.01***	0.51***	2.66***
	(0.02)	(0.15)	(0.02)	(0.15)	(0.02)	(0.15)	(0.05)	(0.50)
N	23	23	23	23	23	23	23	23
R^2	0.19	0.28	0.11	0.27	0.14	0.27	0.30	0.29

*Standard errors in parentheses, * p < 0.05. ** p < 0.01. *** p < 0.001*
Notes: WLS stands for Weighted Least Squares; FGLS for Feasible Generalized Least Squares; OE for the link between social background and educational attainment and ED for the link between educational and occupational attainment.
Source: Author's analyses of the data reported in Table 2 page 299, Table B1 Appendix B, and table C1 Appendix C and Barro and Lee (2013).

Educational expansion is measured by the percentage of people having a tertiary degree among the population aged 25 and older. The data are collected by Barro and Lee (2013) and to be consistent with the other country-level indicators that refer to the beginning of XXI century, the indicator employed in the analyses refers to 2005.

Once the model specifications include this additional country-level variable, the positive association between the index of tracking and the OE link turns insignificant (model 3c) while the ED link association remains statistically significant (model 5c). By comparing model 3b and 3c we can conclude that the coefficient of the index of tracking in model 3b is capturing the negative effect exerted by educational expansion on the OE

link which in model 3b is unobserved (the coefficient of the index of tracking is positive because it is negatively associated with educational expansion).

2.6 Conclusions

In this chapter, I conducted three types of replication: verifiability, generalization, and robustness (Freese and Peterson, 2017). The verifiability replication failed to reproduce the original results as reported by Bol and Van de Werfhorst (2013) for what concerns the OE link. This means that the strength of the association between social background and educational attainment does not vary according to the index of tracking.

To investigate finding generalizability, I employed a different estimator whose results suggest that the index of tracking is statistically associated with both OE and ED links. However, these findings are affected by omitted variable bias as Bol and Van de Werfhorst's (2013) model specifications miss to condition on educational expansion. When this confounder is included in the estimation, the results confirm the findings obtained in the verifiable replication.

These kinds of replication show that the trade-off between equality of educational opportunity and labor market allocation seems not to be in place when the stratification of education systems is measured by the index of tracking. This conclusion is, however, entirely due to the lack of a statistically significant association between the index of tracking and the OE link.

Chapter 3 (Article 2) The stratification of education systems and social background inequality of educational opportunity

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Abstract

This article aims to identify the moderating effect of two dimensions of the stratification of education systems (the extent to which the first selection is based on students' ability and the age of first selection) on social background gradient in educational attainment. Individual-level data of the European Social Survey (round 1 to 9) is complemented with new contextual indicators measuring various education systems' characteristics. This article's contribution to the debate is twofold. First, it investigates both dimensions of the stratification of education systems that so far have never been analyzed together in cross-country studies investigating long-term educational outcomes. Second, it provides a series of indicators of education systems' characteristics collected by means of an online expert survey whose validity and reliability is also tested. Findings show that the two dimensions of the stratification of education systems have opposite effects. As the first selection is increasingly based on students' ability, social background gradient in educational attainment increases. In contrast, postponing the age of first selection decreases social inequality in educational opportunity.

3.1 Introduction

In recent decades, there were several comparative studies on the effect of social background on educational attainment (e.g., Blossfeld et al., 2016). In trying to address differences in social inequality, scholars mainly focused their attention on the level of stratification of education systems or tracking (Bol and Van de Werfhorst, 2013; Brunello and Checchi, 2007; Hadjar and Gross, 2016) – that is, the simultaneous availability of more than one educational path during students' educational career. Since each specific path conveys a different curriculum, opening up a different set of subsequent options, the social selectivity involved, as well as the consequences in terms of educational attainment, increasingly attracted scholars' attention. Following this tradition, the research question of this paper is: does the stratification of education systems affect social background inequality in educational attainment? Stated differently, this article investigates whether the stratification of education systems moderates the strength of the association between social background and education.

So far, comparative analyses predominantly investigated the age of the first selection as the only dimension linking the stratification of education systems to individuals' outcomes (Braga et al., 2013; Brunello and Checchi, 2007; Heisig et al., 2020; Van de Werfhorst, 2019; Vogtenhuber, 2018). Along with the timing of the first selection, this article empirically measures another dimension of stratification of education systems namely, the extent to which the first selection is based on students' ability. This dimension is important if we consider its direct consequence: the more students' ability matters during the selection, the more students attending the same track or the same curriculum within school have homogeneous skill levels when they start their differentiated educational paths. This, in turn, has tremendous consequences for the explanation of inequalities in students' learning opportunities (Bos and Scharenberg

2010; Gröhlich, Scharenberg and Bos, 2009; Köller et al. 2013; Neumann et al., 2007; Opdenakker and Van Damme, 2001; Schiepe-Tiska et al. 2017). Peers' achievement composition not only significantly contributes to their subsequent achievement but its effects on students' outcomes are far more significant than instructional quality – although they are associated with each other (De Fraine et al., 2003; Scharenberg, 2014; Traini, Kleinert and Bittmann, 2021). Risking over-simplification, the main findings here show that scholastic achievement tends to improve when pupils attend schools with high-ability classmates. Accordingly, studying the consequences of ability-based selection processes on social background inequality appears quite relevant.

To identify the moderating effect of the stratification of education systems, this paper provides new empirical measures that are directly collected by means of an online expert survey questioning more than 200 experts in 34 countries. Specifically, stratification of education systems is measured by means of two dimensions: the timing and the extent to which the first selection is based on students' ability. Both dimensions have yet to be considered in a comparative analysis on educational attainment.

The research question is investigated using microdata from round 1 to 9 of the European Social Survey (ESS), integrated with new country-level indicators on education systems. Methodologically, this paper implements a linear random effect model that accounts for the complex data structure. Finally, this paper examines the robustness of the results across different model specifications, sample selections, and indicators of education system characteristics.

3.2 Theoretical framework

To reflect the two dimensions of the stratification of education systems, this section is divided into two subsections. The first is dedicated to the extent to which the

first selection is based on students' ability while the second focuses on the timing of the first selection.

When examining the effects of ability-based first selection on the association between social background and educational attainment, Boudon's (1974) distinction between primary and secondary effects comes to the fore. The former corresponds to the effects exerted by social background on pupils' average levels of (demonstrated) ability while the latter refers to social background differences in choice behavior that influence young people's choices net of achievement (Goldthorpe, 2007; Hauser, 2010).

Since the two components are considered as additive, we could expect that when scholastic performances drive the selection into tracks, the total effect of social background is entirely due to primary effects (Erikson and Jonsson, 1996; Esser, 2016; Jackson and Jonsson, 2013). In other words, the total effect of social background echoes social background differentials in pre-sorting achievement. In such a context, parents' leeway to affect the allocation process on top of social background differences in achievement is restricted (Contini and Scagni, 2011; Dollmann, 2016; Esser, 2016; Jackson and Jonsson, 2013). Put differently,

$$\text{Total effect of social background} = \text{primary effects} + (\text{secondary effects} * \alpha)$$

When the selection is entirely based on students' ability (i.e., when $\alpha = 0$), the above formula is equal to primary effects. In contrast, when the allocation also relies on teacher recommendations (the so-called tertiary effects[15] (see Esser, 2016)) and/or parental preferences to compute the total effect of social background on educational outcomes, the role played by secondary effects has also to be taken into account

[15] Following Esser (2016), tertiary effects are grouped together with secondary effects.

(Dollmann, 2016; Jackson and Jonsson, 2013). Since all these components (primary and secondary effects) go in the same direction of broadening the gap between higher and lower social background groups, by adding them, the total effect of social background on educational attainment would be higher than in systems selecting only on students' ability. Accordingly, the first hypothesis (H3.1) is that ability-based first selection tends to have a negative moderating effect on the social background gradient in educational attainment. In other words, with H3.1 I expect that the more the first selection is based on students' ability the less educational attainment depends on social background.

Turning to the effect of the age of first selection on the social background inequality of educational opportunity, several theories stand out. The most prominent is the life course hypothesis (Blossfeld and Shavit, 1993; Müller and Karle, 1993). This theory argues that one's social background has a greater effect on one's educational success at a younger age and that the size of this effect decreases with age. Put differently, younger students are more dependent on their parents' resources than older students. In an attempt to identify the reasons why we observe this decreasing effect as students grow older, we can draw from the rational action theory (Boudon, 1974; Breen and Goldthorpe, 1997; Breen, Van de Werfhorst and Jæger, 2014; Gambetta, 1987). Accordingly, children and their parents choose, and subsequently act, after evaluating costs, benefits, and success probabilities of various (educational) alternatives. In the case of performance uncertainty, however, it is difficult for the actors involved to form their expectations of success (Berger and Combet, 2017). This happens when parents do not have enough information about their children's cognitive resources. In turn, this situation manifests when the first selection occurs early.

Nevertheless, regardless of the timing of the first selection, evidence shows that students from higher social backgrounds are overrepresented in the academic track

(Blossfeld and Shavit, 1993; Dupriez et al., 2012). This phenomenon is noted by Berger and Combet (2017) whose explanation reports that performance uncertainty matters more for the disadvantaged than the better-off families. Why is this the case? Why are lower social background families more concerned with their children's level of academic performance than their counterparts? A first explanation claims that, in order for parents from lower social backgrounds to send their offspring to the academic track, they require evidence of their children's general academic abilities, as they generally underestimate their children's academic abilities (Erikson, 2013). Such evidence, gathered for example through school grades, grows as students spend more time in school. A second argument points to parents' lack of strategic knowledge and understanding of what is needed to succeed (Lareau, 2011; Lucas, 2001; Pfeffer, 2008). Parents from lower social backgrounds are accustomed neither to helping their children navigate through the system, nor to providing qualified help when needed (Erikson and Jonsson, 1996; Lareau, 2011; Lucas, 2001). A third explanation focuses on social demotion (Breen and Goldthorpe, 1997; Breen, Van de Werfhorst and Jæger, 2014). To obtain the same educational titles as their parents, students from higher social backgrounds need to climb the educational ladder to the top. This is an additional reason why better-off families are more likely to put less emphasis on their offspring's scholastic performance. Regardless of their academic ability, students need to enter the academic track to fulfil intergenerational reproduction. In contrast, given the lower educational qualification of their parents, students from lower social background can be less ambitious while avoiding social demotion than their higher social background counterparts.

Considering all these arguments, the second hypothesis (H3.2) expects that age of first selection tends to have a negative moderating effect on the social background gradient in educational attainment. In other words, with the second hypothesis, I expect

the strength of the association between social background and educational attainment to be negatively affected by the timing of the first selection.

3.3 Previous findings

To properly review the previous literature that examined the effect of the stratification of education systems on inequality of educational opportunity, I first present the strand of research dealing with the effect of ability-based first selection; the rest of this section is dedicated to the age of first selection.

Three comparative studies investigated the effects of ability-based selection on social background achievement inequality exploiting PISA data. Using the school intra-class correlation coefficient as an indicator of selectivity, Marks (2005) finds that selective systems show lower levels of social background inequality than less selective systems. In contrast, Horn (2009) provides evidence that the extent to which students' previous scholastic performance is considered in admitting students to schools does not affect social background gradient in competence acquisition. In a robustness check, the remaining study shows that the positive effect of the number of tracks available to 15 year-olds on equality of performances is amplified when schools select their students based on their previous scholastic performances (Korthals, 2012).

The effect of ability-based selection on educational transitions is investigated in Jackson and Jonsson's (2013) meta-analysis of seven European countries and the United States. They show that the size of secondary effects is larger in less selective systems (England and the United States) while it is smaller in highly selective systems (Germany and the Netherlands). However, they did not find the same pattern in the remaining three countries (Denmark, Italy, and Sweden). While assessing the subsequent educational transition – accessing tertiary education – the authors do not find any associations between selectivity and magnitude of secondary effects.

Besides comparative research, contrasting findings also emerge in within-country studies based on Germany. Dollmann (2016) shows that institutional settings that reduce parents' room to overrule teacher recommendations diminish social inequalities in the transition from primary to secondary education while Roth and Siegert (2016) find the opposite.

Considering the effect of age of first selection on educational attainment, comparative studies find that early tracking amplifies social background inequality of educational opportunity (Braga et al., 2013; Brunello and Checchi, 2007; Heisig et al., 2020; Österman, 2018; Van de Werfhorst, 2019). Only one article shows a positive, though not statistically significant, effect (Vogtenhuber, 2018). Among the studies that employ the index of tracking[16], two of them confirm the negative effect of tracking (Bol and Van de Werfhorst, 2013; Reichelt, Collischon and Eberl, 2019) while Ballarino et al.'s (2016) findings show no moderating effect of tracking on social background gradient in educational attainment. Finally, classifying countries into clusters based on several theoretical considerations, two other studies reach the same conclusions as the majority of the previous studies: in stratified education systems, social background inequality of educational opportunity is higher than in weakly stratified systems (Hadjar and Becker, 2016; Pfeffer, 2008).

National studies reach the same conclusion. Focusing on one federal state which anticipated the age of first selection, Sulzmaier (2020) illustrates that earlier tracking increases intergenerational transmission of education. Another German study, exploiting the variation between federal states, concludes that later tracking decreases social inequality in educational attainment for men (Lange and von Werder, 2017). With a

[16] The index of tracking is based on three sub-indicators: the age of first selection, the length of primary and secondary education that is tracked, and the number of tracks available for 15-year-old students.

similar analytical strategy, Bauer and Riphahn (2006) show that postponing the age of first selection increases educational mobility in Switzerland.

In sum, previous evidence regarding the timing of the first selection is vast and mostly points to the same conclusion: early tracking amplifies social background inequality of educational opportunity. In contrast, the effect of ability-based selection on short-term effects (competence acquisition in upper secondary education or transition probability) yields contrasting results. Furthermore, this review underlines that comparative research has not yet investigated the simultaneous effects of these two dimensions of stratification of education systems on educational attainment.

3.4 Data

Data comes from the European Social Survey. Since 2002, this survey has collected data on about 36 countries every two years, with each edition of the survey referred to as a "round." The population consists of individuals aged 15 and older living in private households. Data is drawn from random probability samples within each country and round.

The analyses in this paper rely on rounds 1 to 9. The cumulative dataset covering the first 8 rounds is integrated with the dataset of the last survey (ESS 2018a; 2018b). Note that although each round is associated to a specific year, the actual interviews are not always carried out within that specific year. For example, in the current analytical sample, 76 respondents belonging to the 9th round (associated with 2018) concluded their interviews in 2019 and 2020.

3.4.1 Sample selection

The sample is restricted to individuals who had turned 25 and left the education and training system and thus completed their education at the time of the survey.

Table 3.1 Number of cases by country

Country		*Observations*
Austria	AT	1516
Belgium	BE	2219
Bulgaria	BG	1304
Croatia	HR	999
Cyprus	CY	634
Czech Republic	CZ	3685
Denmark	DK	1200
Estonia	EE	2904
Finland	FI	1931
France	FR	2436
Germany	DE	3133
Greece	GR	533
Hungary	HU	2368
Iceland	IS	431
Ireland	IE	2499
Israel	IL	2255
Italy	IT	1381
Latvia	LV	179
Lithuania	LT	2033
Luxembourg	LU	159
Netherlands	NL	2393
Norway	NO	2150
Poland	PL	3265
Portugal	PT	1736
Russia	RU	2697
Slovakia	SK	1789
Slovenia	SI	2002
Spain	ES	3322
Sweden	SE	1464
Switzerland	CH	1835
Ukraine	UA	1202
United Kingdom	UK	1772
Total		*59,066*

Source: ESS pooled dataset (2002-2018).

To integrate this data with the information on education systems' characteristics from an expert survey, I further select respondents born between 1973 and 1995. Since the experts assessed how education systems were organized between 1980 and 2000, the respondents exposed to that specific arrangement were born between 1973 and 1995. Additionally, to exclude the respondents who attained their educational qualification in another country, the sample ignores first-generation migrants.

Table 3.2 Univariate descriptive statistics for individual-level variables

Variables	*%*	*%*
Parental education		
Less than lower secondary education (ISCED 0-I)	10.96	11.27
Lower secondary education (ISCED II)	14.65	15.19
Upper secondary education (ISCED III)	36.93	38.45
Post-secondary non-tertiary education (ISCED IV)	11.81	12.36
Tertiary education (ISCED V-VI)	21.75	22.74
Missing	3.90	
Sex		
Male	47.32	47.40
Female	52.59	52.60
Missing	0.10	
ESS round		
2002	2.59	2.52
2004	4.21	4.19
2006	5.11	5.13
2008	8.42	8.61
2010	14.64	14.79
2012	16.56	16.72
2014	13.66	13.09
2016	17.55	17.60
2018	17.28	17.35
Birth year		
1973	7.55	7.70
1974	7.61	7.70
1975	7.69	7.79
1976	7.49	7.59
1977	7.26	7.33
1978	6.83	6.98
1979	6.69	6.79
1980	6.68	6.72
1981	5.85	5.95
1982	5.36	5.44
1983	4.98	5.04
1984	4.60	4.67
1985	4.29	4.35
1986	3.95	3.94
1987	3.16	3.16
1988	2.66	2.68

Table 3.2 Continued

Variables	*%*	*%*
1988	2.66	2.68
1989	2.04	2.07
1990	1.50	1.51
1991	1.10	1.12
1992	0.85	0.87
1993	0.45	0.46
1994	0.13	0.12
1995	0.01	0.01
Missing	1.26	
	Mean	*SD*
DV: Respondent's years of education	13.56	2.85

Source: ESS pooled dataset (2002-2018).

Missing values are dealt with via listwise deletion, and the analytical sample amounts to 59,066 individuals in 32 countries (see Table 3.1). To make sure that the complete case sample is not biased, Table 3.2 reports the univariate distributions of each variable with and without missing values.

3.5 Variables

Respondents' educational attainment is measured via years of education. However, instead of using the information already included in the cumulative dataset, I derived years of education from the most detailed variable available for all rounds of the ESS.[17] To avoid analyzing a categorical dependent variable, I translated the educational variable distinguishing among seven categories into a continuous variable reporting the equivalent years of education. The categorical variable has seven categories: 1) Less than lower secondary (European Survey version of International Standard Classification of Education (ES-ISCED) I); 2) Lower secondary (ES-ISCED II); 3) Lower tier upper

[17] The name of the categorical variable used for this purpose is "eisced."

secondary (ES-ISCED IIIa); 4) Upper tier upper secondary (ES-ISCED IIIb); 5) Advanced vocational (ES-ISCED IV); 6) Lower tertiary education (ES-ISCED V1); 7) Higher tertiary education (ES-ISCED V2). To convert these categories into years of education, I follow the guidelines reported in the ISCED mapping materials (UNESCO, 2011), and the OECD manuals (OECD, 1999). When this was not possible, I consulted the national education variables available in the dataset. The disadvantage of using this dependent variable is that all the countries in the first rounds that measured educational attainment differently had to be excluded. This is the case for Austria, Bulgaria, Cyprus, Finland, France, Greece, Ireland, Italy, Portugal, Sweden, Ukraine and the UK. To account for this potential measurement error, sensitivity analyses omitting rounds 1 to 4 were carried out. The findings of these checks, available upon request, yield similar results.

Social background measures the highest educational degree achieved within the couple.[18] To retain as many observations as possible, I used the dominance approach (Erikson and Goldthorpe, 1992). Parental education has the following categories: 1) Less than lower secondary education (ISCED 1); 2) Lower secondary degree (ISCED 2); 3) Upper secondary degree (ISCED 3); 4) Post-secondary non-tertiary degree (ISCED 4); 5) Tertiary degree (ISCED 5-6).

Other controls at the individual level are ESS rounds, year of birth and sex. Additional analyses, available upon request, show that the results are not affected by the introduction of additional micro-level controls like a dummy for second-generation migrants and parental occupational class. In the latter case, I run three different sensitivity checks. First, I select only those respondents with non-missing values on parental

[18] The names of the categorical variables referring to father's education are "edulvlfa" and "edulvlfb." Since the former is only asked in the first four rounds and presents less categories than the latter, the latter is recoded as the former. The same applies to the nominal variables for mother's education ("edulvlma" and "edulvlmb").

education and occupation and employed the same model specification. Second, I include parental occupation as control. Third, I include an interaction between the macro-level variables and parental occupation. In all three cases, the main results, available upon request, hold. For these analyses, I measure parental social class with the highest occupation held within the couple and only differentiate among three categories as the classification used by the ESS has changed across rounds.

3.5.1 Macro-level indicators

The country-level indicators comprise four variables: two indicators measuring the stratification of education systems (the extent to which the first selection is based on students' ability and age of first selection) and two confounders of the association between stratification of education systems and social background gradient in educational attainment (the linkages between education and labor market and educational expansion).

The first three indicators come from an expert survey carried out in 2016. The experts who took part are scholars and practitioners (such as school principals and staff of the ministries of education) who were selected through academic networks, reading of scholarly publications, and internet searches to identify members of scientific associations or research institutions. To boost the number of participants, respondents were able to suggest other potential contributors. The completion rate is 27%, which in absolute terms translates into 206 completed questionnaires on 34 OECD countries. For each nation, at least 3 experts participated (see Table 3.5 in the supplementary material). To synthesize this information into one single country indicator, indexes of central tendency were computed (mode for the timing of the first selection and mean for the others). Apart from the age of first selection, the other questions asked participants to rate the provided statement on a continuum going from "not at all" (later identified as 0)

to “completely” (identified as 100). To correct for individual differences in the use of response scales, each respondent’s value was centered on his/her average response before computing the within country mean. This correction was performed on all the valid responses to the questions with this same format (max of 13 questions).

To make sure that the experts recognized the comparative aim of the survey, the first questions aimed at rating their educational system compared to those in Germany and the USA. The introductory page explaining this task recorded the highest number of dropouts: 94%. In light of the validity tests reported in the supplementary material and the replication checks, this can be seen as a signal that only the invited experts with a fair knowledge of both their country’s education system and its standing in international comparison participated in the survey.

The experts were asked to reply to the questionnaire by conveying what the education system looked like in the period between 1980 and 2000. To account for changes over time, the questionnaire inquired about major educational reforms. In the case of positive responses, experts had to provide information on each reform, specifying how the system was structured before and after the implementation of each reform. Within each country, experts agreed on reforms only for the timing of the first selection.

In the following, I report the wording of the online questionnaire while the results of the reliability and validity tests are discussed in the supplementary material (see Tables 3.5 and 3.6. Note that Table 3.5 also includes the country values of the indicators). The actual questionnaire is reported in appendix A.

To measure how early the first selection took place, I employ the age at which the first selection occurs. In the questionnaire, after providing the following definition: “with first selection we refer to the allocation of students into different school types or different curricula within school. Such differentiation can be based on either student’s

scholastic abilities or personal preferences and it lasts for all the school day and all the subjects," experts had to reply to this question "at which age did the first selection occur?". As depicted in Table 3.5 in the supplementary material, age of first selection was reformed around the 1990s in Belgium, Hungary, Czech Republic, Latvia, and Spain and 1994 in France. Because of the low number of cases in the post-reform groups, these respondents are excluded from the analyses. Sensitivity checks confirm that if the post-reform groups are included in the analytical sample, results hold.

To collect information on the extent to which the first allocation is associated with student's ability, the question in the expert survey stated: "to what extent was the first selection associated with student's scholastic abilities?"

One of the two confounders at the country level accounts for firms' involvement in school-based vocational schools and dual-system institutions (Blossfeld, 1992). The two questions in the questionnaire asked the extent to which private industries are involved in the design of a) school-based vocational curricula, b) dual systems. Since there is no reason to consider one dimension more relevant than the other, the final indicator is computed as the simple average between firm involvement in school-based and dual systems. The analyses were replicated using the two components separately and these findings are consistent with those discussed in the results section.

The other macro-level confounder is educational expansion. Every five years, Barro and Lee (2013) recorded the percentage of people educated to tertiary level among the population aged over 24. To each respondent in the analytical sample, I assign the value of educational expansion which conveys the percentage of people with tertiary-level education when the respondent was 10 years old.

Table 3.3 reports the correlations between the four institutional variables. All the values are quite low, confirming that the indicators measure different aspects of the educational system and can be analyzed simultaneously.

Table 3.3 Pairwise correlations between country-level variables

	(1)	(2)	(3)
Ability-based first selection (1)			
Age of first selection (2)	0.10*		
Linkages between education and labor market (3)	-0.02*	-0.22*	
Educational expansion	0.19*	0.25*	-0.13*

** $p < 0.05$.*
Source: Barro and Lee (2013) and expert survey.

3.6 Method

Since the respondents in the ESS pooled data are nested within 9 rounds and 32 countries, following the suggestions of Schmidt-Catran and Fairbrother (2016), I run a linear random slope model with three levels. Respondents are in the first level, the 182 combinations between country and round constitute the second level and the 32 countries and the 9 ESS rounds comprise the third level. Since not all the countries participated in every round, the model treats the 182 combinations of country and round as cross-classified within the 32 countries and 9 ESS rounds whereas respondents are hierarchically nested in the 182 combinations of country and round.

Considering that the focus of this paper is the moderating effect of stratification of education systems (which vary at the country level) on an individual-level association between social background and educational attainment, the model specification includes a random slope at the third level for parental education (Heisig et al., 2017) along with cross-level interactions between parental education and the indicators of stratification of education systems (Heisig and Schaeffer, 2019).

These interaction effects may however be biased because the stratification of education systems is correlated with country-level variables that also influence the effect of social background on educational attainment: namely, linkages between education and labor market and educational expansion (Becker and Hadjar, 2016). To obtain unbiased interaction effects, I also introduce cross-level interactions between these country-level confounders and parental education (Giesselmann and Schmidt-Catran, 2018). The complete model specification is reported below.

$$y_{ijk} = \beta_{0jk} + \beta_{1k}\ PEDUC_{ijk} + \beta_2\ ABILITY\text{-}BASED_k + \beta_3\ (PEDUC_{ijk} * ABILITY\text{-}BASED_k) + \beta_4\ AGE_k + \beta_5\ (PEDUC_{ijk} * AGE_k) + \beta_6\ LINKAGES_k + \beta_7\ (PEDUC_{ijk} * LINKAGES_k) + \beta_8\ Expansion + \beta_9\ (PEDUC_{ijk} * EXPANSION_k) + \beta_{10}\ Sex_{ijk} + \beta_{11}\ Birthyear_{ijk} + \beta_{12}\ Round_{ijk} + Z_{ijk}u_{ijk} + Z_{ijk}u_{jk} + e_{ijk}$$

The equation estimates years of education y_{ijk} of individual $_i$ in combination country*round $_j$ in country and round $_k$ to be a function of sex, year of birth, parental education (β_1), the institutional variables of interest (β_2, β_4, β_6, β_8) and their cross-level interactions with parental education (β_3, β_5, β_7, β_9). To get rid of any additional difference among ESS rounds, the equation also contains eight dummies.

3.7 Results

Table 3.4 in appendix reports the results of the linear random effect model. Unsurprisingly, parental education is strongly associated with children's educational attainment. Advantages are particularly visible among respondents born to tertiary-educated parents, but the other categories also display higher years of attained education than individuals born to poorly educated parents.

Holding constant the effect of age of first selection and the other institutional confounders, the interaction terms between parental education and ability-based first selection show that there is a positive moderating effect for the highly educated backgrounds. This means that for these families, years of education become more dependent on parental education as the first selection is increasingly based on students' ability. Put differently, the positive main effect of coming from a family with tertiary-educated parents (relative to lower educated parents) is 6.3. This effect refers to an educational system whose ability-based selection (and the other institutional level confounders) is at its minimum. On top of this, the advantage of coming from a tertiary-educated background is amplified as attained years of education increases by 0.02 for every unit increase in ability-based first selection (in the current sample, the latter ranges from 41-Cyprus- to 89-Bulgaria).

Considering the other dimension of stratification, age of first selection, Table 3.4 reported in the appendix shows that the interactions with parental education are all significantly different from the reference category and their coefficients are negative. This means that as the age of first selection increases, social background gradient in educational attainment decreases.

To facilitate the interpretation of the cross-level interactions, Figures 3.1 and 3.2 show the predicted years of education by means of marginal effects plots. These graphs illustrate the predicted outcome (on the vertical axis) by parental education (the different lines) as the two dimensions of stratification increase (on the horizontal axis). Figure 3.1 shows that ability-based first selection does not impact the attained years of education of individuals born to middle educated parents. Regardless of the extent to which the education system selects based upon students' ability, the attained years of education are 13. In contrast, ability-based first selection is associated with all the other categories,

although in opposite ways. It is negatively related to middle-low and poorly educated families. For individuals coming from these backgrounds, changing from a system that does not select its students upon their ability to a system that does translates into one year less in educational attainment. The advantage gained by respondents stemming from middle-high and highly educated families is of the same magnitude but in the opposite direction. To further illustrate the effect of ability-based first selection for different background groups, I carry out additional analyses by parental education (analyses available upon request). I distinguish among three groups: up to lower secondary degree, upper secondary, and at least post-secondary degree. The OLS models with clustered country*round standard errors show that the effect of ability-based first selection is negative and not statistically significant for the offspring of lower educated parents and null for those of middle educated parents. On the contrary, respondents of highly educated parents show a positive and statistically significant effect of 0.02 school year for every unit increment in ability-based first selection.

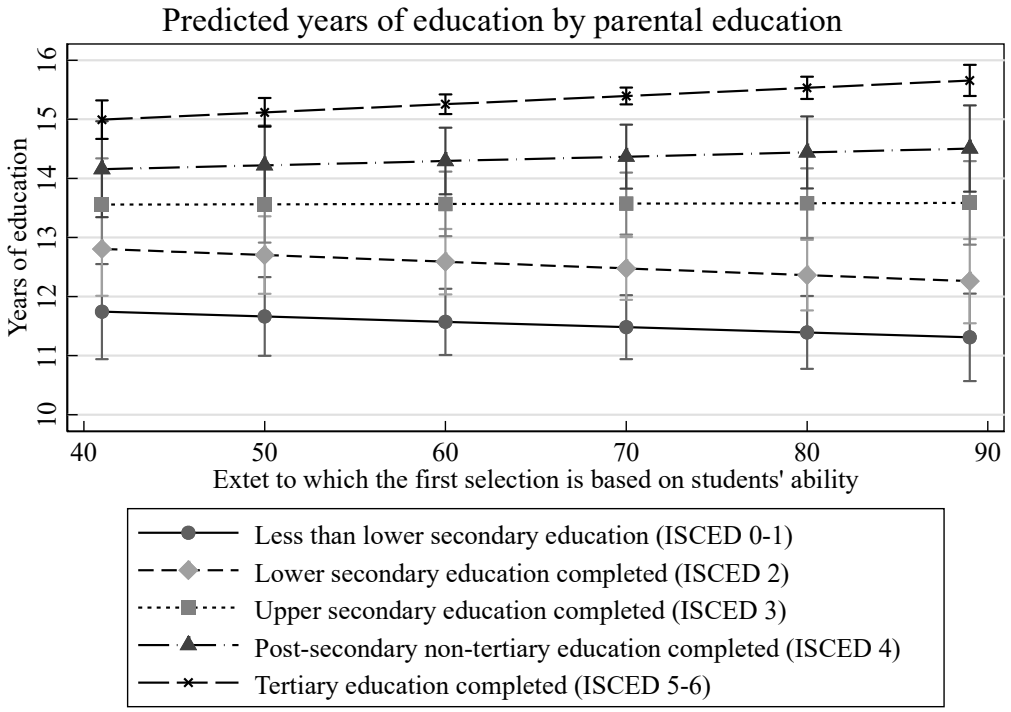

Figure 3.1: Predicted educational attainment by social background at different ability-based first selection levels

Source: ESS pooled dataset round 1 (2002) to 9 (2018) and expert survey.

Figure 3.2 shows the effect of age of first selection on the association between parental education and educational attainment. With differing degrees, age of first selection reduces the effect of parental education on years of education. The figure also shows that the reduction is especially strong among the children of poorly educated parents. Here the increment between weakly and strongly selective education systems is 2 school years.

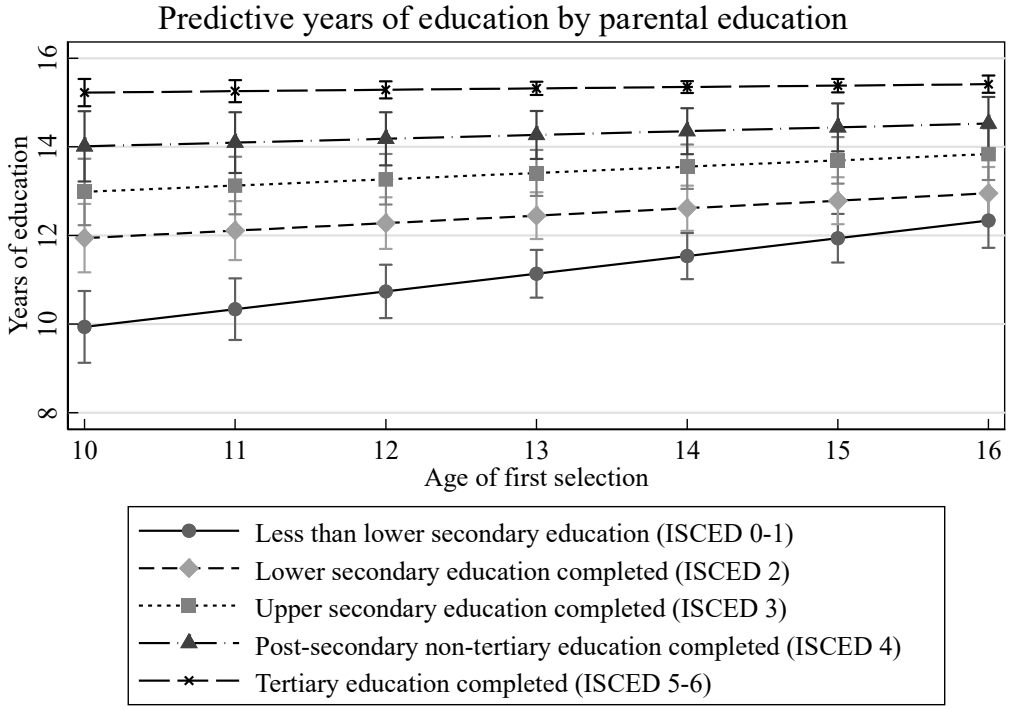

Figure 3.2: Predicted educational attainment by social background at different ages of first selection

Source: ESS pooled dataset round 1 (2002) to 9 (2018) and expert survey.

To gauge how robust these findings are, the analyses are replicated with different model specifications (results are all available upon request). To test whether the effect of ability-based first selection on social inequality in educational attainment depends on the timing of the first selection, I include a three way interaction between parental education, ability-based and timing of the first selection to the basic model. The three way interaction, as well as the two-way interaction between ability-based and timing of the first selection, is not statistically significant. I also include parental occupation (and its interactions with the macro-level variables) to check whether these additional model specifications would yield different results. Findings are robust.

The second series of robustness checks involves the indicators of the expert survey. Specifically, I replace the indicators collected by the expert survey with indicators used in previous studies. As for the age of first selection, I employ the measure

collected by Brunello and Chechi (2007). For more information on this indicator, see the supplementary material. Results are in line with the ones discussed previously. To substitute the extent to which the first selection is based on students' ability, I employ an indicator coming from PISA (see the supplementary material). Since in six countries the first selection takes place later than in grade 10 (when PISA is carried out), I exclude these countries from this test (i.e., Denmark, Finland, Ireland, Norway, Russia, and Sweden). The findings show that the PISA indicator produces similar results with slightly stronger negative moderating effects than the indicator collected by the expert survey. Considering that the PISA measure is collected from school principals who provide information on the selection procedure applied in their schools, this alternative indicator may suffer from measurement error, especially in decentralized systems. Nevertheless, since this robustness check yields bigger moderating effects than the ones found using expert judgement, there are no reasons to believe that the indicators of the expert survey are neither valid nor reliable.

The results discussed in this paper show that the two dimensions of the stratification of education systems (ability-based selection and timing of the first selection) moderate the association between social background and educational attainment. However, these moderating effects may, in turn, be affected by an egalitarian political ideology (Van de Werfhorst, 2019). In the third sensitivity check, I add to the model specification a measure of the ideological orientation of policy makers as well as its interaction with parental education. The indicator comes from the ParlGov database (see Döring and Manow, 2019). Results of this third robustness check do not vary from those discussed earlier.

3.8 Conclusions

Using data from the ESS round 1 to 9 on 32 countries, integrated with macro data from other sources, this analysis shows that the positive effect of social background on achieved characteristics varies with the stratification of education systems. These findings are robust to alternative model specifications and measurements. Confirming earlier studies (Brunello and Checchi, 2007; Braga et al., 2013; Heisig et al., 2020; Van de Werfhorst, 2019), current results show that the later the first selection takes place, the weaker the effect of social background is on educational attainment. Specifically, the strongest impact is the improvement of lower educated families. The hypothesis 3.2 thus finds support.

In contrast, as students' ability becomes more important in the selection process, educational attainment becomes more dependent on social background. This is especially the case for highly educated families. Since the hypothesis 3.1 expects lower social background inequality in educational opportunity the more the first selection is based on students' ability, I reject H3.1.

These findings suggest that, even in the presence of reforms limiting access to certain educational paths, families from higher social backgrounds find alternative ways to maintain and pass on their advantages to their offspring (Lucas, 2001). It may be possible that, in ability-based education systems, parents from high social backgrounds anticipate their children's potential risk of failure and decide to invest more in their early achievement (Roth and Siegert, 2016). Other ways to boost their offspring's academic performance may include buying houses in residential areas with good quality schools, sending their children to a private teacher, having private testing carried out (Card and Giuliano, 2015), switching to a private school (Hirschman, 1970), and influencing the

advice students receive during the orientation process (Barg, 2013; Rosenbaum et al., 1996; Useem, 1991, 1992; Yonezawa, 2000).

Although more research needs to be carried out to directly test the above mentioned micro-level mechanisms, this study suggests that high social background parents actively react to institutional reforms that theoretically should decrease the effect of ascriptive traits on educational outcomes. Using Goldthorpe's (2007, p. 171) words: "it is then in these ways that children of more advantaged class backgrounds are given a clear competitive edge in seemingly meritocratic selection processes or, as Halsey puts it (1977: p. 184) that "ascriptive forces find ways of expressing themselves as achievement." This positive moderating effect of ability-based first selection among privileged backgrounds provides indirect support for the latest reading of Boudon (1988), investigated by Bernardi (2012), that primary effects can be compensated for by secondary effects.

In line with the theory of compensatory advantage (Bernardi, 2014), this finding shows that this compensation occurs only among higher social backgrounds families. The previous literature suggests two reasons in support of this pattern. First, parents from privileged backgrounds are more likely to modify their investment in their children's education due to social demotion avoidance (Boudon, 1974, 1988; Breen and Goldthorpe, 1997; Lucas, 2001). Second, parents from lower social backgrounds tend to delegate their role in children's education to schools or to the children themselves, while families from higher social backgrounds see it as a shared responsibility with schools and teachers (Lareau, 2011).

One limitation of this article (which it shares with all the other comparative studies presented in the literature review) is that the processes of self-selection into tracks cannot be disentangled from the track effects (Esser, 2016). As international datasets do

not contain measurements of ability pre-tracking, for the time being, such a distinction cannot be implemented empirically. However, if we consider the findings of the eduLIFE project, a comparative study that relies on national longitudinal datasets where the possibility to control for ability pre-tracking is fully exploited, we reach the same conclusions (Blossfeld et al., 2016). The concluding article of this international project is entitled: "Advantage 'finds its way': how privileged families exploit opportunities in different systems of secondary education" (Triventi et al., 2020: p. 1). Accordingly, the current findings show that social inequality of educational opportunity is only weakly altered by the stratification of education systems and not completely eliminated. From one side, age of first selection decreases social background gradient in educational attainment, while from the other side, ability-based selection increases it.

As in other cross-national comparative studies, the analyses are based on cross-sectional data making a causal interpretation problematic. Nevertheless, this study illustrates the role of different dimensions of stratification of education systems in shaping social background gradient in educational attainment. The analyses show not only that the age of first selection affects social background gradient in educational attainment, but also that, by considering the extent to which the first selection is based on student ability, the advantage of the higher background group is further amplified. Complementing quantitative studies with macro- and micro-level longitudinal data as well as qualitative studies investigating the actual strategies employed by higher social background parents might both be valuable avenues for future research.

Appendix

Table 3.4 Random slope linear regression model (DV: years of education)

ESS rounds (ref. 1)	
2	0.34
	(0.35)
3	0.28
	(0.35)
4	0.29
	(0.33)
5	0.50
	(0.31)
6	0.77*
	(0.31)
7	0.71*
	(0.32)
8	0.85**
	(0.32)
9	0.92**
	(0.31)
Sex (ref. Male)	
Female	0.48***
	(0.02)
Birth year (ref. 1973)	
1974	-0.07
	(0.05)
1975	-0.03
	(0.05)
1976	0.02
	(0.05)
1977	0.02
	(0.05)
1978	0.03
	(0.05)
1979	-0.02
	(0.05)
1980	0.05
	(0.05)
1981	-0.02
	(0.06)
1982	-0.03
	(0.06)
1983	-0.05
	(0.06)

Table 3.4 Continued

1984	-0.03
	(0.06)
1985	-0.19**
	(0.07)
1986	-0.11
	(0.07)
1987	-0.07
	(0.08)
1988	-0.13
	(0.08)
1989	-0.41***
	(0.09)
1990	-0.23*
	(0.10)
1991	-0.40***
	(0.11)
1992	-0.47***
	(0.12)
1993	-0.45**
	(0.16)
1994	-0.68*
	(0.28)
1995	-0.63
	(1.35)
Parental education (ref. Less than lower secondary education (ISCED 0-I))	
Lower secondary education (ISCED II)	2.99***
	(0.78)
Upper secondary education (ISCED III)	4.24***
	(0.77)
Post-secondary non-tertiary education (ISCED IV)	4.77***
	(0.79)
Tertiary education (ISCED V-VI)	6.27***
	(0.57)
Ability-based first selection	-0.01
	(0.01)
Age of first selection	0.40***
	(0.08)
Linkages between education and labor market	0.06***
	(0.01)
Educational expansion	-0.01
	(0.02)
Lower secondary education*Ability-based first selection	0.00
	(0.01)
Upper secondary education*Ability-based first selection	0.01
	(0.01)

Table 3.4 Continued

Post-secondary non-tertiary education*Ability-based first selection	0.02
	(0.01)
Tertiary education*Ability-based first selection	0.02*
	(0.01)
Lower secondary education*Age of first selection	-0.23*
	(0.10)
Upper secondary education*Age of first selection	-0.26**
	(0.10)
Post-secondary non-tertiary education*Age of first selection	-0.31**
	(0.10)
Tertiary education*Age of first selection	-0.37***
	(0.07)
Lower secondary education*Linkages between education and labor market	-0.04*
	(0.02)
Upper secondary education*Linkages between education and labor market	-0.06***
	(0.02)
Post-secondary non-tertiary education*Linkages between education and labor market	-0.06***
	(0.02)
Tertiary education*Linkages between education and labor market	-0.06***
	(0.01)
Lower secondary education*Educational expansion	-0.00
	(0.02)
Upper secondary education*Educational expansion	-0.01
	(0.02)
Post-secondary non-tertiary education*Educational expansion	0.02
	(0.02)
Tertiary education*Educational expansion	-0.02
	(0.02)
Constant	8.12***
	(0.67)
Variance (2nd level)	0.67***
	(0.08)
Variance (3rd level)	0.43***
	(0.07)
Variance (Residual)	5.39***
	(0.03)
N	59,066
BIC	268981,5

*Standard errors in parentheses, + p < 0.10. * p < 0.05. ** p < 0.01. *** p < 0.001*
Source: ESS pooled dataset (2002-2018), expert survey, and Barro and Lee (2013).

3.9 Supplementary material

Testing the expert survey's reliability and validity

To provide a complete overview of the expert survey data, this section is dedicated to assessing their reliability and validity. Reliability is the degree to which an assessment tool produces stable and consistent results. Because of the structure of the data the meaning attached to reliability varies somewhat from the traditional one. Since I questioned multiple experts on each country, I am interested in assessing the inter-expert agreement within country. The term is defined here as the degree to which different experts of the same country agreed on their answers. Note that inter-expert (or rater) agreement, reliability, and concordance can all be considered synonymous here. Empirically, it is tested by looking at mean standard deviations (Steenbergen and Marks, 2007). By convention, values higher than 1/5 of the theoretical range of variation are considered as problematic (Ray, 1999). To assess how well the indicators measure what they claim to measure, I test their criterion-related validity by looking at the correlation between the indicators collected through the expert survey and an alternative indicator previously used in the field to measure the same construct. The validity of the expert answers holds if the correlation is high and positive.

The macro-level indicators from the expert survey are listed in Table 3.5 together with the results of their reliability test while the results of their validity assessment are reported in Table 3.6.

The timing of first selection

Table 3.5 shows that the mean standard deviation is quite high in Latvia and Lithuania. In the former, on average, experts responded off of the mode by about 4 years while in the latter the discrepancy reaches 6 years. A deeper look into the expert answers reveals that the unreliable standard deviation values are due to one or two experts who

replied with very low values while the remaining experts (respectively 4 in Latvia and 5 in Lithuania) agreed on the median value which constitutes the final indicator.

To mimic a simplified construct validity test, I run correlation analyses between the indicator of the expert survey and similar indicator(s) collected by other scholars or surveys. Table 3.6 shows that the associations between the indicator collected by the expert survey and the indicators of Brunello and Checchi (2007) is 0.5 regardless of the indicator used (the authors collect two indicators, one referring to the mid' 80 and the other to the mid' 90). In both cases, they are measured on 26 countries (Croatia, Cyprus, Estonia, Iceland, Israel, and Lithuania are missing).

The extent to which the first selection is based on students' ability

As shown in Table 3.5, the values of Ireland, Lithuania, and Spain are far from the threshold identified by Ray (1999).

To evaluate convergent validity, I follow Horn (2009) by employing the percentage of how much previous academic records or entrance examinations count to be accepted in schools as reported by its school principals in PISA. To get closer to the cohorts used in these analyses, I employ the indicator from the first PISA survey (2000). Since Croatia, Estonia, Italy, Lithuania, Norway, Portugal, Slovenia, and Slovakia did not participate in PISA 2000, their values in the next available PISA studies are used (PISA 2003 for Norway, Italy, Portugal, and Slovakia; and PISA 2006 for Croatia, Estonia, Lithuania, Slovenia). The correlation coefficient, shown in Table 3.6, amounts to 0.6. The countries excluded from this analysis are Cyprus and Ukraine. The former has never participated in PISA while the latter took part in 2018, which is too late to be used as an indicator for the birth cohorts employed in the main analyses. This PISA indicator captures the extent to which the selection is ability-based in systems where the first selection has already taken place (early tracking countries) along with systems where

it has not yet occurred (like the Scandinavian or the English speaking countries). If I select only the nine countries where the first selection takes place at that age (i.e., Croatia, Estonia, Greece, Iceland, Lithuania, Latvia, Poland, Portugal, and Slovenia) and compute the correlation again, the coefficient reaches 0.7.

In summary, the countries whose reliability and validity are problematic are Ireland, Lithuania, and Spain. I have replicated the multilevel analyses by excluding these three countries and the results are robust.

The linkages between education system and labor market

As depicted in Table 3.5, the average standard deviation of Switzerland appears to be unreliable on the first sub-indicator (the one focusing on school-based vocational schools), while the Czech Republic's, Denmark's, Finland's, Germany's, and Iceland's are challenging on the second sub-indicator. Moreover, Cyprus and Ukraine show high values on both sub-indicators.

To assess the convergent validity of this indicator, I employ the indicator of vocational specificity (Bol and Van de Werfhorst, 2013). Table 3.6 shows that the correlation coefficient is 0.6 (the countries excluded are Bulgaria, Croatia, Cyprus, Estonia, Latvia, Lithuania, Portugal, Russia, Slovenia, and Ukraine).

Two countries have reliability issues on both sub-indicators (Cyprus and Ukraine). After excluding these two countries, robustness checks support the main findings.

Table 3.5 Indicators derived from the expert survey: univariate statistics and mean standard deviations

	# of experts	*Age of first selection*		*Ability-based first selection*		*Linkages between education and labor market*				
		Indicator	*SD*	*Indicator*	*SD*	*Indicator*	*Indicator A*	*Indicator B*	*SD A*	*SD B*
Austria	5	10	0.89	60.07	13.96	49.88	41.94	57.82	15.98	17.27
Belgium	9	14 (1988: 12)	0.67	79.46	17.11	41.96	36.14	47.77	7.39	15.82
Bulgaria	5	14	0.00	89.63	7.36	15.20	19.55	10.86	7.15	0.58
Croatia	5	15	0.00	68.92	20.05	28.97	28.15	29.78	10.23	13.34
Cyprus	6	15	0.45	41.35	18.70	33.85	36.77	30.92	25.78	35.88
Czech Republic	4	14 (1990: 11)	0.58	82.08	14.59	39.42	41.44	37.39	19.56	22.24
Denmark	6	16	0.00	67.07	15.39	49.81	37.98	61.64	16.77	27.14
Estonia	4	15	0.50	83.34	14.34	28.87	31.55	26.18	10.98	9.55
Finland	4	16	0.00	73.63	8.64	39.00	42.85	35.15	11.44	31.08
France	7	13 (1994: 15)	0.63	80.70	9.67	33.73	33.08	34.37	10.89	16.00
Germany	10	10	0.35	61.59	20.73	47.00	41.48	52.52	18.43	23.02
Greece	5	15	0.00	50.43	17.48	24.27	24.35	24.18	14.58	13.59
Hungary	4	14 (1989: 10)	0.00	63.53	7.71	41.88	51.64	32.13	7.02	14.05
Iceland	4	15	0.00	62.04	15.31	48.85	46.20	51.50	18.93	26.95
Ireland	7	16	1.73	55.07	31.23	19.57	21.67	17.47	15.83	11.50
Israel	9	12	1.13	71.38	5.55	21.24	27.54	14.94	11.00	9.30
Italy	5	14	0.00	53.90	7.60	27.34	27.77	26.90	15.44	10.78
Latvia	6	15 (1991: 16)	3.51	68.22	16.96	46.44	50.86	42.01	12.45	13.24
Lithuania	6	15	6.25	52.13	25.21	49.18	66.83	31.52	19.02	12.56
Luxembourg	4	12	0.50	66.71	3.61	49.26	50.60	47.92	17.38	5.86
the Netherlands	7	12	0.00	75.46	8.84	52.20	50.61	56.73	9.18	10.29
Norway	8	16	0.00	61.09	19.71	53.67	50.26	54.14	15.74	15.11
Poland	4	15	0.50	84.28	8.59	30.30	29.36	31.23	4.20	3.95
Portugal	16	15	1.60	51.75	18.32	27.42	29.12	25.71	15.37	16.56
Russia	5	16	4.15	80.15	14.83	40.62	41.26	39.98	15.33	14.41
Slovakia	9	10	2.20	68.48	9.17	36.25	35.97	36.53	11.15	14.16

Table 3.5 Continued

	# of experts	*Age of first selection*		*Ability-based first selection*		*Linkages between education and labor market*				
		Indicator	*SD*	*Indicator*	*SD*	*Indicator*	*Indicator A*	*Indicator B*	*SD A*	*SD B*
Slovenia	8	15	0.00	66.03	20.34	42.57	47.04	38.09	13.73	17.78
Spain	4	14 (1990: 16)	0.00	49.39	35.63	38.09	42.72	33.46	19.54	7.10
Sweden	4	16	0.58	75.36	12.43	38.56	44.70	32.42	7.85	4.89
Switzerland	4	12	0.00	47.00	8.95	67.35	52.78	81.92	34.46	7.88
Ukraine	3	15 (1989: 10)	1.73	78.89	4.81	35.40	36.41	34.40	23.67	22.63
the United Kingdom	8	11	2.14	48.28	14.37	38.03	40.62	35.43	15.29	19.87

Note: A refers to firms involved in the design of school-based curricula, while B to firms' provision of on-the-job training.
Source: expert survey.

Table 3.6 Testing convergent validity: pairwise correlations

	(1)	(2)	(3)
Ability-based selection (PISA 2000, 2003, 2006)	0.55*		
Age of first selection mid-1980 (Brunello and Checchi, 2007)		0.51*	
Age of first selection mid-1990 (Brunello and Checchi, 2007)		0.46*	
Vocational specificity (Bol and Van de Werfhorst, 2013)			0.60*

Note: the number corresponds to the indicators collected through the expert survey. Specifically, (1) stands for ability-based first selection; (2) for age of first selection; and (3) for linkages between education and labor market

** P < .05*

Source: expert survey, Bol and Van de Werfhorst (2013), Brunello and Checchi (2007), and PISA (2000, 2003, and 2006).

Chapter 4 (Article 3) The association between educational and occupational attainment. Does the stratification of education systems really matter?

Abstract

This article's contribution is twofold. First, it provides a theoretical framework to explains the moderating effect of the stratification of education systems on the link between educational and occupational attainment considering a new micro-level risk that the previous micro-level theories have failed to address. It is argued that the criterion guiding the first selection reduces employers' risk of productivity loss strengthening the association between education and occupation. Data of the European Social Survey is complemented with new indicators measuring education system's characteristics. The new indicators have been collected through an online survey questioning more than 200 experts in 34 OECD countries which represents the second contribution of this study. Findings show that the extent to which the first selection is based on students' ability a) positively affects the association between educational and occupational attainment b) mediates the moderating effect of the index of tracking on the link between education and occupation. Sensitivity analyses however proof that these results do not hold when the sample of countries changes. Thus, the empirical evidence does not support the theoretical argument of a positive association between the extent to which the first selection is ability-based and the educational gradient in occupational attainment.

4.1 Introduction

Research on the effect of the stratification of education systems on the association between educational attainment and occupational attainment (hereafter ED link) has been at the core of sociological research for several years (Allmendinger, 1989; Shavit and Müller, 1998; Bol and Van de Werfhorst, 2013; Hadjar and Becker, 2016; Reichelt, Collischon and Eberl, 2019). In different ways, education systems sort students, and in the process, they distribute opportunity and status unequally across groups (Kerckhoff, 1995). The institutional criteria guiding such distributions bear important consequences in determining subsequent life-course events like entering into the labor market and, more in general, life chances (Müller and Gangl, 2003). Because of this interconnection, it is quite relevant to understand in which ways the criteria guiding students' allocation into different schools or curricula may impact individuals' future positions.

As suggested by Gross, Meyer and Hadjar (2016), this vast literature suffers from a major shortcoming. Scholars appear to be still puzzled when it comes to identify how the stratification of education systems affects individuals. Put differently, scholars do not agree on how stratification of education systems affects the way in which education is rewarded in the labor market. From a theoretical standpoint, the most cited explanation of the moderating effect of stratification on the ED link at the micro-level is grounded in the human capital theory. Indeed, scholars claim that the endowment of general versus (occupationally specific) vocational skills affects the transition into the labor market because of the linkage between education system and labor market (Allmendinger, 1989; Müller and Shavit, 1998; Bol and Van de Werfhorst, 2013; Hadjar and Becker, 2016; Reichelt, Collischon and Eberl, 2019). However, the assumptions made by this micro-level theory are compatible with another characteristic of education systems namely, vocational orientation. As shown in the next session, this misunderstanding has

influenced the measurement of stratification of education systems as well as the identification of its moderating effect in empirical research. At the same time, along with the human capital theory, also other theoretical approaches have been employed to explain the effect of the stratification of education systems on the ED link, such as the theories grouped under the term 'positional good' (i.e., credentialist and social closure) and the signalling or filter theories. However, as proposed by the training cost model (Glebbeek, Nieuwenhuysen and Schakelaar, 1989), all the above mentioned micro-level theories do not solve employers' risk of productivity loss. The first contribution of this article is to identify the dimension of the stratification of education systems able to reduce the risk of productivity loss thereby reinforcing the ED link that is the extent to which the first selection is based on students' ability. This article thus aims at explaining the moderating effect of stratification of education systems on the ED link by considering the extent to which the first selection is based on students' ability. Consequently, the research question reads *does the extent to which the first selection is based on students' ability mediate the moderating effect of the stratification of education system on the ED link?* This question is investigated by using microdata from round 1 to 9 (2002-2018) of the European Social Survey (ESS) integrated with macro indicators on education systems.

Since no international database reports the extent to which the first selection is based on students' ability, the second contribution of this work is an improvement of the operationalization of education systems' characteristics. To strengthen the relationship between theoretical concepts and empirical indicants, the theoretically derived dimensions of education systems have been directly measured through a web survey inquiring more than 200 national experts who provided information on 34 countries: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia,

Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Latvia, Lithuania, Luxembourg, the Netherlands, Norway, Poland, Portugal, Romania, Russia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine and the United Kingdom.

4.2 Literature review

As stressed in the introduction, the macro-level association between the stratification of education systems and the ED link has been explained at the micro-level by exploiting a mechanism traditionally used to explain the moderating role on the ED link of another characteristic of education systems i.e., vocational orientation. The mix-up between these two education systems' characteristics has also affected previous empirical analyses. For example, Andersen and Van de Werfhorst (2010) built an index of skill transparency that includes aspects of both stratification of education systems and vocational orientation. They employed the percentage of students at the secondary level studying in vocational courses and the percentage of students enrolled in dual track (indicators of vocational orientation) along with the number of tracks available to students in lower secondary education, the age of first selection, and the percentage of students enrolled in tertiary education (indicators of stratification of education systems). Analysing the second round of the ESS through random intercept model, they found that as the index of skill transparency increases, the ED link gets stronger.

The remaining studies acknowledged the conceptual difference between the stratification of education systems and vocational orientation but dealt with it differently. In the first case, analyses are conducted as if the two institutional features had not been associated. From an empirical point of view, this translates in identifying the bivariate effect of the stratification of education systems on the ED link. Reichelt and colleagues (2019) using data of the ESS (rounds 6 and 7) rejected their hypothesis of a positive

correlation between the index of tracking[19] and the ED link. Vogtenhuber (2018) reached the same conclusion analysing a different data source (PIAAC), measuring stratification of education systems and respondent's education differently, and implementing a different empirical strategy. In contrast, the two-level random intercept model computed by Bol and Van de Werfhorst (2011) provided supporting evidence of the positive effect of the stratification of education systems on the ED link. However, also in this case, the differences from the previous studies are important: measurement of stratification of education systems and respondents' education along with different individual level data.

In addition to recognizing the conceptual difference between stratification of education systems and vocational orientation, the second group of studies estimated the moderating effect of stratification of education system on the ED link while controlling for the effect of vocational orientation. By relying on national high-quality life-course data, Müller and Shavit (1998) concluded that in the 12 countries analysed (Australia, Britain, Japan, Sweden, the United States, France, Israel, Italy, Taiwan, Germany, the Netherlands, and Switzerland), the effect of the stratification of education systems is mediated by vocational specificity. In contrast, Bol and Van de Werfhorst (2013) showed that tracking has an independent effect on the ED link, on top of the effect of vocational enrolment and vocational specificity. Besides conditioning on vocational orientation, Hadjar and Becker (2016) also controlled for the moderating effect of educational expansion. Their multilevel analysis found that the strength of the ED link does not vary across 'low-stratified' and 'medium- plus high-stratified' countries. Also among these studies however, the differences are relevant. The most important are: analytical strategy, measurement of stratification of education systems and respondents' education.

[19] More information on this index is reported in the measurement section.

To summarize, the previous research investigating the effect of the stratification of education systems on the ED link has not reached a common conclusion. Depending on methodological choices and data sources, previous results vary substantially. It therefore appears quite difficult to directly compare these results to draw general conclusions.

Additionally, comparisons are challenging as these studies are affected by at least one of the following drawbacks. First, as Bol and Van de Werfhorst (2011) argue, the measurement of stratification of education systems is sometimes based on arbitrary classifications whose details are not provided. Second, model specifications suffer from omitted variable bias at both individual and country-level. Since these studies focus on the moderating role of an institutional variable on the association between two individual variables, confounders at both levels must be accounted for in the model specification (Brunello and Checchi, 2007; Giesselmann and Schmidt-Catran, 2018; Österman, 2018). Considering the former, when educational attainment is positively correlated with unobserved individual characteristics that also affect occupational attainment (such as, social background), the effect of education on occupation is upwardly biased. As for the latter, scholars have often failed to simultaneously control for the confounders associated with both the stratification of education systems and ED link namely, vocational orientation and educational expansion.

From this literature review the need for further studies on the effect of the stratification of education systems on the ED link emerges quite clearly.

4.3 Theoretical framework

4.3.1 Is stratification of education systems moderating the ED link?

Comparative literature focusing on the moderating effect of the stratification of education systems on the ED link is rooted in the following hypothesis: the higher the degree of stratification the stronger is the association between educational and occupational attainment (Allmendinger, 1989; Müller and Shavit, 1998; Bol and Van de Werfhorst, 2013; Hadjar and Becker, 2016; Reichelt, Collischon and Eberl, 2019). At the micro-level, the given explanation reads: different educational paths lead to different occupations, thereby reinforcing the strength of the ED link. Because of the linkage between education system and labor market, the endowment of general versus vocational skills affects the transition into the labor market. According to this micro-level explanation, labor market entrants are expected to be productive right away. Therefore it is assumed that education provides school-leavers with work-relevant skills that, by enhancing their future productivity, increase their labor market pay off. This viewpoint on the role of education is typical of the human capital theory (Becker, 1964). Hence, the human capital approach appears to be the most employed theory at the micro-level to explain how the moderating effect of the stratification of education systems on the ED comes about.

In contrast, empirical support for the micro-mechanism elucidated by the human capital theory is more likely to be found in combination with strongly vocationally oriented education systems (Van de Werfhorst, 2011). From a theoretical standpoint, the extent to which recruitment occurs on the basis of productivity-enhancing skills is likely to be influenced by the types of skills provided by education systems (Blommaert et al., 2020). Some systems endow students with generic skills, while in vocationally oriented systems, employers influence the types of skills conferred by education systems. This

means that the skills provided in school directly increase school leavers' productivity in the labor market. Hence, in those countries where education systems provide vocational skills, the productivity-enhancing skills mechanism is likely to be the most relevant explanation for the moderating role of vocational orientation on the ED link.

Back to the research question, this means that the micro-level mechanism working in institutional contexts characterized by vocationally oriented education systems is often used to explain the moderating role of the stratification of education systems on the ED link. Consequently, agreement about the specific micro-level mechanism explaining the moderating effect of the stratification of education systems on the ED link has not been reached yet.

I argue that when the stratification of education systems increases the congruence between educational attainment and ability, educational qualifications give reliable information to employers to estimate job seekers' productivity. Within this institutional setting, the micro-level mechanism of the human capital theory holds. The dimension of the stratification of education systems able to augment the congruence between educational credentials and ability is the criterion upon which the first selection takes place. If students are sorted according to their skills, students' abilities and educational qualifications more strongly coincide than in education systems where students' academic ability is not the only criteria upon which the allocation takes place. The supplementary material reports a simple test of this assumption that holds in 18 of the 22 countries analysed in this paper (Switzerland, Hungary, Iceland, Luxembourg are excluded from the Programme for the International Assessment of Adult Competencies PIAAC and hence from these checks).

4.3.2 A focus on the micro-level theories explaining the strength of the ED link

Besides human capital theory, comparative research has however also claimed that other micro-level theories may explain the moderating effect of the stratification of education systems on the ED link. For example, Van de Werfhorst (2011) has argued that in highly stratified systems it is likely that education functions as a credential (partly) unrelated to productive ability. Social closure (Weber, 1978 [1922]; Parkin, 1979) theories do not attach any value to schooling and claim that the ED link is due to the possession of educational credentials (Collins, 1979). Education sorts individuals but it does so relying on neither their expected levels of productivity nor trainability. Those with high credentials, obtain access to more prestigious positions in the occupational structure as entry to the latter is restricted by institutional barriers. However, as explained above, when educational systems select students upon their ability, differentiation practices produce efficient sorting increasing the congruence between educational attainment and ability. Thus, the extent to which differentiation occurs upon students' ability affects the role of educational credentials in providing sufficient and reliable information to employers to assess applicants' expected productivity.

In another article, Bol and Van de Werfhorst (2011) stated that signalling and filter theories may be at work in systems characterized by strong between-school differentiation (see also Andersen and Van de Werfhorst, 2010 and Blommaert et al., 2020). According to these theories, education works as a signal (Spence, 1973) on whose basis employers screen candidates (Stiglitz, 1975). Education thus helps employers in sorting individuals according to their productivity or training costs (Thurow, 1975). I argue that this micro-mechanism is reinforced when students are sorted according to their ability.

However, in all these three broad groups of theories (human capital, credentialist/social closure, and signalling/filter theories), employers still face a risk of productivity loss (Glebbeek, Nieuwenhuysen and Schakelaar, 1989). Graduates holding the same educational credential are indeed endowed with different skill levels (Levels, van der Velden and Allen, 2014; Vogtenhuber, 2018), which, in turn, lead to different productivity levels (human capital and credentialist/social closure theories) and productivity costs (signalling/filter theories). If school leavers have heterogeneous skill levels, some are very productive from the beginning while others are less productive and perhaps in need of training on-the-job. In this context, an employer may end up hiring the least productive applicant facing a disadvantage. This means that selecting applicants upon educational credentials alone does not guarantee that expected productivity levels and costs are met when individuals have heterogeneous skill levels.

In contrast, when education systems select students based on their ability (or measured skills), pupils within the same school are more homogenous when they start studying (Sørensen 1970). Put it differently, the input of the educational process is characterized by less within school/track variance. Furthermore, because of specialization effects, the initial homogenization allows teachers to perform tailored instructions (Rosenbaum, 1999; Eccles and Roeser, 2011), ultimately fostering a uniform skill development (Brunello and Checchi, 2007). This results in an even lower dispersion of skills (among those with the same qualification), coupled with a broaden skill gaps between educational qualifications (Marsh, 1987; Epple, Newlon and Romano, 2002; Zimmer, 2003) once students leave the education system and enter the labor market.

I argue that the dimension of the stratification of education systems able to influence skills' homogeneity is the criterion upon which the first selection takes place. If students are grouped according to their ability, the dispersion of skills (within

qualification) is lower than in education systems where students' academic ability is not the only criteria upon which the allocation takes place. In the former context, educational credentials become very strong signals of future productivity levels and costs as academic ability is reflected in educational credentials/qualifications. As explained by Glebbeek and colleagues (1989), skill level homogeneity reduces the risk of productivity loss, and educational selection based on students' ability may increase skill level homogeneity.

To summarize, this section stresses that the three broad groups of micro-level theories used to explain the moderating effect of the stratification of education systems on the ED link have missed to identify the risk of productivity loss that is reduced the more the first selection is based on students' ability. As a consequence, the ED link is supposed to become stronger the more the first selection is based on students' ability. Additionally, this paragraph also highlights that the extent to which one of the three groups of micro-level theories can be used to explain the moderating effect of the stratification of education systems on the ED link depends on the criteria upon which the first selection is based. As a result, *I hypothesize that the effect of the stratification of education systems on the ED link is mediated by the extent to which the first selection is based on students' ability (H4)*.

To sustain my hypothesis, I have made an additional assumption whose empirical assessment is also reported in the supplementary material. As in the previous case, this additional analysis provides empirical evidence in favour of the assumption.

4.4 Data and sample selection

Data comes from the ESS. Since 2002, this international biennial survey collects data on individuals aged 15 and older living in a private household. Data is drawn from random probability samples within each country and round (the latter identifies each edition of the survey). This article analyses make use of the rounds 1 to 9 where the

dataset of the last round has been appended to the cumulative dataset of the first eight rounds.

Table 4.1 Number of observations by country

Country		*Observations*
Austria	AT	2124
Belgium	BE	2616
Switzerland	CH	2313
Czech Republic	CZ	4022
Germany	DE	3513
Denmark	DK	1223
Spain	ES	3415
Finland	FI	2334
France	FR	2805
Greece	GR	539
Hungary	HU	2460
Ireland	IE	2724
Israel	IL	2327
Iceland	IS	441
Italy	IT	1641
Luxembourg	LU	230
the Netherlands	NL	2749
Norway	NO	2456
Poland	PL	3321
Sweden	SE	1913
Slovakia	SK	1846
the United Kingdom	UK	2045
Total		*49,057*

Source: ESS pooled dataset (2002-2018).

To be sure that the respondents were exposed to the educational system as described by the indicators employed at the institutional/country-level and that they began and completed their study in the country they were interviewed, the analytical sample includes respondents born between 1973 and 1995 who had turned 25 before the interview took place excluding migrants of first generation.

After listwise deletion of missing values on analytical variable, the sample amounts to 49,057 individuals in 22 countries (see Table 4.1). Since running analyses on

complete case sample may lead to bias, Table 4.2 reports the univariate distributions of each variable with and without listwise deletion.

4.5 Measurement

4.5.1 Individual level

Respondents' occupational attainment is measured by Treiman's Standard International Occupational Prestige Scale (SIOPS). This scale accounts for occupational standing while disregarding individuals' socioeconomic characteristics. Therefore, SIOPS appears better suited for this research question than other measures like for example ISEI (Ganzeboom, De Graaf and Treiman, 1992).

To adequately measure respondents' education, two variables are employed. First, a categorical variable distinguishing among seven categories: 1) Less than lower secondary (European Survey version of International Standard Classification of Education (ES-ISCED) I); 2) Lower secondary (ES-ISCED II); 3) Lower tier upper secondary (ES-ISCED IIIa); 4) Upper tier upper secondary (ES-ISCED IIIb); 5) Advanced vocational (ES-ISCED IV); 6) Lower tertiary education (ES-ISCED V1); 7) Higher tertiary education (ES-ISCED V2). Second, a numerical variable reporting the equivalent years of schooling. The inclusion of both measures allows to quantify the effect of educational qualifications (measured through the categorical variable) on top of the effect of years of education. Besides being a proper test for the micro-level theories here considered (see Bol and Van de Werfhorst, 2011), this twofold operationalization tests the core argument of this article namely, the stratification of education system strengthens the ED link because it increases skill homogeneity within educational qualifications. Hence, it is important to measure the effect of educational qualification and to show that they have an independent effect on occupational attainment from the effect of years of education.

The micro-level controls are year of birth, sex, and social background. The latter is measured by parents' occupational class and educational qualification. Both variables are built using the dominance approach (Erikson and Goldthorpe, 1992). Parents' occupation measures six classes (routine working class, semi/routine working class, technicians/crafts, intermediate/middle management, senior management/administration, and professionals). Parental education has five categories: Less than lower secondary education (ISCED I), Lower secondary degree (ISCED II), Upper secondary degree (ISCED III), Post-secondary non-tertiary degree (ISCED IV), and Tertiary degree (ISCED V-VI).

To account for any differences among the different editions of the survey, the analyses also control for rounds. Additionally, I also include as a proxy for labor market experience that registers the number of years that have passed since the respondents had left the education system. Monovariate distributions are available in Table 4.2.

Table 4.2 Monovariate distributions

Variables	*%*	*%*
Parental occupational class		
Routine working class	7.36	7.14
Semi/routine working class	17.67	19.14
Technicians/crafts	25.13	27.13
Intermediate/middle management	20.42	22.92
Senior management/administration	5.42	5.88
Professionals	16.04	17.79
Missing	7.97	
Parental education		
Less than lower secondary education (ISCED I)	13.07	11.19
Lower secondary education (ISCED II)	15.93	15.47
Upper secondary education (ISCED III)	35.38	38.94
Post-secondary non-tertiary education (ISCED IV)	9.51	11.32
Tertiary education (ISCED V-VI)	21.61	23.09
Missing	4.51	
Sex		
Male	47.60	48.19
Female	52.19	51.81
Missing	0.21	
ESS round		
2002		2.69
2004		4.17
2006		4.53
2008		7.03
2010		12.28
2012		13.55
2014		13.09
2016		15.80
2018		26.87
Respondent's educational qualification		
Less than lower secondary (ISCED I)	2.25	1.62
Lower secondary (ISCED II)	9.32	8.90
Lower tier upper secondary (ISCED IIIa)	18.25	20.24
Upper tier upper secondary (ISCED IIIb)	17.66	19.68
Advanced vocational (ISCED IV)	12.39	14.17
Lower tertiary education (ISCED V1)	14.15	16.66
Higher tertiary education (ISCED V2)	15.92	18.75
Missing	10.05	

Table 4.2 Continued

Variables	*%*	*%*
Year of birth		
1973	7.99	7.75
1974	8.03	7.64
1975	7.99	7.79
1976	7.75	7.54
1977	7.57	7.30
1978	7.01	6.93
1979	6.56	6.62
1980	6.62	6.72
1981	5.65	5.76
1982	5.19	5.48
1983	4.65	4.90
1984	4.22	4.63
1985	3.86	4.28
1986	3.41	3.70
1987	2.91	3.14
1988	2.60	2.86
1989	2.03	2.30
1990	1.42	1.57
1991	1.08	1.22
1992	0.96	1.04
1993	0.59	0.71
1994	0.16	0.13
Missing	1.74	
	Mean	*SD*
Respondent's years of education	13.53	2.71
Respondent's years of education (with missing)	13.54	2.81
Labor market experience	12.33	6.31
Labor market experience (with missing)	11.90	6.45
SIOPS	42.77	13.42

Source: ESS pooled dataset (2002-2018).

4.5.2 Macro-level

The country-level indicators comprise five variables: two indicators measuring the stratification of education systems (the index of tracking and the extent to which the first selection is based on students' ability), two indicators of vocational orientation

(linkages between education and labour market and vocational specificity), and one proxy for educational expansion.

The extent to which the first selection is based on students' ability and the linkages between education and labour market come from an expert survey carried out in 2016 (Traini, 2019). The typical expert was an academic specialized in his/her national education system. The selected experts were scientists and academics belonging to different disciplines (sociology, economics, demography and educational science), as well as practitioners (like school principals and staff of the ministry of education). Since the quality of expert survey data is directly influenced by the quality of the participants, identify the population of experts represents the major challenge (Benoit and Laver, 2006). In this case, several channels had been used to select participants. As usually done in convenient sampling, the starting sample was identified via personal connection. Additionally, a reading of scholarly scientific publications and membership of scientific associations or research centres were scoured. Following networking sampling procedures, the initial list of starting seeds was asked to name additional experts. For 34 OECD countries, the completed questionnaires are 206 with a completion rate of 27%. Among the countries here considered, the average number of participants for each nation ranges from 4 to 10 (see the first column of Table 4.3). As a result, for each education system more than one answer was gathered. To synthesize these multiple answers into one single indicator, indexes of central tendency have been computed after correcting for individual differences in response scale use. The latter had been achieved by centring each respondent's value with his/her average response (correction performed on all the valid responses given to the questions offering the same response tool i.e., max of 13 questions).

To make sure that the experts recognise the comparative aim of the survey, the first set of questions was aimed at rating their educational system compared to the educational system in Germany and the USA. The purpose of this survey was to measure overlooked education systems' characteristics to integrate them into the ESS data. Thus, the experts were asked to reply to the questionnaire bearing in mind that their replies should convey how the education system looked like in the period between 1980 and 2000 (which mirrors the years when the ESS respondents were studying). To account for changes over time, the questionnaire inquired about major educational reforms but experts did not report any reforms that changed the two indicators employed in this analysis. For more information on the questionnaire see Appendix A.

Since the debate on the use of expert disagreement to judge data reliability has not settled yet (Meyer and Booker, 2001), I will present the two indicators (the extent to which the first selection is based on students' ability and the linkages between education and labour market) describing how they performed in two tests aimed at assessing their reliability along with a simple convergent validity test.

Table 4.3 Indicators derived from the expert survey and their mean standard deviations

	# of experts	*Ability-based*		*Edu-LM Linkages*				
		Indicator	*SD*	*Indicator*	*Indicator A*	*Indicator B*	*SD A*	*SD B*
Austria	5	60.07	13.96	49.88	41.94	57.82	15.98	17.27
Belgium	9	79.46	17.11	41.96	36.14	47.77	7.39	15.82
Czech Republic	4	82.08	14.59	39.42	41.44	37.39	19.56	22.24
Denmark	6	67.07	15.39	49.81	37.98	61.64	16.77	27.14
Finland	4	73.63	8.64	39.00	42.85	35.15	11.44	31.08
France	7	80.70	9.67	33.73	33.08	34.37	10.89	16.00
Germany	10	61.59	20.73	47.00	41.48	52.52	18.43	23.02
Greece	5	50.43	17.48	24.27	24.35	24.18	14.58	13.59
Hungary	4	63.53	7.71	41.88	51.64	32.13	7.02	14.05
Iceland	4	62.04	15.31	48.85	46.20	51.50	18.93	26.95
Ireland	7	55.07	31.23	19.57	21.67	17.47	15.83	11.50
Israel	9	71.38	5.55	21.24	27.54	14.94	11.00	9.30
Italy	5	53.90	7.6	27.34	27.77	26.90	15.44	10.78
Luxembourg	4	66.71	3.61	49.26	50.60	47.92	17.38	5.86
the Netherlands	7	75.46	8.84	52.20	50.61	56.73	9.18	10.29
Norway	8	61.09	19.71	53.67	50.26	54.14	15.74	15.11
Poland	4	84.28	8.59	30.30	29.36	31.23	4.20	3.95
Slovakia	9	68.48	9.17	36.25	35.97	36.53	11.15	14.16
Spain	4	49.39	35.63	38.09	42.72	33.46	19.54	7.10
Sweden	4	75.36	12.43	38.56	44.70	32.42	7.85	4.89
Switzerland	4	47.00	8.95	67.35	52.78	81.92	34.46	7.88
the United Kingdom	8	48.28	14.37	38.03	40.62	35.43	15.29	19.87

Note: A refers to firms involved in the design of school-based curricula, while B to firms' provision of on-the-job training.
Source: expert survey.

As expert surveys questioned multiple experts for each country, the first test compares inter-rater agreement within country by judging the indicators' mean standard deviations (Ray, 1999; Steenbergen and Marks, 2007). Additionally, as in some countries less than 5 experts responded (that is considered a critical threshold in political science where this methodology is largely used, see Laver and Hunt (1992) and Hubert and Inglehart (1995)), I perform a series of simulations to inspect how the indicators would have looked like if fewer experts would have responded. Specifically in the second test, I draw all the possible samples of *n-1* experts (where *n* is the original sample within country) and, for each sample, I compute the new final indicator. If the final indicators computed with these new samples are close to the original indicator, I can conclude that having one expert less in each country does not distort the original data. In contrast, if the new samples provide new indicators quite different from the original one, additional analyses are run by excluding the specific country where this happens as its indicator severely depends on the number of experts interviewed. Finally, to test whether the indicators of the expert survey really measure what they are supposed to measure, I rely on criterion validity. In other words, I investigate the performance of the two indicators against other well-known indicators used in the literature to measure the same concept. If the evidence is in favour of convergence, I can conclude that the indicators of the expert survey behave as expected when proven against convergent validity. The two indicators are listed in Table 4.3.

To be sure that all the experts had in mind the same concept when referring to the first selection, the following definition was provided: "With first selection we refer to the allocation of students into different school types or different curricula within school. Such differentiation can be based on either student's scholastic abilities or personal preferences and it lasts for all the school day and all the subjects". Subsequently, to

measure the extent to which the first allocation is associated with student's ability, experts were asked to rate "to what extent was the first selection associated with student's scholastic abilities". By convention, while discussing the values of the mean standard deviations, values higher than 1/5 of the theoretical range of variation are considered as problematic (Ray, 1999). Germany is just above the threshold while Ireland and Spain are far from it. However, if we consider the second reliability test, Figure 4.1 shows that for all the countries the new indicators (depicted in grey) are not far from the original indicator (black dots). The only exception is Spain whose new indicators are far from the original indicator and from each other.

To evaluate converge validity, I employ an indicator also used by Horn (2009) collected in PISA among school principals: the percentage of how much previous academic grades or entrance examinations has counted in accepting students in their schools. While Horn employs the 2003 survey, I use the closet indicator available in the 2000 survey (the values for Norway, Italy, and Slovakia come from PISA 2003). As shown in Table 4.4, the correlation coefficient between the indicator of the expert survey and PISA is 0.6.

Table 4.4 Correlation between macro-level indicators

	(1)	(2)	(3)	(4)
Ability-based selection (PISA 2000, 2003, 2006)	0.60			
Index of employer involvement (Busemeyer and Schlicht-Schmälzle, 2014)			0.70	
Ability-based first selection (1)				
Index of tracking (2)	-0.23			
Linkages between education and labor market (3)	0.13	-0.18		
Vocational specificity (4)	0.24	-0.52	0.66	
Educational expansion	-0.18	0.36	-0.24	-0.43

Source: Busemeyer and Schlicht-Schmälzle (2014), Barro and Lee (2013), expert survey, and PISA (2000, 2003, 2006).

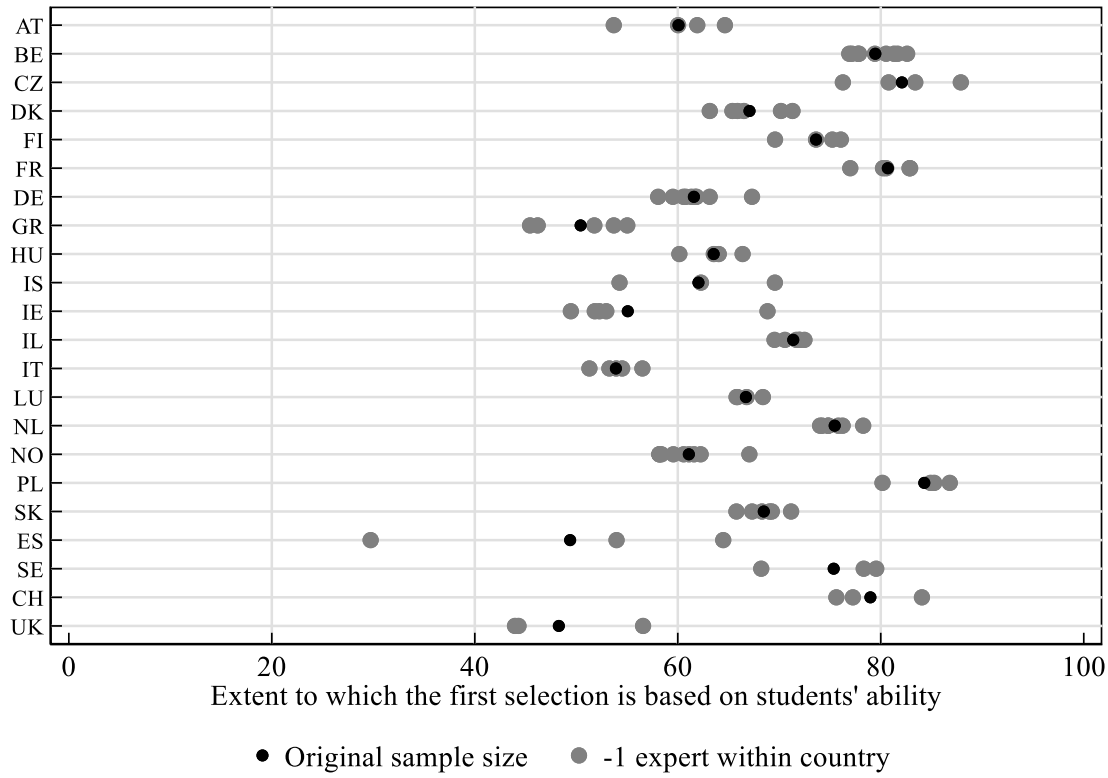

Figure 4.1: Reliability test for the indicators of the expert survey: the extent to which the first selection is based on students' ability

Note: the explanation of country abbreviations can be found in Table 4.1

Source: expert survey.

One of the main downsides of this PISA indicator is that it is measured among 15 year-old students while the interest here lays on the first selection. If I select only the four countries selecting at that age (Greece, Iceland, Poland and Portugal) and compute the correlation again the coefficient reaches 0.96. Despite the low number of countries (22), the size of the effect certainly reassures on the validity of the indicator coming from the expert survey. Summarizing, the results of the reliability tests converge casting doubts on the Spanish value. Consequently, sensitivity checks excluding this country will be performed.

One of the two confounders at the country level accounts for firms' involvement in school-based vocational schools and dual-system institutions (Blossfeld, 1992). The two questions in the questionnaire asked: "to what extent a) were firms involved in the design of school-based vocational curricula? b) did firms provide on-the-job training (e.g., dual system) to students simultaneously enrolled in vocational programs?". Since the two dimensions have been considered as equally important in the literature, the final indicator has been computed as the simple average between firm involvement in school-based and on-the-job training. If we consider the average standard deviations, the value of Switzerland appears to be problematic on the first indicator (the one focusing on school-based vocational schools), while the problematic values of the second indicators are more: Czech Republic, Denmark, Finland, Germany, and Iceland.

By focusing on the distances between the new indicators computed on the simulated samples of experts (depicted in grey) and the original indicators (black dots), Figure 4.2 shows that the only unreliable countries are Switzerland for what concerns the first indicator and Finland for the second.

To validate this indicator, I employ the index of employer involvement collected by Busemeyer and Schlicht-Schmälzle (2014). The correlation coefficient is 0.7 (see Table 4.4). Note that Busemeyer and Schlicht-Schmälzle's indicator is collected for 15 countries only. As a consequence, the countries excluded from this check are Czech Republic, Hungary, Israel, Iceland, Poland, Spain, and Slovakia.

Because of the discrepancies between the indicators computed upon the simulated samples and the original sample of experts for the values of Switzerland and Finland, robustness checks will investigate whether the main findings hold after excluding these two countries.

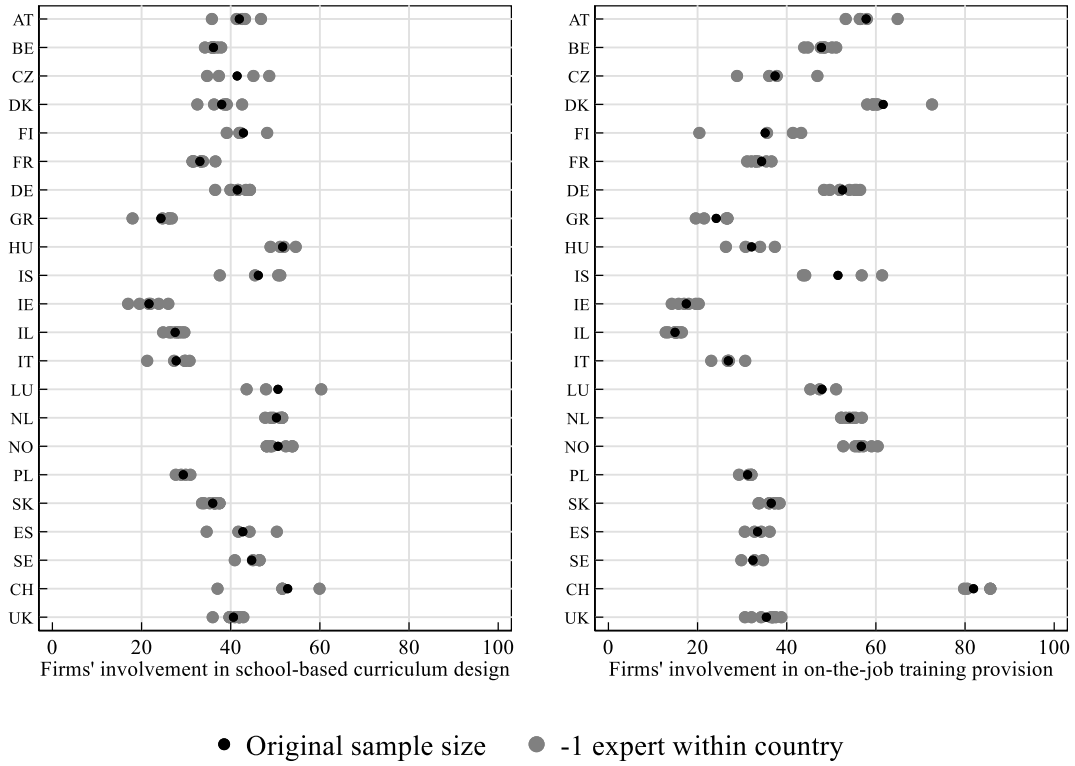

Figure 4.2: Reliability test for the indicators of the expert survey: linkages between education system and labor market

Note: the explanation of country abbreviations can be found in Table 4.1

Source: expert survey.

To measure stratification of the education systems, I employ the index of tracking (Bol and Van de Werfhorst, 2013). It is a numerical indicator based on a factor analysis employing three different indicators: the age of first selection, the length of the stratified curriculum, and the number of tracks available for 15 year-old students.

To adequately control for the vocational orientation of education systems, I also employ another country-level indicator built by the same authors: vocational specificity. The indicator registers the percentage of upper secondary vocational education students that is in a dual system (Bol and Van de Werfhorst, 2013).

Finally, the second confounder at country level, educational expansion, is measured through the percentage of tertiary educated people (Barro and Lee, 2013). Specifically, this indicator has been computed every five years from 1950 to 2010 for different age groups. As the mean value of our respondents' age is 33.5, I selected the following age groups: 25-29, 30-34, and 35-39. In a second step, I assigned to each respondent the corresponding value of educational expansion according to a) the year in which they left the education and training system and b) their age.

Table 4.4 also reports the correlation coefficients between these five country-level indicators. The values are all quite low apart from the expected positive association between vocational specificity and the linkages between education and labor market (0.7).

4.6 Empirical strategy

Because of the data structure, I run linear random slope models with three levels with respondents (level 1) nested in 117 combinations of country and rounds (level 2), cross-classified in 22 countries and 9 ESS rounds (level 3) (Schmidt-Catran and Fairbrother, 2016).

Considering that the focus of this paper is the effect of the stratification of education systems on the ED link, the model specification includes random slopes at the third level for respondents' education along with cross-level interactions between respondents' education (numerical and categorical variables) and the indicator of stratification (Heisig, Elbers and Solga, 2017). Since the interaction effects may be biased due to unobserved variables at the country level correlated with stratification of education systems and ED link, I introduce cross-level interactions between vocational orientation and respondents' education as well as educational expansion and respondents' education (Giesselmann and Schmidt-Catran, 2018).

Since I am especially interested in testing a mediation, I run two different nested models. The equation of the first one is:

$$y_{ijk} = \beta_{0jk} + \beta_{1k}\ EDU\_C_{ijk} + \beta_2\ TRACKING_k + \beta_3\ (EDU\_C_{ijk} * TRACKING_k) + \beta_4\ SPECIFICITY_k + \beta_5\ (EDU\_C_{ijk} * SPECIFICITY_k) + \beta_6\ LINKAGES_k + \beta_7\ (EDU\_C_{ijk} * LINKAGES_k) + \beta_8\ EXPANSION_k + \beta_9\ (EDU\_C_{ijk} * EXPANSION_k) + \beta_{10k}\ EDU\_Y_{ijk} + \beta_{11}\ (EDU\_Y_{ijk} * TRACKING_k) + \beta_{12}\ (EDU\_Y_{ijk} * SPECIFICITY_k) + \beta_{13}\ (EDU\_Y_{ijk} * LINKAGES_k) + \beta_{14}\ (EDU\_Y_{ijk} * EXPANSION_k) + \beta_{15}\ Micro\text{-}controls_{ijk} + Z_{ijk}u_{ijk} + Z_{ijk}u_{jk} + e_{ijk}$$

The equation estimates y_{ijk} occupational prestige scores (SIOPS) of individual $_i$ in combination country*round $_j$ in country and round $_k$ to be a function of micro-controls (i.e., sex, year of birth, ESS round, parental occupation and education, labor market experience) and education (categorical β_1 and years of education β_{10}), the institutional variable of interest (β_2) and its cross-level interactions with respondents' education (β_3 and β_{11}).

The second model adds to the first one the institutional variable that is supposed to mediate the association between the stratification of education systems and the ED link namely, the extent to which the first selection is based on students' ability along with its interactions with respondents' education. The hypothesis finds support if the effect sizes of the interactions between educational credentials and the index of tracking found in the first model are bigger than those found in the second model that should also report statistically significant interactions between educational qualifications and the extent to which the first selection is based on students' ability.

4.7 Findings

Table 4.5 reports the findings of the linear random effect models. M1 stands for the first model while M2 represents the model including the extent to which the first is based on students' ability.

Holding constant the effect of the other institutional and micro-level confounders, the interaction terms between respondents' education and tracking show that, there is a positive moderating effect for the individuals with a lower secondary qualification and for those with the highest educational qualification. Put differently, for these individuals, occupational prestige scores become more dependent on educational qualifications as the education system gets more tracked.

On top of the positive main effect, the advantage of having attained a lower secondary degree is amplified as prestige scores increase by 0.06 for every unit increase in the index of tracking. For individuals who achieved the highest educational qualification, the magnitude of the effect is twice the size of the previous effect, along with a much higher main effect.

Table 4.5 also shows that the interaction between the index of tracking and respondents' education measured in year of education is positive and statistically significant. This mean that, controlling for educational qualifications, the effect of additional years of education on SIOPS become stronger the more the educational system is tracked.

Table 4.5 Random slope linear regression models (DV: SIOPS)

	M1	M2
Years of education	-0.29	-0.06
	(0.47)	(0.48)
Respondent's educational qualification (ref. Less than lower secondary ED I))		
Lower secondary (ISCED II)	0.45	-0.37
	(2.51)	(2.56)
Lower tier upper secondary (ISCED IIIa)	-0.23	-1.69
	(3.24)	(3.34)
Upper tier upper secondary (ISCED IIIb)	3.61	1.72
	(3.55)	(3.66)
Advanced vocational (ISCED IV)	6.68	4.41
	(4.00)	(4.10)
Lower tertiary education (ISCED V1)	13.59**	11.45*
	(4.75)	(4.89)
Higher tertiary education (ISCED V2)	19.80***	16.59**
	(5.60)	(5.77)
Index of tracking	0.09**	0.07
	(0.03)	(0.04)
Lower secondary (ISCED II) * Tracking	0.06*	0.03
	(0.03)	(0.03)
Lower tier upper secondary (ISCED IIIa) * Tracking	0.06	0.01
	(0.04)	(0.04)
Upper tier upper secondary (ISCED IIIb) * Tracking	0.05	-0.01
	(0.04)	(0.05)
Advanced vocational (ISCED IV) * Tracking	0.08	0.00
	(0.04)	(0.05)
Lower tertiary education (ISCED V1) * Tracking	0.09	0.01
	(0.05)	(0.06)
Higher tertiary education (ISCED V2) * Tracking	0.13*	0.03
	(0.06)	(0.07)
Years of education * Tracking	0.01**	0.01
	(0.00)	(0.01)
Ability-based first selection		0.25*
		(0.12)
Lower secondary (ISCED II) * Ability-based first selection		0.23*
		(0.10)
Lower tier upper secondary (ISCED IIIa) * Ability-based first selection		0.32*
		(0.13)
Upper tier upper secondary (ISCED IIIb) * Ability-based first selection		0.36*
		(0.15)
Advanced vocational (ISCED IV) * Ability-based first selection		0.43*
		(0.18)
Lower tertiary education (ISCED V1) * Ability-based first selection		0.55*
		(0.21)

Table 4.5 Continued

	M1	M2
Higher tertiary education (ISCED V2) * Ability-based first selection		0.61*
		(0.25)
Years of education * Ability-based first selection		0.05*
		(0.02)
Constant	38.33***	37.06***
	(3.40)	(3.50)
Variance (2nd level)	1.41***	1.45***
	(0.28)	(.29)
Variance (3rd level)	1.34***	1.31***
	(0.25)	(0.25)
Variance (Residual)	111.59***	111.59***
	(0.72)	(0.72)
N	49057	49057
BIC	372041.7	372160.6

*Standard errors in parentheses, + p < 0.10. * p < 0.05. ** p < 0.01. *** p < 0.001*
Note: the model also controls for parental occupation and education, sex, birth year, labor market exposure, ESS rounds, and the institutional confounders plus their interactions with respondents' education (linkages between education system and labor market, vocational specificity, and educational expansion)
Source: ESS (2002-2018), Barro and Lee (2013), Bol and Van de Werfhorst (2013), and expert survey.

Model 2 includes the extent to which the first selection is based on students' ability and its interactions with the measurements of respondents' education. By comparing the interaction terms between the index of tracking and respondents' education in model 1 and 2, we see that the size of the effects diminishes getting close to zero and the statistically significant effects present in model 1 lose their statistical significance. This means that after controlling for the extent to which the first selection is based on students' ability, the index of tracking does not independently affect the ED link. Additionally, the interaction terms between ability-based first selection and educational credentials are all statistically significant and positive and their effect sizes grow as educational qualification increases. This shows that the effect of educational qualifications (on top of years of education) on SIOPS gets stronger the more the first selection is based on students' ability and suggests that the extent to which the first selection is based on students' ability mediates the effect of the index of tracking on the

ED link.

Table 4.5 also highlights that keeping constant educational qualifications, occupational prestige scores become more dependent on years of education the more the first selection account for students' ability.

4.7.1 Robustness checks

I have repeated the previous analyses restricting the sample to employee only. Findings, available upon request, do not change. Robustness checks have also been estimated to control for occupational upgrading across countries employing within country standardized SIOPS. Analyses lead to the same conclusions.

Since three countries have failed the reliability tests, Finland, Spain, and Switzerland have been excluded. This supplementary analysis yields to the same results. In addition, to consider the potential presence of influential cases, I have omitted each country (one by one) from the model specification. Evidence shows that for all the countries but two, the findings described before slightly change without altering the substantial conclusions. For what concerns Holland and the UK, I find that by excluding either of them the effects of educational credentials on SIOPS are not moderated by ability-based first selection.

4.8 Conclusions

This article suggests a theoretical framework to explain how the effect of the stratification of education systems on the ED link comes about at the micro level. The training cost model (Glebbeek, Nieuwenhuysen and Schakelaar, 1989) claims that graduates having the same educational qualification but different skill levels constitute a threat for employers (the so-called risk of productivity loss) which has not been discussed

by previous micro-level theories explaining the labor market pay off of educational credentials.

It is argued that one way to reduce this potential loss is reducing the skill variance among school leavers having the same qualification and, at the same time, increasing the skill gap between educational qualifications. The characteristic of the stratification of education systems able to influence skills' homogeneity is the criterion upon which the selection takes place. The hypothesis thus expects that the effect of the stratification of education systems on the ED link is mediated by the extent to which the first selection relies on student's ability.

Drawing on microdata from round 1 to 9 of the European Social Survey (2002–2018), enriched with macro indicators also coming from an expert survey (Traini, 2019), this analysis makes a step further including all the relevant variables at the micro and macro level that rarely have been controlled for. Moreover, the ED link measured here is the additional and independent effect exerted by educational qualifications beyond the effect of years of education.

As expected, I find stronger ED link as the index of tracking increases. Once the extent to which the first selection is based on students' ability is included in the analysis, the moderating effects of the index of tracking on the association between educational and occupational attainment turns insignificant and their effect sizes get close to zero. Since the analyses also show that the more students' ability counts during the first selection the stronger is the ED link, they suggest that the moderating effect of the index of tracking on the ED link is mediated by ability-based first selection. This answers to the request of Gross and colleagues (2016) of identifying the specific dimension channelling the institutional effect of the stratification of education systems on individuals' behaviour.

Although the results indicate the importance of a new dimension of the stratification of education systems, the following limitations have to be considered. First, one of the sensitivity checks shows that the findings are not robust to different sets of countries. Specifically, when either the Netherland or the United Kingdom is excluded, ability-based first selection does not moderate the association between educational and occupational attainment. As a result, H4 has to be rejected.

Second, the ESS does not collect a measure of respondents' ability before the first selection, so it is impossible to disentangle the effect exerted by ability-based first selection from the selection process into different type of schools or curricula within school (Esser, 2016). Consequently, these analyses likely overestimate the ED link as they fail to control for students' ability before the first selection takes place. Besides, estimates of ED link in comparative perspective are prone to be spurious as they often lack proper control for individual motivation.

Third, the analyses are based on cross-sectional data that, because of their nature, questions a causal interpretation of the findings.

Despite the rejection of the main hypothesis, this study illustrates the potential role of a different dimension of the stratification of education system thereby seeking to fill the current research gap identified at the theoretical level. Future research should thus focus on finding different micro-level mechanisms to be tested empirically.

4.9 Supplementary material

Testing the assumptions of the theoretical argument

1st Assumption

The extent to which students are sorted according to their skills increases the likelihood that students' abilities and educational qualifications coincide. To test this first assumption, I make use of the PIAAC data[20] (2016) and, as a measure of the stratification of education systems, I employ the index of tracking which, to the best of my knowledge, is the only numerical measure available of the stratification of education systems (see literature review section).

The assumption made here is that the more the first selection in the education system is based on students' skills, the more ability and educational qualifications overlap. Empirically this assumption can be checked by regressing numeracy skill[21] on educational qualifications[22] for each country. To understand how much variance in skills is explained by educational qualifications, I focus on the coefficient of determination (R^2).

The assumption holds if the share of variance in skills explained by educational qualifications is positively associated with the index of tracking. Figure 4.3 plots the values of the R^2 (on the vertical axis) against the index of tracking (on the horizontal axis) showing the existence of a positive association. This means that the share of the total (within country) variance in numeracy explained by educational credentials is

[20] Individuals who obtained foreign qualification have been excluded, as well as those who left the education system more than 5 years before the survey. For more info on the survey visit http://www.oecd.org/skills/piaac/about/#d.en.481111

[21] Numeracy is preferred over literacy because educational systems are primarily responsible for the development of the former (Becker, et al., 2006).

[22] Educational qualification is measured through the most detailed variable included in the survey. It has 14 categories (ISCED 1, ISCED 2, ISCED 3C shorter than 2 years, ISCED 3C 2 years or more, ISCED 3A-B, ISCED 3 (without distinction), ISCED 4C, ISCED 4A-B, ISCED 4 (without distinction), ISCED 5B, ISCED 5A bachelor degree, ISCED 5A master degree, ISCED 6, ISCED 5A and 6 (without distinction).

greater the more education systems are tracked. Controlling for parental education yields similar results (analyses available upon request).

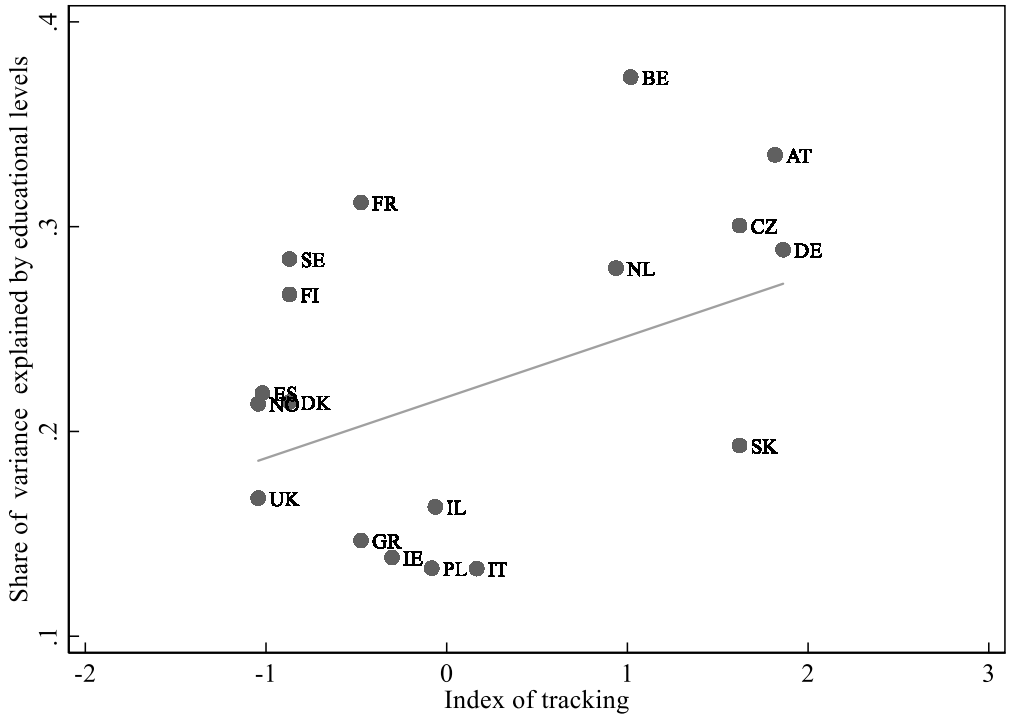

Figure 4.3: Variance in skills (share of variance within countries explained by educational levels)

Note: the explanation of country abbreviations can be found in Table 4.1

Source: PIAAC and Bol and Van de Werfhorst (2013).

2nd Assumption

I assume that at the end of the educational career, individuals trained in stratified systems display lower dispersion of skills within educational qualification coupled with a broaden skill gaps between educational qualification.[23] To test this, I employ again the

[23] Another assumption has also been made namely, the more education systems select upon students' ability the lower is the within school/track variance in skills. Unfortunately, to the best of my knowledge, there is no international dataset collecting information on students' skills right after the first selection (which does not occur at the same in all the countries) which also provides info on schools and tracks.

PIAAC data (applying the same restrictions implemented for testing the previous assumption) and perform country-wise multilevel regression models with respondents nested into educational credentials. This allows the partition of the variance in skills in a between educational qualification component and a within educational qualification component. The Intra-class correlation (ICC) that results from these models indicates the proportion of the variance that is found between educational degrees that, according to my assumption, should be higher in more strongly tracked systems. Figure 4.4 plots the ICC on the vertical axis and the index of tracking on the horizontal axis. The fitted line between the countries clearly shows the existence of a positive correlation. The variance between educational qualifications increases the more education systems are tracked proving empirical evidence in favour of the assumption made earlier.

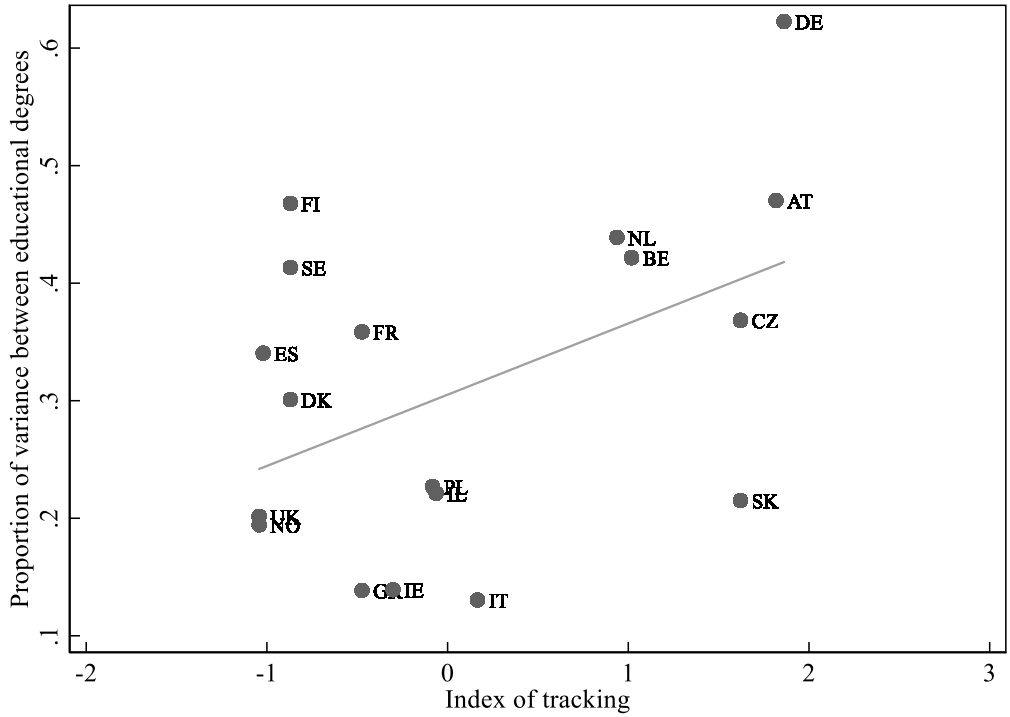

Figure 4.4: Decomposition of variance in skills (proportion of between educational qualification variance of total unexplained variance within countries)

Note: the explanation of country abbreviations can be found in Table 4.1

Source: PIAAC and Bol and Van de Werfhorst (2013).

Chapter 5 (Article 4) Like parents, like children. Does the stratification of education systems moderate the direct effect of social backgrounds on destinations?

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Abstract

This article aims to identify the moderating effect of the stratification of education systems (especially the extent to which the first selection is based on student ability) on the association between social backgrounds and destinations, while holding the effect of education constant. Two hypotheses are formulated. A null hypothesis expects no effects of the stratification of education systems on the direct effect of social backgrounds on destinations, while the other hypothesis argues for a negative moderating effect. Individual-level data from the European Social Survey (round 1 to 5) are complemented with new contextual indicators measuring various education system characteristics. Apart from employing these new indicators, another contribution of this article is the use of a more comprehensive measurement of social backgrounds, simultaneously accounting for social class and parental education. Findings show that the direct effect of social backgrounds on occupational attainment is not moderated by the extent to which the first selection is based on student ability. The null effect holds against several robustness checks employing different measurements, sample selections and model specifications.

5.1 Introduction

This paper is grounded in a research strand focusing on inequality, and more specifically, on the role of social backgrounds (the famous O of the OED triangle) in the process through which individuals come to occupy particular rungs on the social ladder. Previous research has shown that in several countries occupational status is persistently preserved across generations (Bernardi and Ballarino, 2016; Marks, 2014). With this paper, I seek to uncover whether the institutional setup of education systems moderates the effect of social backgrounds on destinations, independently of individuals' educational attainment (also stated as OD|E association or link). Since the stratification of education systems affects both the link between social backgrounds and education (OE), and the link between education and destinations (ED) (Bol and Van de Werfhorst, 2013; Brunello and Checchi, 2007; Hadjar and Becker, 2016; Reichelt, Collischon and Eberl, 2019), it is crucial to investigate whether the stratification of education systems also affects the remaining path of the mobility triangle i.e., the direct effect of social backgrounds on destinations (OD|E). Knowledge about such processes is key, as policy reforms that aim to tackle the social background effect on destinations may work differently when we look at the effect mediated by education (that is, the indirect effect), or at the effect that remains once we condition on education. Families could indeed react to the introduction of reforms directed at weakening their influence on their children's educational attainment by strengthening their influence on their children's outcomes in the next phase of the life course. For instance, in the case of an aptitude test being introduced to allocate students to different school types, parents may react by exploiting their connections to ensure that their offspring are still able to enter prestigious occupations, even when the achieved educational qualifications would not normally allow it.

The research question addressed in this paper is: *does the stratification of education systems moderate the direct effect of social backgrounds on destinations?* This question is investigated using individual data from round 1 to 5 (2002-2010) of the European Social Survey (ESS) integrated with macro indicators on education systems (Barro and Lee, 2013; Traini, 2019). Methodologically, a two-step model is implemented and its results are assessed against several model specifications, as well as sample selections.

The approach used here for measuring intergenerational transmission differs from earlier studies in one important respect. Social stratification scholars have measured social backgrounds in terms of either social classes (Hadjar and Becker, 2016) or education (Reichelt, Collischon and Eberl, 2019). This practice produces biased conclusions because of unobserved variables simultaneously correlated with unobserved family characteristics and occupational attainment (Bukodi and Goldthorpe, 2013; Jæger, 2007; Marks, 2011). I instead focused on both social class and education. This change in the measurement allows the impact of a composite measure of family social background to be assessed (Meraviglia and Buis, 2015), producing unbiased estimates of the direct effect of social backgrounds on destinations.

Another difference from previous studies is that here the stratification of education systems is expected to affect the OD|E link through the extent to which the first selection into different school curricula is based on student ability instead of the age of the first selection. With the term first selection, I refer to the allocation of students into different school types or different curricula within a school for the first time in the educational career. The allocation can be based on either students' academic abilities or personal preferences, and lasts for the entire school day involving all subjects.

5.2 Previous literature

Previous studies investigating the effect of stratification of education systems on the OED triangle have mainly focused on the indirect path (i.e., through education), overlooking the influence that social backgrounds has on destinations beyond the effect exerted by education. To the best of my knowledge, there are only two exceptions: Hadjar and Becker's (2016) and Reichelt and colleagues's (2019) analyses. The latter shows that there is a correlation between stratification of education systems and the intergenerational transmission of occupational status once the mediating effect of education is controlled for. By including two country-level confounders, namely the vocational orientation of the education system and educational expansion, Hadjar and Becker (2016) show that the stratification of education systems has no statistically significant effect on the OD|E link. Thus, these findings seem to suggest the existence of a spurious association that vanishes as soon as the two country-level confounders are included in the model.

Despite their quite different conclusions, these two contributions to the literature also present quite different operationalizations of the constructs of interest. Hadjar and Becker (2016) measure the stratification of education systems with a dummy differentiating between weakly stratified systems and all other systems. In contrast, Reichelt and colleagues (2019) employ the index of tracking (Bol and Van de Werfhorst, 2013). Social background is operationalized as social classes in the former, and parental education in the latter. Most importantly, they also measure education differently. Hadjar and Becker (2016) distinguish between individuals who obtained at least a certificate of upper secondary general education and those that did not, while Reichelt and colleagues (2019) use a more detailed classification. As will be discussed in the method section, the operationalization of education has relevant consequences on the magnitude of the OD|E link.

It therefore appears quite difficult to directly compare these results and draw general conclusions from them. This underlines the need for further investigation into the effect that the stratification of education systems has on the direct effect of social backgrounds on destinations.

5.3 Does (and if so, how) the stratification of education system moderate the direct effect of social backgrounds on destinations?

Although with the data at hand it is not feasible to directly test the four mechanisms through which social backgrounds affect destinations, because they clarify whether the stratification of education systems moderates the OD|E link, their discussion is fundamental for the derivation of the hypotheses for this study. To this end, the four mechanisms are grouped and discussed according to the actors involved (employers and job seekers). First, I discuss the demand-side mechanisms and secondly the supply-side mechanism.

According to the literature, the direct effect of social backgrounds on destinations results from four mechanisms: favouritism, social connections, non-cognitive skills, and career aspirations[24] (Bernardi and Ballarino, 2016; Erikson and Jonsson, 1998; Hällsten, 2013; Mastekaasa, 2011; Reichelt, Collischon and Eberl, 2019). Favouritism refers to the practice of recruiting and hiring people who are similar, or have an analogous lifestyle. As employers often belong to the higher strata, according to this argument, they may prefer individuals who come from the same social background. Social networks make a difference in terms of information flow because having a high social background usually provides information about more prestigious occupations. Productivity differences are

[24] There is an additional mechanism consisting of succession planning from one generation to the next. In line with most of the literature, the direct inheritance of family businesses is disregarded (Erikson and Jonsson, 1998).

related to skills learnt while growing up that may be unrelated to education, but positively associated with productivity on the job such as social skills which are quite useful in the service sector (Jackson, Goldthorpe and Mills, 2005).

Since these first three mechanisms directly involve employers, their relative importance within the hiring process is compared with the relevance of another signal: applicants' educational qualifications. Theories of the school-to-work transition tell us that the reliability of educational qualifications depends on the amount of information they convey to employers (Gangl, 2003). Besides communicating expected levels of productivity (as argued by the human capital theory (Becker, 1964) and training costs (as stressed by the queuing theory (Thurow, 1975)), qualifications also inform employers about the risk of productivity loss (Glebbeek, Nieuwenhuysen and Schakelaar, 1989) that is, the risk employers face when applicants with the same qualification have heterogeneous skills and thus productivity levels. It can be argued that when education systems select according to student ability, employers may feel more reassured that graduates holding the same qualification have homogeneous productivity levels. Put differently, the more the education system selects its students based on their abilities, the more likely employers are to trust qualifications, as they convey the information needed for a successful match. Accordingly, the role of these three demand-side mechanisms becomes stronger when employers cannot sort applicants just by relying on their educational qualifications, that is, when the first selection into different school curricula is based more on self-selection than on student ability. In such a context, employers may rely more on ascriptive characteristics and, by making use of the three demand-side mechanisms discussed above, favour respondents from affluent social backgrounds (Goldthorpe, 1996). In contrast, when the first selection into different school curricula is based on student ability, social networks, non-cognitive skills, and favouritism may lose

their importance compared with education. Consequently, the first hypothesis states that *the more student ability matters during the first selection into different school curricula, the weaker the direct effect of social backgrounds on labour market attainment is (H5.1).*

Apart from the demand-side mechanisms, the remaining avenue through which social backgrounds affect occupational attainment is career aspirations. By assuming that a) aspirations are partly determined by parents' achievement, and that b) people want to avoid social demotion (Breen and Goldthorpe, 1997), researchers conclude that people from high social backgrounds need to obtain better and more prestigious occupations than those from low social backgrounds, even when they have reached the same level of education (Erikson and Jonsson, 1998). This means that, regardless of the stratification of the education system, families from higher social strata keep exploiting their resources to ensure that their least academically talented offspring get ahead in the occupational structure. This argument expands Lucas's (2001) Effectively Maintained Inequality theory (EMI) to occupational outcomes. As a result, when the supply-side mechanism dominates over the demand-side mechanisms, the alternative hypothesis posits that *the extent to which student ability matters during the first selection does not exert any moderating effect on the direct effect of social backgrounds on labour market attainment (H5.0 or null hypothesis)*.

5.4 Data

Data come from the European Social Survey (ESS). Although the ESS collects information on both parental education and occupation, it does not collect the four International Standard Classification of Occupations (ISCO) digits necessary to measure social classes (Erikson and Goldthorpe, 1992). At the cost of restricting the data to round

1 to 5, parental social class can be analysed employing a supplementary dataset elaborated by Harry Ganzeboom[25] (2013).

To integrate the ESS data with information on education system characteristics from a previous expert survey (Traini, 2019), the analytical sample targeted respondents born between 1973 and 1995.[26] In addition, the sample selection ignored respondents who obtained their educational qualification in another country, as well as those working in family businesses and the self-employed. The analyses were based on complete cases, which amount to 39,322 individuals in 34 countries (see Table 5.1).

[25] Because of the social selectivity in response rates, we may run the risk of underestimating the OD|E link in countries with relatively low response rates (Goldthorpe, 2007). In order to get a sense of how severely the present data suffer from this bias, additional checks (available upon request) show no association between the average ESS response rates and the proportion of missing on parents' class positions.

[26] Since the experts assessed how education systems were organized between 1980 and 2000, the respondents exposed to that specific arrangement were born between 1973 and 1995.

Table 5.1 Number of cases by country

Country		*Observations*
Austria	AT	1208
Belgium	BE	1367
Bulgaria	BG	1139
Croatia	HR	609
Cyprus	CY	740
Czech Republic	CZ	1745
Denmark	DK	1068
Estonia	EE	1292
Finland	FI	1550
France	FR	1548
Germany	DE	1878
Greece	GR	1525
Hungary	HU	1399
Iceland	IS	95
Ireland	IE	1641
Israel	IL	1350
Italy	IT	206
Latvia	LV	331
Lithuania	LT	408
Luxembourg	LU	215
Netherlands	NL	1346
Norway	NO	1485
Poland	PL	1899
Portugal	PT	1472
Romania	RO	301
Russia	RU	1983
Slovakia	SK	1335
Slovenia	SI	870
Spain	ES	1659
Sweden	SE	1033
Switzerland	CH	1182
Turkey	TR	475
Ukraine	UA	1395
United Kingdom	UK	1573
Total		*39,322*

Source: ESS (2002-2010).

5.5 Method and operationalization

The hypotheses were tested with two-step models also known as Estimated Dependent Variable Models (Lewis and Linzer, 2005). In the first step, regression models were run separately for each country. In the second step, the estimates of the previous

stage were regressed on institutional variables. More specifically, in the first step, occupational attainment was regressed on parental social class and education, controlling for respondent education, age, and sex. Since I am interested in the remaining effect of social backgrounds once education is controlled for, the individual-level analysis was affected in the following way. First, to measure respondent occupational attainment, I used Treiman's Standard International Occupational Prestige Scale (SIOPS). SIOPS appears best suited to this research question because it accounts for occupational standing, while disregarding individuals' educational achievements (Ganzeboom and Treiman, 1992).

Second, information on respondent education needs to be as detailed as possible to avoid poor measurements of achieved education leading to an overestimation of the social background effect (Erikson and Jonsson, 1998). Additionally, a more detailed measure avoids underestimating social background differences in educational attainment (Bernardi and Ballarino, 2016; Hällsten, 2013). Unfortunately, no fine-grained variable simultaneously measuring vertical and horizontal (general vs. vocational) education is available for all the rounds of the ESS. Therefore, the variable employed in the analysis measures respondent educational achievement using 5 categories defined by the first digit of the International Standard Classification of Education (ISCED): 1) up to primary education (ISCED 0-1); 2) lower secondary education (ISCED 2); 3) upper secondary education (ISCED 3); 4) post-secondary non-tertiary education (ISCED 4); 5) tertiary education (ISCED 5-6).

Social backgrounds were measured using parental social class and education. Both measures report the highest category within the family. Social class was defined according to six categories: higher service class (I); lower service class (II); routine nonmanual (IIIab); self-employed (IVabc); skilled manual workers (V+VI); and

unskilled manual workers (VIIab) (see Erikson and Goldthorpe 1992). Educational credentials were measured by means of three categories: a) up to ISCED 2, b) ISCED 3 and 4, and c) ISCED 5 and 6. Dummies for N-1 rounds were also included in the model specification to capture differences between the five rounds. Descriptives are reported in Table 5.2.

Table 5.2 Number of cases by country

Variables		*%*
Parental social class	I	18.52
	II	24.37
	IIIab	15.51
	IVabc	7.33
	V & VI	16.65
	VIIab	17.63
Parental education	Up to ISCED 2	27.74
	ISCED 3 and 4	48.26
	ISCED 5 and 6	23.99
Sex	Male	48.10
	Female	51.93
Education (ISCED)	Up to ISCED 1	2.81
	ISCED 2	11.93
	ISCED 3	45.98
	ISCED 4	4.45
	ISCED 5-6	34.84
ESS round	2002	9.10
	2004	12.81
	2006	14.00
	2008	22.23
	2010	41.88
	Mean	SD
Age	27.90	4.99
SIOPS	40.52	13.56

Source: ESS (2002-2010).

The equation of the first step is reported below:[27]

Respondent's SIOPS = β_0 + β_1 parental EGP(II) + β_2 parental EGP(IIIab) + β_3 parental EGP(IVabc) + β_4 parental EGP(V & VI) + β_5 parental EGP(VIIab) + β_6 parental edu(ISCED 3 & 4) + β_7 parental edu(ISCED 5 & 6) + β_8 R's age + β_9 R's sex + β_{10} R's edu(ISCED 2) + β_{11} R's edu(ISCED 3) + β_{12} R's edu(ISCED 4) + β_{13} R's edu(ISCED 5-6) + $\beta_{14\text{-}17}$ ESS round +e

Standard errors are clustered by round. The attention lay on the coefficients measuring social backgrounds (social class: β_1, β_2, β_3, β_4, and β_5; and parental education: β_6 and β_7 where EGP I and ISCED 0-2 act as reference categories). The sheaf coefficient was used to summarize these country-values into one single measure identifying the cumulative effect of social backgrounds (Buis, 2009).

The equation at the second step is reported below:

OD|E = β_0 + β_1 age of first selection + β_2 ability-based first selection + β_3 educational expansion + β_4 education-LM linkages + e

To be sure that the theoretically identified effect of stratification of education systems moderates the OD|E link through the extent to which the first selection is based on student ability, the equation also included the time of the first selection. The latter records at which age students are separated for the first time into different schools or different curricula within schools.[28] The former reports the extent to which this first

[27] I used the provided design weights to account for the unequal selection probabilities in some countries.
[28] The age of first selection has changed in some countries therefore pre and post reform groups were distinguished within countries. Because of the low number of cases in the after-reform group, I only investigated the before groups.

allocation is associated with student ability, and ranges from 0 “not at all based on student ability” to 100 “completely based on ability”. For more information on the expert survey, see the detailed description reported in Traini (2019). Appenidx A also includes the original questionnaire.

Along with the two dimensions of the stratification of education systems (the extent to which the first selection is based on student ability and the age of first selection), the equation also controlled for educational expansion. The indicator of educational expansion is the percentage of people having a tertiary degree among the population aged 25 and older. Barro and Lee (2013) provide measurements every five years and those matching the collection period of the first 5 rounds of the ESS (2002 to 2010), refer to 2000, 2005, and 2010. Among these, the measurement employed in the analyses was that which had the highest number of ESS respondents i.e., 2010 (see Table 5.2). Additional analyses showed that the results are robust to the other values of the indicator (i.e., 2000 and 2005).

The indicator of the linkages between education systems and labour markets was also provided by the above-mentioned expert survey. In brief, the indicator measures the extent to which private industries are involved in the design of school-based vocational curricula and dual systems. The indicator ranges from 0 (industries not involved in either school-based nor apprenticeship programs) to 100 (industries participate actively in both).

Besides their role as confounders, controlling for vocational orientation and educational expansion is also required from a methodological point of view (Breen, 2018). Since respondents’ education is fixed, the equation needs to condition on the country-level variables that affect respondent’s educational and occupational attainment (namely, vocational orientation and educational expansion).

Table 5.3 reports the correlations between the institutional variables at the country level. All the values are quite low, confirming that the indicators measure different aspects of the institutional setup and can therefore be introduced in the model simultaneously.

Table 5.3 Pairwise correlations at the country-level

	Extent to which the first selection is based on students' ability	Age of first selection	Linkages between education system and labor market
Age of first selection	0.16		
Linkages between education system and labor market	0.09	-0.14	
Educational expansion	0.19	0.22	-0.04

Source: Barro and Lee (2013) and expert survey.

5.6 Findings

Figure 5.1 shows the results of the first step of the analysis. The black dots represent the coefficient of the OLS country-wise models, with the bars displaying the 95% confidence intervals. In all the countries, social backgrounds (measured by social class and education) are shown to exert a positive and statistically significant effect on SIOPS, when education and the other individual confounders are held constant. This means that regardless of educational credentials, individuals coming from advantaged social backgrounds reach better occupational position than those coming from disadvantaged social backgrounds.

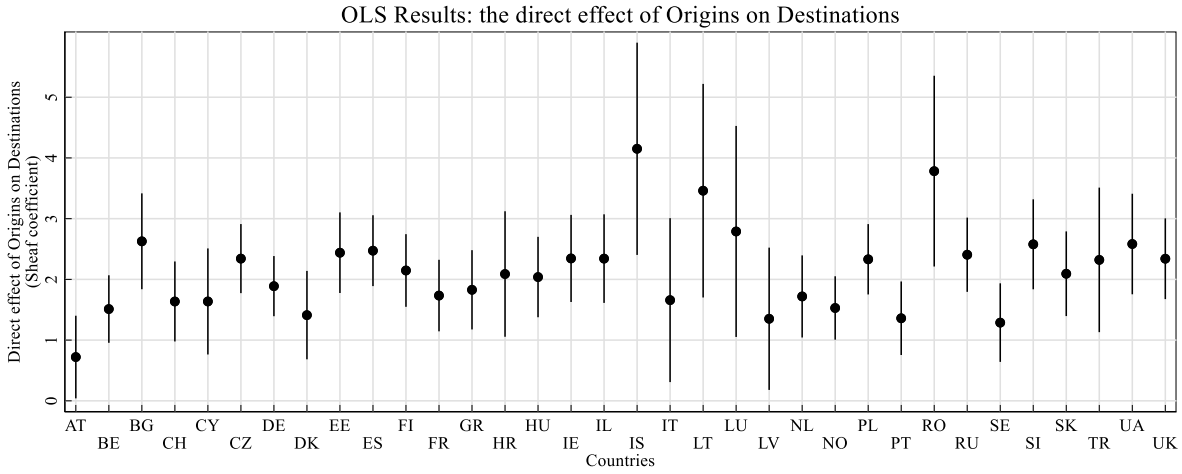


Figure 5.1: the direct effect of social backgrounds on destinations (first step)

Note: the explanation of country abbreviations can be found in Table 5.1

Source: ESS (2002- 2010).

To test the null hypothesis (H5.0), it was necessary to investigate whether the extent to which the first selection is based on student ability has an impact on the direct effect of social backgrounds on occupational attainment: in other words, whether the effect of stratification of education systems exists. To do so, the equation of the second step was estimated.

Figure 5.2 displays the bivariate plot between the direct effect of social backgrounds on occupational attainment (reported on the vertical axis) and the extent to which the first selection is based on student ability (on the horizontal axis).

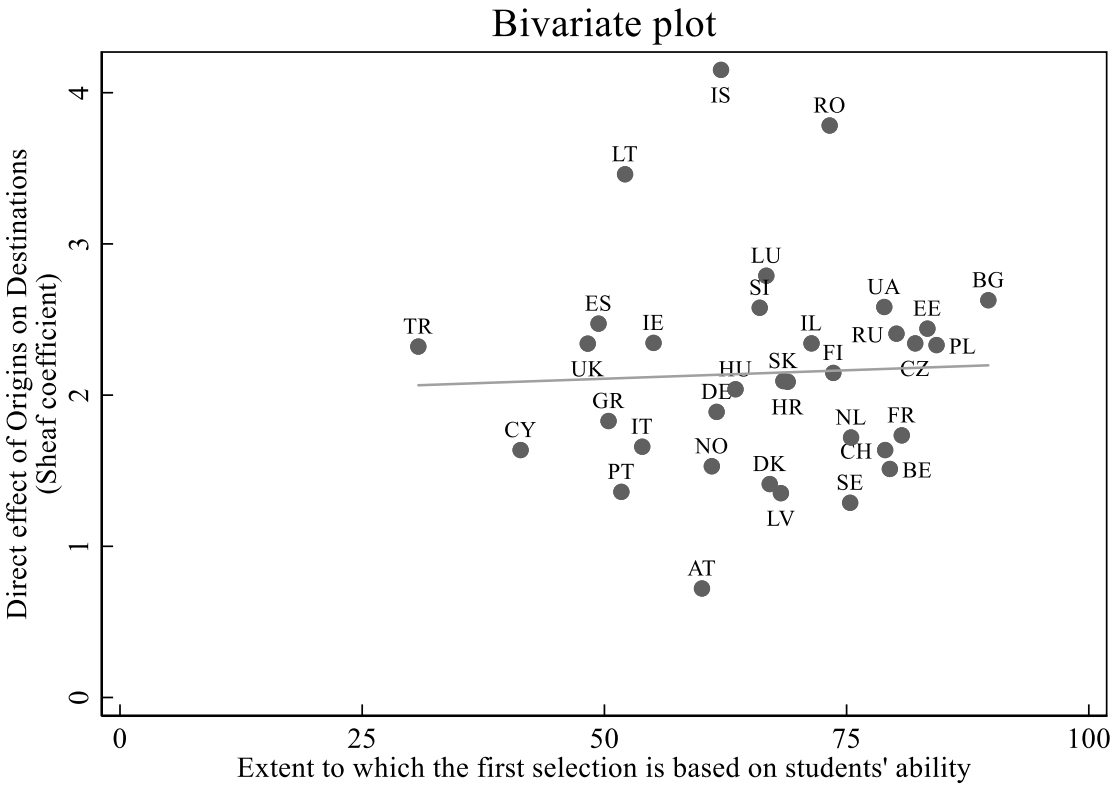


Figure 5.2: Association between the direct effect of social backgrounds on destinations and the extent to which the first selection is based on students' ability (second step)

Note: the explanation of country abbreviations can be found in Table 5.1

Source: ESS (2002- 2010).

This step allows any correlation between the two variables of interest to be identified, thus enabling these results to be compared with those from the previous literature (Reichelt, Collischon and Eberl, 2019). Figure 5.2 does not suggest the existence of any associations between the extent to which the first selection is based on student ability and the OD|E estimates. Since Reichelt and colleagues (2019) employed the index of tracking (Bol and Van de Werfhorst, 2013) to measure the stratification of education systems, additional analyses were conducted, replacing the indicators collected through the expert survey by the index of tracking. Findings show that even with a

different indicator of the stratification of education systems, the correlation remains statistically not significant (analyses available upon request).

Once the other indicator of the stratification of education systems (i.e., age of first selection) and the two confounders at the country-level were included in the regression model, Table 5.4 shows that the extent to which the first selection is based on student ability has no statistically significant effect on the direct effect of social backgrounds on occupational attainment. These results are thus in line with those reported by Hadjar and Becker (2016).

Table 5.4 OLS Regressing the direct effect of social backgrounds on Destinations on institutional variables (second step)

Extent to which the first selection is based on students' ability	0.00
	(0.01)
Age of first selection	0.03
	(0.07)
Linkages between education system and labor market	-0.01
	(0.01)
Educational expansion	0.00
	(0.02)
Constant	2.14***
	(0.13)
R^2	0.04
N	34

*Standard errors in parentheses, + p < 0.10. * p < 0.05. ** p < 0.01. *** p < 0.001*
Source: ESS (2002-2010) and expert survey.

Looking at the confidence interval of the estimates, Table 5.4 illustrates that our data are compatible with a negative, a null, and a positive effect of the extent to which the first selection is based on student ability on OD|E. At this point the question remains of whether the null effect is the most likely outcome (Bernardi, Chakhaia and Leopold, 2007; Masson, 2011).

As the likelihood ratio measures how strongly the observed data are predicted by two competing hypotheses, it can be used to compare the 'null' hypothesis (existence of

a null effect) to the 'alternative' hypothesis (which hypothesizes the existence of an effect different from zero). The first 'null' model included only one dimension of stratification of education systems (the timing of the first selection) and the two confounders, whereas the second 'alternative' model added the extent to which the first selection is based on student ability.

By computing the maximum-likelihood ratio, I obtained an index of the strength of the evidence for one model relative to the other (Glover and Dixon, 2004; Masson, 2011). In the current case, the test statistic was 0.04 with a p-value of 0.84. This means that the null model fits the data better than the alternative model.

Turning to the initial hypotheses, the findings clarify that the null hypothesis is supported by the data, whereas H5.1 is rejected. Substantively, the extent to which the first selection is based on student ability does not moderate the association between social backgrounds and destinations while the effect of education is kept constant.

5.6.1 Sensitivity analyses

To assess whether the findings result from methodological choices, robustness checks were run. The analyses are available upon request. First, I altered the operationalization of respondent destinations. To account for occupational upgrading trends, I standardized SIOPS by country and cohort. Another change applied consisted of using the International Socio-Economic Index of Occupational Status (ISEI) instead of SIOPS. Results hold across these alternative models.

The second series of sensitivity checks involved more detailed measurements of respondent education. Along with the measurement here employed, the checks included years of education or the International Standard Level of Education ISLED (Schröder and Ganzeboom, 2014). To see whether a finer classification of respondent education would change the results, the analytical sample was restricted to contain only the last

round of the ESS, where the questionnaire includes a much more detailed classification (the same used by Reichelt and colleagues (2019)).[29] For all these three specifications, the effect of the extent to which the first selection is based on student ability is null.

An additional remark needs to be made regarding our initial measurement of education, which may not perform equally well across countries (Schneider, 2008). An indirect way to test this potential bias is to compare the estimates of the direct effect of social backgrounds on destinations obtained by employing different variables of individuals' education. To do so, I relied on the restricted analytical sample employed in the last robustness check. In the process, I was forced to exclude the seven countries that did not participate in this last round of the ESS (Austria, Iceland, Italy, Luxembourg, Latvia, Romania, and Turkey).

Figure 5.3 reports the different estimates of the OD|E effects by the two different measurements of education available. The black estimates (with their confidence intervals) were computed employing the ISCED classification with 1 digit, which is the one used in this paper. The grey estimates were obtained employing the much more detailed measure of respondent education (see footnote 29). If the grey estimates are lower than the black estimates, the measurement of education used in this analysis over-estimates the direct effect of social backgrounds on destinations. In most of the cases, the grey estimates are smaller, as we would have expected. Nevertheless, Figure 5.3 shows that the estimates are quite close to each other: the biggest differences are found in Greece (1.0), Ukraine, Czech Republic (1.3), and Slovenia (1.5). However, if we compare these values with the theoretical range of the dependent variable, (the SIOPS scale ranges from 12 to 80), the positive bias does not seem particularly severe, thought its possibility should still be kept in mind. This conclusion, of course, holds for the more detail

[29] This finer classification has 3 digits. For more info see http://nesstar.ess.nsd.uib.no/webview/.

measurement available in the ESS round 5, and for the 27 countries that took part in this round.

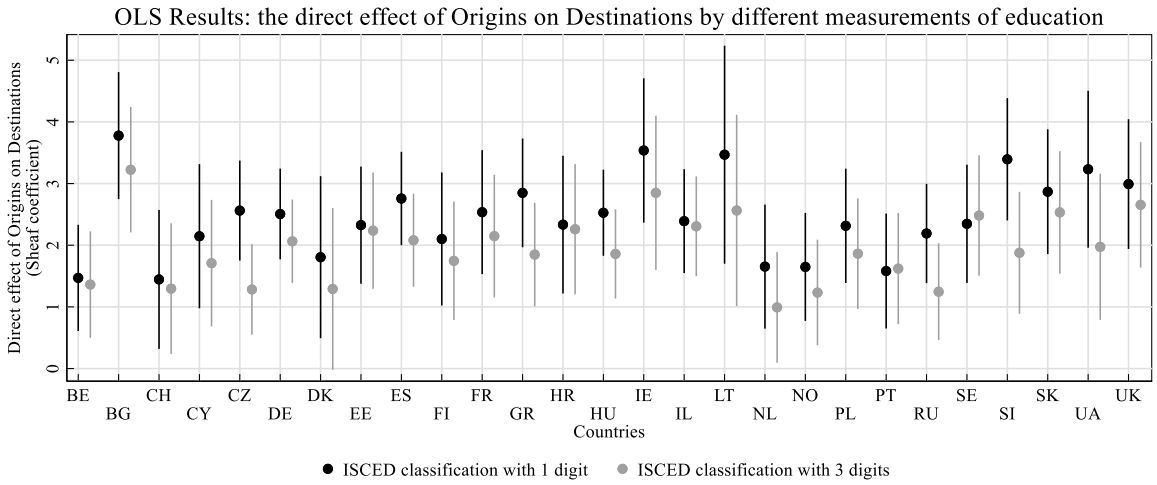


Figure 5.3: Estimates of the direct effect of social backgrounds on destinations by different measurements of education

Note: the explanation of country abbreviations can be found in Table 5.1

Source: ESS (2002- 2010).

Another check involves the measurement of social backgrounds. This is especially relevant as, in the original model, I proposed to parsimoniously capture information on parental social class and education into the sheaf coefficient. Since this choice might be questioned, the individual-level model was repeated using single indicators of social backgrounds: ISEI, education, EGP, and the International CAMSIS scale of social distance between occupations (ICAM). The size of the effect of our main independent variable is robust against these specifications.

Finally, it could be argued that this analysis should account for labour market experience. To avoid losing too many cases restricting the analytical sample to either labour market entrants (Gangl, 2003) or occupationally mature respondents (Bukodi,

Paskov and Nolan, 2019), the model included a proxy for labour market exposure. Also in this case, the effect of the extent to which the first selection is based on student ability on the OD|E link is null.

Besides changing the individual-level variables, the robustness checks also involved the indicator of stratification of education systems. By employing the index of tracking (Bol and Van de Werfhorst, 2013), findings show that the latter is not statistically significantly associated with the OD|E link even when educational expansion and vocational training systems are controlled for. Together with the findings of this paper, this result provides additional support for the conclusion that the stratification of education systems is not associated with the OD|E link.

In the last check, the countries with decentralized educational systems (i.e., Belgium, Germany, Switzerland, and the UK) were omitted from the analyses. When these cases were excluded, the effect of the extent to which the first selection is based on student ability remained statistically not significant.

5.7 Conclusions

The results discussed here show that OD|E does not depend on the extent to which the first selection is based on student ability. This conclusion holds across all the robustness checks described above. These findings are in line with previous results showing that intergenerational mobility does not vary across countries with different institutions (Clark, 2014; Erikson and Goldthorpe, 1992; Featherman, et al., 1975; Grusky and Hauser, 1984; Lipset and Zetterberg, 1959) and, more specifically, across countries with different levels of stratification of education systems (Hadjar and Becker, 2016).

The stratification of education systems is measured by two different indicators: the extent to which the first selection is based on student ability, and the age of first

selection. This result shows that beyond the timing of the first selection, the extent to which education systems select upon student ability does not moderate the OD|E association.

Furthermore, the bivariate findings contradict the results reported by Reichelt and colleagues (2019). Since it has already been proven that this incongruence is due to neither the indicator of stratification of education systems, nor the measurement of respondent education and occupation, I carried out additional analyses to replicate Reichelt and colleagues' analysis as closely as possible. In this final check, I employed different operationalizations of social backgrounds and occupational attainment simultaneously.[30] Here, social backgrounds are measured by parental education and, instead of SIOPS, occupational attainment is measured by ISEI. Results show a positive (0.02), although not statistically significant, bivariate association. Once I included the other indicator of stratification of education systems (i.e., the age of first selection) and the confounders, the coefficient decreased by half. Since the range of possible effect sizes still included a null effect of ability-based selection, the maximum-likelihood ratio test between the null and alternative model was replicated on these new values. The null hypothesis still finds support (2.47 with a p-value of 0.12). This replication further strengthens the findings discussed in this article, as they are highly robust to different operationalizations.

In this paper, I also address another issue concerning how social backgrounds are operationalized to properly capture the type of resources through which parents exert their influence on their offspring's occupational attainment. In accordance with previous

[30] The decision to replicate this finding instead of those of Hadjar and Becker (2016) is due to the detailed measurement of achieved education employed by Reichelt and colleagues (2019) that guarantees a lower risk of upwardly biased direct effect of social backgrounds (Erikson and Jonsson, 1998). Furthermore, Hadjar and Becker (2016) have not released the information necessary to replicate their classification of education systems.

studies (Bukodi and Goldthorpe, 2013; Meraviglia and Buis, 2015), I expanded the conceptualization of social backgrounds to include two components, namely cultural and economic resources measured on both parents.

From a substantive point of view, since the construction of the hypotheses assumes the dominance of one avenue over the other (supply-side in case of the null hypothesis and demand-side in case of the first hypothesis), the current result seems to suggest that the OD|E link is predominantly driven by career aspirations. Arguably, the direct effect of social backgrounds on occupational attainment seems to be due to persons of higher and lower social standing being more or less career-oriented and willing to make risky choices in the labour market. Nevertheless, since it is not possible to directly investigate these micro-mechanisms with the data at hand, this conclusion lies in the realm of speculation. Further studies should thus try to focus on these micro-mechanisms to provide clear recommendations to policymakers.

Appendix A. The expert survey's questionnaire

The questionnaire was divided into 3 sections and each section was introduced by an instruction page with information regarding: a) the educational level they should refer to and b) the time period they should consider.

The goal of the first section was to assess whether respondents were using the extreme values on the response scale and make sure that the scope of the survey (i.e., provide information on one education system to be compared with other systems) was clear to respondents. The second section aimed to obtain expert's opinions on the indicator of the stratification of education systems, while the third, and final section, focused on the other characteristics of education systems: linkages between education systems and labour markets, standardization and centralization.

In the ***first section***, experts were asked to rate their education system against the ones of the US and Germany. Experts were always asked to rate their system first, then the German one (in case of non-German experts), and finally the American one. To guide them, each question provided a specific definition. This was the only section in which experts had no time frame to refer to. There were 4 questions total: tracking, standardization, centralization and linkages between education and labour market. Figure A1 displays a screenshot of one of the questions. Experts could reply using a slider.[31] I opted for this tool in order to obtain nuanced responses. The answer consisted of a continuum with 'not tracked' (=0) and 'tracked' (=100) as extreme values. Neither the pointer (usually located in the slider's start position) nor the labels in between the extremes were shown.[32] Instead of providing numbers, the extremes of the slider were

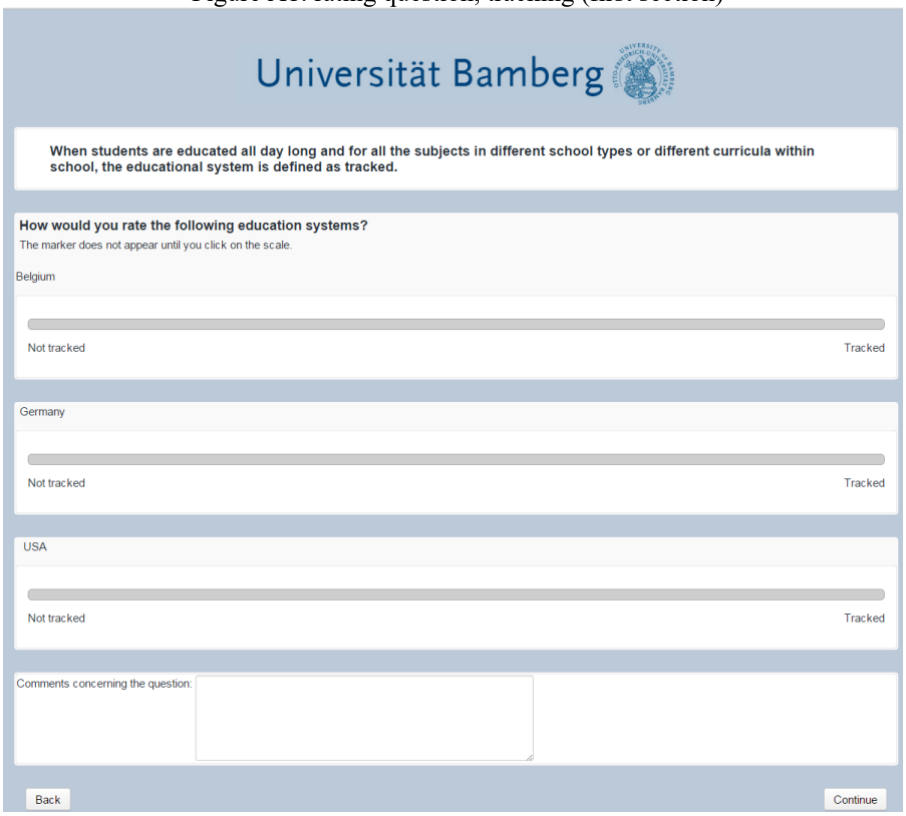
[31] This description applies to all the other questions in the questionnaire that employ the same tool.

[32] By construction, when the pointer appears on one extreme and the respondent does not move it from there, it is not possible to distinguish between those who decide to do it on purpose from those who do not answer to the question.

labelled. To avoid providing additional and possibly misleading name tags, no labels in between the extremes were given (Krosnick, 1999).

As currently done in expert surveys (see Busemeyer and Schlicht-Schmälzle, 2014), the bottom of each page included a box where experts could leave comments or remarks. Studies show that offering a 'don't know' option causes more people to report that they do not know their answer than when such an option is omitted (Krosnick, 2002).

Figure A1: rating question, tracking (first section)



The main indicators of the stratification of education systems were asked ***in the second section***. They were preceded by the instruction page that asked experts to focus on secondary education and to keep in mind what the education system looked like between 1980 and 2000.

To account for changes over time, the questionnaire inquired about major educational reform(s). In the case of a positive response, they had to provide information on whether

the reform changed the specific indicator by specifying how many and how the system was structured before and after the implementation of each reform. The tree structure is reported in Figure A2.

Figure A2: tree structure, age of first selection (second section)

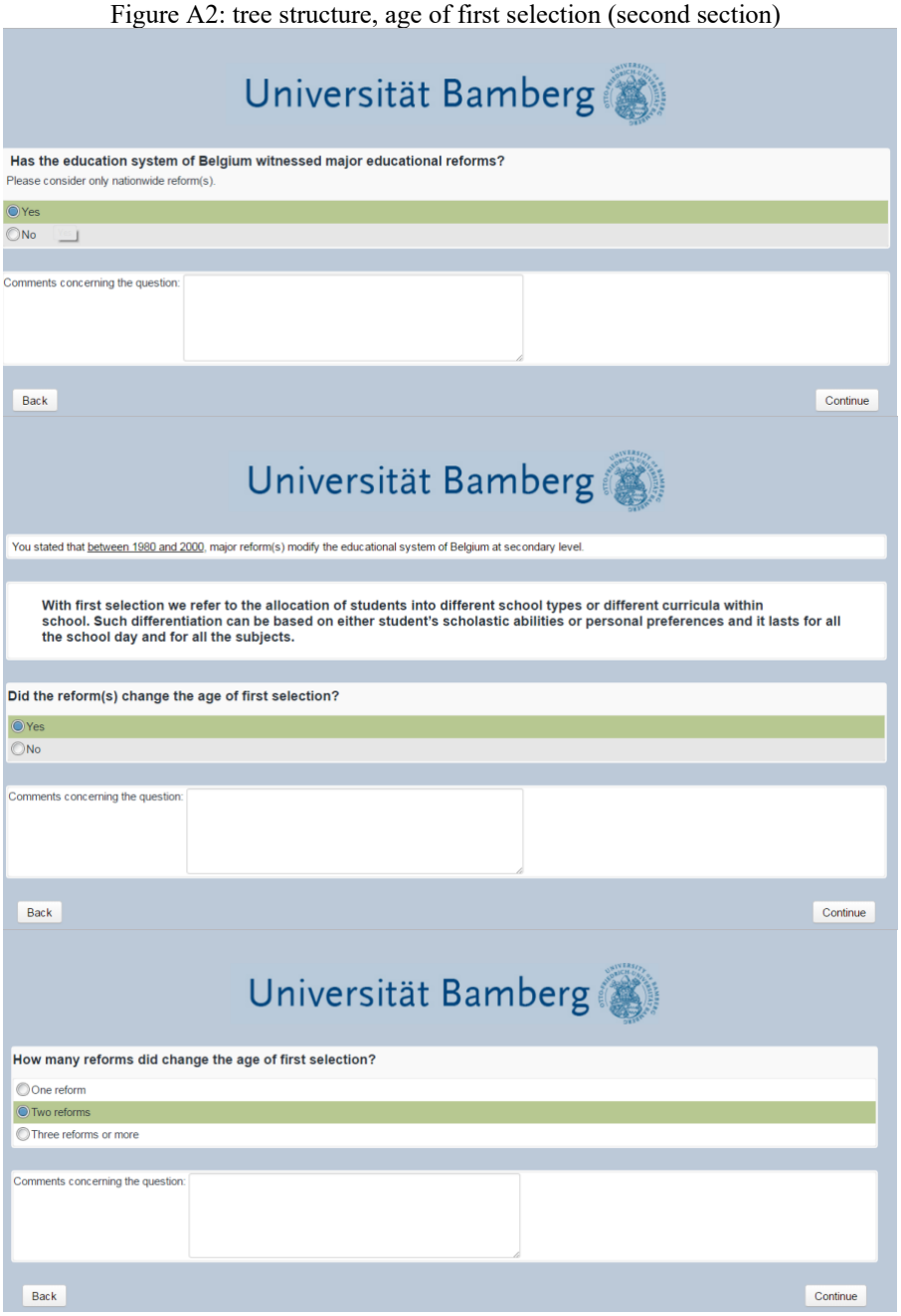
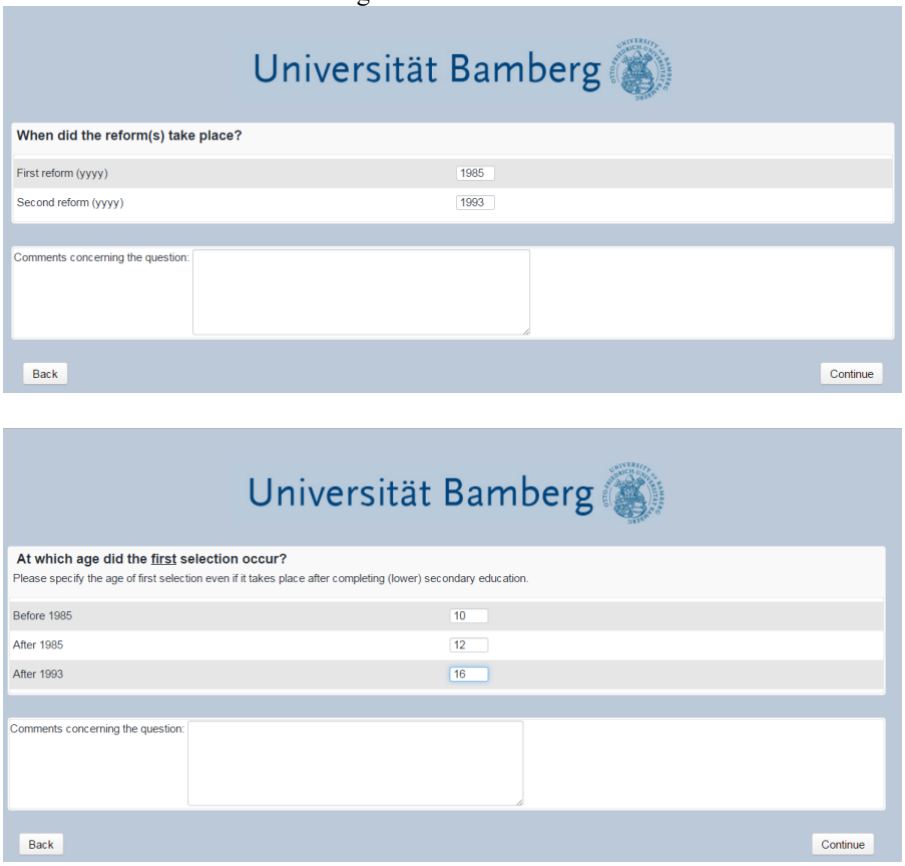


Figure A2: continued



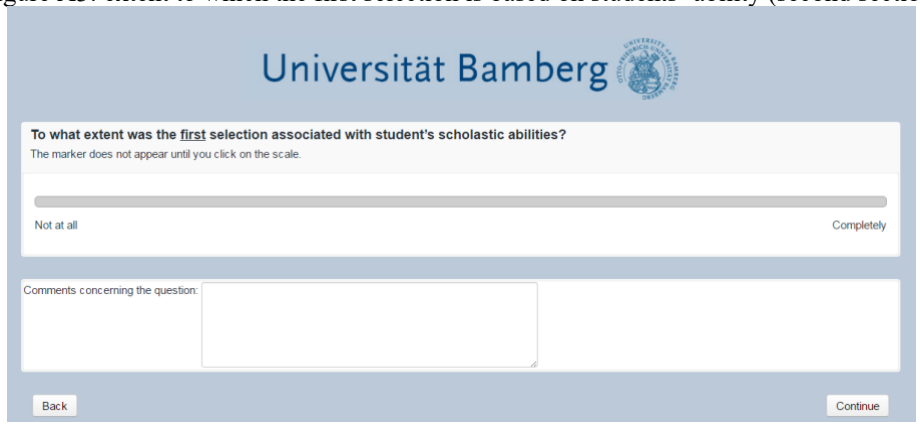
To be sure that all the experts had the same concept in mind, a brief definition was provided. "With the first selection, we refer to the allocation of students into different school types or different curricula within school. Such differentiation can be based on either student's scholastic abilities or personal preferences and it lasts for all the school day and all the subjects."

For the first dimension of stratification of education systems, the questionnaire included the following question: 'at what age did the first selection occur?'.

For the second dimension, assignment criteria, the question was: 'to what extent was the first selection associated with student's scholastic abilities?' and the provided answer was a slider with 'not at all' and 'completely' as extreme values.[33]

[33] The tree structure has been replicated for this indicator. Few experts declared that at least one reform has modified this dimension. In some of these cases, experts reported very similar values before and after the reform denoting no relevant change over time. In the case of a positive answer for more than one expert within a country, they reported very different reform. Once asked, through clarification email, they did not

Figure A3: extent to which the first selection is based on students' ability (second section)



To measure the extent to which the education system channelled students into predefined and fixed educational paths (i.e., the rigidity of the educational system) an additional indicator was initially included. To measure the likelihood to which students who initially opted for the vocational route were allowed to switch into the most prestigious ones, the indicator recorded the percentage of vocationally trained school-leavers who enrolled at tertiary level. Following the practice of recent research, the definition of upper secondary vocational programmes was taken for granted (Bol and Van de Werfhorst, 2013). Despite being widely used, the concept of upper secondary vocational programmes created a lot of confusion among the experts. As I learned from their comments, some defined upper secondary vocational programmes by adding technical to vocational programmes while others only accounted for occupational specific courses. Additionally, in the clarification emails, some experts wrote that instead of vocational upper secondary graduates they considered upper secondary school-leavers in general.

reply while their colleagues who reported no change over time did so. Poland is the only case where all the experts agreed (reform in 1999) which is only one year before the end of our observational window. As a result, this indicator has been built as time constant.

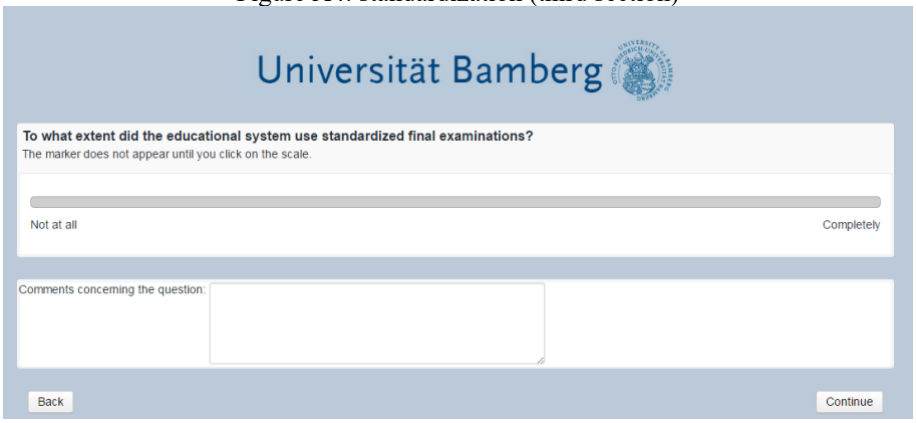
The questionnaire also included a few questions about further forms of differentiation (e.g., public versus private, within school differentiation according to either additional subjects or students' ability). For each chosen answer, the tree structure was repeated. For these specific questions, a significant number of missing values emerged along with numerous comments and remarks signalling experts' uncertainty about the given answers. This section has therefore been disregarded.

Moreover, 'not at random' missing values constitute another problematic issue. As documented by one Irish expert: "VET tends to be provided as a post-school option in the Irish system so there are no secondary vocational leavers". This means that the reason for the observations being missing depends on the missing values themselves (Little and Rubin, 2002). Also, the values of Luxembourg are quite problematic because, as explained by the experts themselves, no universities were established before 2003. This means that these values refer to students who moved to another country to get access to tertiary institutions. Therefore, these values are probably driven by mechanisms not exclusively related to the stratification of the education system. By recognizing the limitations concerning measurement errors and mechanisms generating missing values, the data collected for this specific indicator has been disregarded.

The third section of the questionnaire aimed at collecting information on the additional country-level indicators, namely standardization, centralization, and linkages between education and labour market. The introduction page recommended considering how the overall system looked between 1980 and 2000.

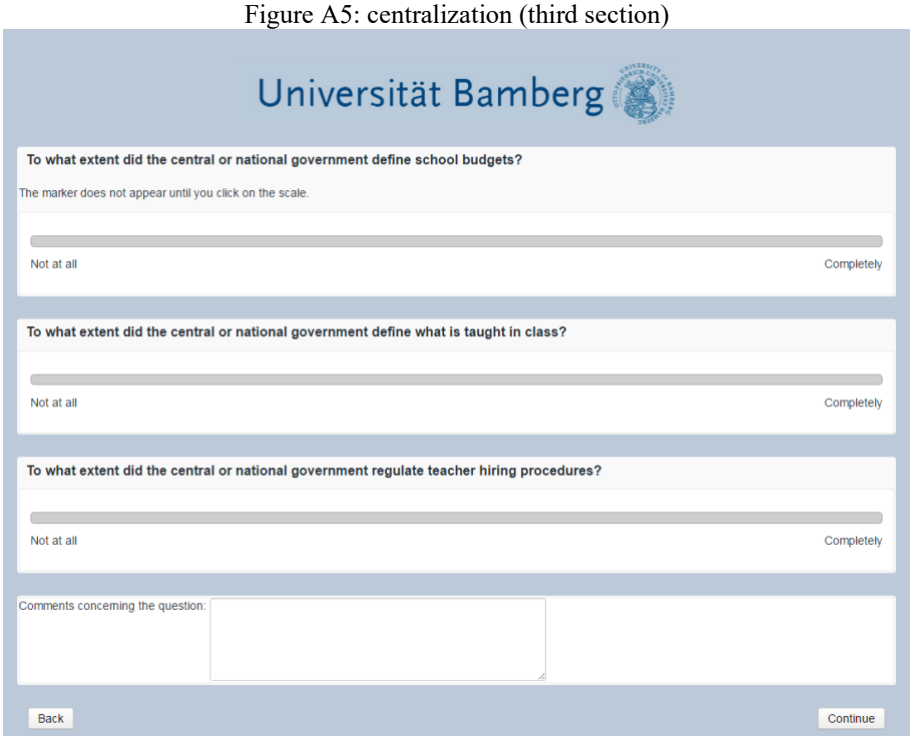
To measure the level of standardization the question reads: '*to what extent did the educational system use standardized final examinations?*'.

Figure A4: standardization (third section)



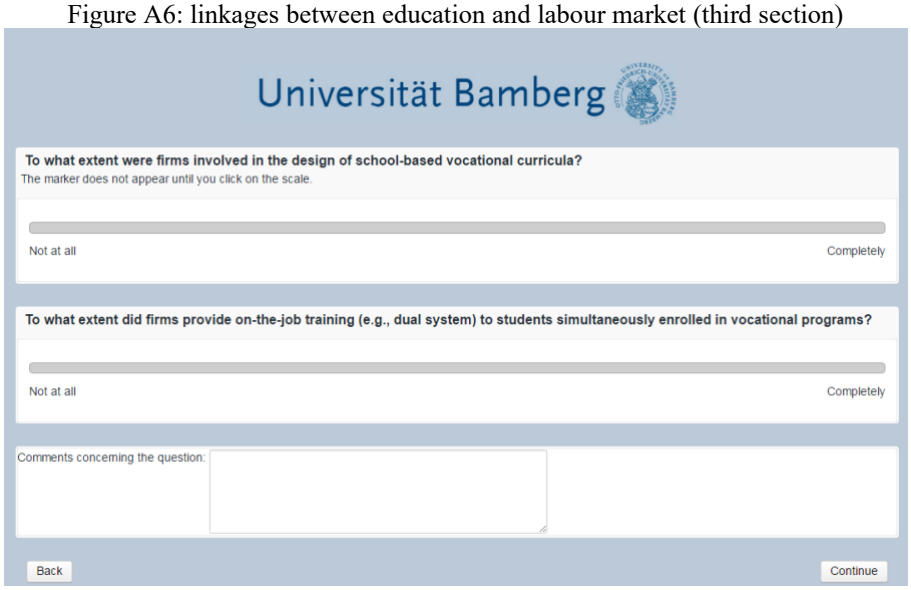
Concerning centralization, the question targeted the extent to which the national government defined school budgets, curricula, and teacher hiring procedures. The questions thus stated, ‘to what extent did the central or national government: a) define school budgets? b) define what is taught in class? c) regulate teacher hiring procedures?’.

Figure A5: centralization (third section)



The last two questions covered linkages between education and labour market. As shown in the screenshot, the questions asked, ‘to what extent a) were firms involved in the design of school-based vocational curricula? b) did firms provide on-the-job training (e.g., dual system) to students simultaneously enrolled in vocational programs?’.

Figure A6: linkages between education and labour market (third section)



As usual, at the end of the survey respondents could express their preference for having their names registered in the list of contacted experts.

Table A1: Experts' institutional affiliation

	Initial seeds	*Suggested experts*
Austria	1. X, Department of Sociology of the University of Vienna 2. Martin Unger, Institut für Höhere Studien – Institute for Advanced Studies (IHS) Vienna	3. X, Department for Continuing Education Research and Educational Management, Donau-Universität Krems (University for continuing education) 4. Peter Schlögl, Austrian Institute for Research on Vocational orientation 5. Kurt Schmid, Austrian Institute for Research on Vocational orientation
Belgium	6. Van Houtte Mieke, Department of Sociology, Ghent University 7. X, Department of Sociology, University of Tübingen	8. Jan Van Damme, Faculty of Psychology and Educational Sciences, University of Leuven 9. X, Faculty of Psychology and Educational Sciences, University of Leuven 10. Jef C. Verhoeven, Sociological research, Emeritus, University of Leuven 11. Simon Boone, Department of Political Science, Vrije Universiteit Brussel 12. Kurt De Wit, Education Policy Department, University of Leuven 13. Peter Van Petegem, Instructional and Educational Sciences, University of Antwerp 14. Dominique Lafontaine, Department of Education and Training, research centre, University of Liege
Bulgaria	15. Rumiana Stoilova, Institute for the Study of Societies and Knowledge, Bulgarian Academy of Sciences 16. Pepka Boyadjieva, Institute for the Study of Societies and Knowledge, Bulgarian Academy of Sciences	17. Blagoevgrad Boyan Zachariev, Research Institute, Open Society Institute – Sofia (OSI) 18. X, Institute for the Study of Societies and Knowledge, Bulgarian Academy of Sciences 19. Petya Ilieva-Trichkova, Institute for the Study of Societies and Knowledge, Bulgarian Academy of Sciences
Croatia	20. Matković Teo, Faculty of Law, University of Zagreb 21. Saša Puzić, Institute for Social Research in Zagreb 22. X, University of Zagreb	23. Milan Matijević, Faculty of Teacher Education, University of Zagreb 24. Nikola Pastuovic, Educational psychology, Emeritus, University of Zagreb

Cyprus	25. Loizos Symeou, Department of Education, European University Cyprus 26. X, School of Arts & Education Sciences, European University Cyprus	27. Elena Papanastasiou, School of Education, University of Nicosia 28. Petros Pashiardis, Studies in Education Program, Open University of Cyprus 29. Panayiotis Persianis, University of Cyprus 30. Emilios Solomou, School of Humanities and Social Sciences, University of Nicosia
Czech Republic	31. Jana Straková, Institute for the Research and Development of Education, Faculty of Education, Charles University in Prague 32. Martin Kreidl, Faculty of Social Studies, Masaryk university	33. Natalie Simonová, The Czech Academy of Sciences, Institute of Sociology 34. Petr Soukup, Institute Of Economic Studies, Faculty Of Social Sciences, Charles University in Prague
Denmark	35. Kristian Karlson, University of Copenhagen	36. X, Danish National Centre for Social Research 37. X, Danish National Centre for Social Research 38. X, Danish National Centre for Social Research 39. X, Danish School of Education, Aarhus University 40. Peter Allerup, Danish School of Education, Aarhus University
Estonia	41. Unt Marge, Institute of International and Social Studies, Tallinn University 42. Ellu Saar, Institute of International and Social Studies, Tallinn University 43. Kadri Täht, School of Governance, Law and Society, Tallinn University	44. X, Eurydice programme coordinator
Finland	45. Jani Erola Faculty of Social Sciences, University of Turku 46. Juho Härkönen, Department of Sociology, Stockholm University	47. X, Faculty of Social Sciences, University of Turku 48. Elina Kilpi-Jakonen, Faculty of Social Sciences, University of Turku

France	49. Elise Tenret, Université Paris Dauphine 50. Louis-André Vallet, CNRS & Sciences Po Paris 51. Mathieu Ichou, French Institute for Demographic Studies (INED)	52. Denis Fougere, CNRS, OSC, Education Policies Research Group, Science Po Paris 53. X, University of Burgundy 54. Christine Guégnard, University of Burgundy Franche Comté 55. Jake Murdoch, Institute for Research in the Sociology and Economics of Education (IREDU), University of Burgundy Franche-Comté
Germany	56. Marita Jacob, Institute for Sociology and Social Psychology, University of Cologne	57. Christiane Gross, University of Hannover 58. X, German Centre for Higher Education Research and Science Studies 59. Volker Stocké, University of Kassel 60. X, WZB Berlin Social Science Center 61. Julia Schilling, German Institute for International Educational Research (DIPF) 62. X, Department of Educational Research and Social Systems, University of Berlin 63. X, German Institute for International Educational Research (DIPF) 64. X, German Institute for International Educational Research (DIPF) 65. X, University of Mannheim
Greece	66. Tsakloglou, Panagiotis, Athens University of Economics and Business 67. Eleni Sianou-Kyrgiou, Department Of Philosophy, Education & Psychology, University of Ioannina 68. Alexandra Ioannidou, German Institute for Adult Education - Leibniz Centre for Lifelong Learning 69. X, University of Peloponnese	70. Ioannis Cholezas, Centre of Planning and Economic Research (KEPE)
Hungary	71. Róbert Péter, Centre for Social Sciences, Hungarian Academy of Sciences 72. Dániel Horn, Hungarian Academy of Sciences	73. Júlia Varga, Centre of Economic and Regional Studies Hungarian Academy of Sciences 74. X, Hungarian Institute for Educational Research and Development

Iceland	75. X, School of Education, University of Iceland 76. X, School of Education, University of Iceland	77. Jón Torfi Jónasson, University of Iceland, Department of Teacher education, School of Education 78. X, Educational Research Institute, University of Iceland
Ireland	79. Emer Smyth, Economic and Social Research Institute	80. X, Economic and Social Research Institute 81. X, University College 82. X, Educational Research Centre, St Patrick's College 83. X, Faculty of Education, University College 84. Nicola Tickner, Department of Children and Youth Affairs 85. X, Educational Research Centre
Israel	86. Carmel Blank, Tel Aviv University 87. Yossi Shavit, Tel Aviv University 88. Meir Yaish, University of Haifa 89. Hanna Ayalon, Tel Aviv University	90. X, Bar-Ilan University 91. Yariv Feniger, Ben-Gurion University of the Negev 92. Svetlana Chachashvili-Bolotin, Ruppin Academic Center 93. Abraham Yogev, Tel Aviv University 94. Eyal Bar-Haim, University of Luxembourg
Italy	95. Moris Triventi, European University Institute 96. Gabriele Ballarino, University of Milano 97. Loris Vergolin, FBK-IRVAPP 98. Giovanni Abbiati, FBK-IRVAPP 99. Alessandra Minello, European University Institute	
Latvia	100. X, University of Latvia 101. X, University of Latvia	102. X, Rīga Stradiņš University (RSU) 103. X, Riga Technical university 104. X, University of Latvia 105. X, University of Latvia
Lithuania	106. Juozas Ruzevicius, Vilnius University	107. Rimanatas Želvys, Vilnius University 108. X, Ministry of Education and Science 109. X, Lithuanian ministry of science and education 110. X, Ministry 111. X, Ministry of Education and Science

Luxembourg	112. Andreas Hadjar, University of Luxembourg	113. Jos Bertemes, Luxembourg Centre for Educational Testing (LUCET) 114. Anne Hartung, University of Luxembourg 115. X, LISER (Luxembourg Institute of Socio-Economic Research)
Netherlands	116. Thijs Bol, University of Amsterdam 117. Mark Levels, Research Centre for Education and the Labour Market 118. Rolf van der Velden, Research Centre for Education and the Labour Market 119. Maarten Wolbers, Radboud University	120. Roxanne Korthals, Maastricht University 121. Carla Haalerman, Maastricht University 122. Karien Coppens, Maastricht University
Norway	123. X, Research institute	124. Katharina Sass, University of Bergen, Department of Sociology 125. Liza Reisel, Institute for Social Research 126. X, Nordic Institute for Studies in Innovation, Research and Education 127. Kristinn Hegna, University of Oslo, Department of Education 128. Svein Michelsen, University of Bergen, Department of Sociology 129. Håkon Høst, Nordic Institute for Studies in Innovation, Research and Education 130. Elisabeth Hovdhaugen, Nordic Institute for Studies in Innovation, Research and Education
Poland	131. X, Warsaw School of Economics	132. Michał Sitek, Educational Research Institute, Warsaw, Poland 133. Agnieszka Chlon-Dominczak, Educational Research Institute, Warsaw, Poland 134. Krzysztof Biedrzycki, Educational Research Institute, Warsaw, Poland

Portugal	135. Margarida Chagas Lopes, University of LISBON	136. Ana Balcão Reis, Nova SBE, Universidade Nova de Lisboa 137. X, University of Lisbon 138. Jorge Sarmento Morais, University of Lisbon 139. X, University of Aveiro 140. Carlos Francisco de Sousa Reis, Faculty of Psychology and Educational Sciences, University of Coimbra 141. Ana Gonçalves Matos, Faculty of Social Sciences and Humanities / Universidade Nova de Lisboa 142. Tiago Neves, University of Porto 143. David Justino, Universidade Nova de Lisboa 144. Valter Lemos, Instituto Politécnico de Castelo Branco 145. Pedro N. Teixeira, University of Porto and CIPES 146. X, Research Centre for the Study of Higher Ed: Policies, Porto 147. Maria João Rosa, University of Aveiro 148. X, University of Porto 149. Cecília Galvão, University of Lisbon 150. Madalena Pires da Fonseca, Agency for Assessment and Accreditation of Higher Education (Portugal)
Romania	151. Cristina Mocanu, National Scientific Research Institute for Labour and Social Protection	152. Cezar Bîrzea, Institute of Education Sciences 153. Serban Iosifescu, Romanian Agency for Quality Assurance in Pre-University Education 154. Roxana Mihail, National Center for Assessment and Examinations 155. Laura Capita, Institute of Educational Sciences 156. Mihaela Stingu, University of Bucharest 157. X, Faculty of International Business and Economics, Academy of Economic Studies
Russi	158. Yuliya Kosyakova, Institute for Employment Research 159. Gordey Yastrebov, European University Institute	160. Alexey Bessudnov, University of Exeter 161. Isak Froumin, National Research University Higher School of Economics

a		162. X, National Research University Higher School of Economics
Slovakia	163. X, Institute of Economic Research	164. X, National Institute for Certified Educational Measurements 165. Ján Košta, Institute of Economic Research 166. Stanislav Bencic, Paneurópska univerzita, Bratislava 167. Romana Kanovská, National Institute for Certified Educational Measurements 168. X, The National education office 169. Karolčík, Comenius University in Bratislava 170. X, National Institute for Certified Educational Measurements 171. Ivana Pichaničová, National Institute for Certified Educational Measurements
Slovenia	172. Klemen Miklavič, Centre for Educational Policy Studies, University of Ljubljana	173. Slavko Gaber, University of Ljubljana 174. Janko Muršak, University of Ljubljana 175. Alojz Pluško, Headmaster of School for kindergarten teachers and grammar school 176. X, Slovenian Institute for Adult Education 177. Janez Krek, University of Ljubljana, Faculty of Education 178. Marjan Šimenc, Education Research Institute/Faculty of Education 179. X, Ministry of education Science and Sports
Spain	180. Daniela Vono de Vilhena, Max Plank Institute for Demographic Research 181. Pau Miret-Gamundi, Centre for Demographyc Studies (University Autonoma of Barcelona) 182. Luis Ortiz, Universitat Pompeu Fabra	183. Julio Carabaña Morales, Universidad Complutense, Madrid
Swede	184. Frida Rudolphi, Swedish Institute for Social Research 185. Robert Erikson, Stockholm University	186. X, Swedish Centre for Educational Research 187. X, Stockholm University

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Switzerland	188. Christian Imdorf, University of Bern 189. Ariane Basler, University of Zurich	190. Regula Julia Leeman, University of teacher education 191. Farinaz Fassa, University of Lausanne
Turkey	192. Aysit Tansel, Middle East Technical University	193. Süleyman Sadi Seferoglu, Hacettepe University 194. Ali Ekber Şahin Hacettepe University 195. X, Instanbul Kultur University
Ukraine	196. Olena Nizalova, University of Kent	197. Olga Kupets, Kyiv School of Economics 198. Iryna Kogut, CEDOS former Centre for Society Research
UK	199. Markus Klein, University of Strathclyde 200. Vikki Boliver, Durham University 201. Anthony Heath, Oxford University	202. Stephen Gorard, Durham University 203. Steve Strand, Oxford University Department of Education 204. X, University of Edinburgh 205. X, University of Warwick 206. X, UCL Institute of Education, University College London

Note: to simplify the table does not include titles.

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