

Educational Expansion, Skills Diffusion, and a New Dimension of the OED Triangle: Evidence from PIAAC

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Abstract

Among wide-ranging functions of education, sociologists have paid close attention to its role in social stratification and mobility. While research has promoted our understanding of the association between origins, education, and destinations (OED triangle), the distinction between educational credentials and skills has been largely overlooked at both individual and societal levels. This paper thus empirically investigates the OED association in consideration of educational specifications (the combination of credentials and skills that individuals possess) and the degree of skills diffusion (the proportion of highly skilled people in a given society), which is a different societal condition from educational expansion that has been quantified by the share of highly educated people. Multilevel logistic regression analyses, using internationally comparable data for approximately 30,000 individuals in 26 OECD countries, reveal that educational credentials play more significant roles, as compared with skills, in forming the OED triangle. This supports the soundness of conventional approach focused on educational qualifications. Nevertheless, whereas credentials are likely to lose their economic returns in societies where the degree of educational expansion is relatively high, skills are not devalued even though their scarcity diminishes due to the higher extent of skills diffusion. Meanwhile, the impact of origins becomes smaller in association with the larger share of highly skilled people as well as that of highly educated people in a nuanced way. This suggests that what we have understood as the consequence of educational expansion is significantly shaped by skills diffusion. It is particularly important to note that, while educational expansion undermines the contribution of origins whilst penalising highly educated people, skills diffusion operates as an equaliser without diminishing rewards for high skills. This implies that skills diffusion is the key to realising meritocracy. I argue that these perspectives markedly contribute to elucidating the nuanced OED triangle and broader social mechanisms.

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I. Introduction

1. Background: Functions of Education

The function of education has been investigated for decades. In addition to direct effects of educational activities on the development of learners' cognitive and non-cognitive skills (OECD 2007, 2015c; World Bank 2017), a variety of indirect/external effects have been elucidated. From economic viewpoints, for example, Smith ([1776] 1977) pointed out that a set of skills cultivated via education could be one of the essential inputs into economic activity. Becker (1975), Mincer (1958, 1974), and Schultz (1961) developed human capital theory focused on the economic return to education, revealing that higher levels of education/longer years of schooling resulted in greater economic benefits. Indeed, Psacharopoulos and colleagues calculated private and social rates of return to investment in education to clarify the huge economic benefit of education, albeit its dispersion across socio-economic backgrounds such as gender, geographical areas, and household income (Psacharopoulos 1981, 1994; Psacharopoulos and Patrinos 2004; Psacharopoulos and Woodhall 1985). Extending this approach, much research has confirmed that education contributes to socio-economic success of individuals whilst reducing public expenditure and increasing tax revenues (e.g. Jim 2000; Levin et al. 2007; London Economics 2005; Maani 1999; Montenegro and Patrinos 2014; Nores et al. 2005; O'Donoghue 1999; Okachi 1985; Temple and Reynolds 2007).

Another aspect of indirect economic effects of education is employment. For example, McMahon (1998) and OECD (2007) advocated education as a tool to increase employability via providing learners with meaningful skills that would be favoured in the world of work. Likewise, Mincer (1991) analysed the relationship between education and the risk of unemployment to conclude that highly educated workers were less likely than others to lose their jobs.

Furthermore, paying attention to the societal-level impact, Nelson and Phelps

(1966) examined the association between education, technological diffusion, and economic growth, revealing that the accumulation of human capital promoted technological progress and macroeconomic development. Barro and colleagues also empirically proved the positive correlation between the level of schooling and GDP growth rate (Barro 1991; Barro, Mankiw, and Sala-I-Martin 1995), while the World Bank (1993) concluded that educational expansion was one of the key factors of equitable economic development in East Asian countries from the 1960s to 1990s. Although Bils and Klenow (2000) pointed out the necessity to carefully evaluate the impact of schooling on macroeconomic development, Aghion et al. (2009) clarified the mechanism through which investment in education promoted economic growth.

In addition to economic outcomes, a variety of non-economic effects have been claimed as outcomes of education, ranging from better health to positive civic engagement, higher interpersonal trust, and better subjective well-being at an individual level (e.g. Diener and Seligman 2004; Iacobucci and Tuohy 2005; McMahon 1998; OECD 2007, 2013a, 2015a). Meanwhile, at a societal level, Dewey (1916) emphasised the importance of a democratic education system that would enable citizens to play active roles in promoting a democratic society. Likewise, after witnessing the catastrophic World War II, the United Nations Education, Science and Cultural Organization (UNESCO) declared the significance of education from the perspectives of peace-building and social cohesion in its Constitution (UNESCO 2014).

Whereas a variety of socio-economic benefits have been suggested as consequences of education, the vast literature has cast doubts on the positive function of education. Illich (1971), for example, criticised institutionalised education as a system that deprived people of freedom, emphasising the importance of "deschooling" (Illich 1971:3). In addition, while recognising the value of education as a tool to foster critical consciousness, Freire (1972) raised an alarm over the classical one-way instruction at schools where learners were obliged to be passive without unlocking their

potential and capabilities. Foucault (1977) also critically argued that formal schools, like prisons, played a role in forcing people to internalise specific disciplines controlled by the authorities.

Furthermore, contrary to the myth that education systems offer fair competition and selection, the significant association between learners' success and their socio-economic backgrounds has been detected. For instance, Coleman et al. (1966) analysed the factors of learners' success in education systems and concluded that social origins had a significant impact on the result of achievement tests, whereas school related variables had limited influences. In addition, Bowles and Gintis (1976) shed light on the association between the social mechanism within school systems and the world of work with the principle of "correspondence" (Bowles and Gintis 1976:12), claiming that schools contributed to intensifying the exiting hierarchical social structure. Likewise, Bourdieu and Passeron (1977) paid attention to "cultural capital" (Bourdieu and Passeron 1977:3) and social capital as well as economic capital to argue that formal education systems maintained social inequality through cultural reproduction. Moreover, Bernstein (1996, 2003) clarified the difference in type of language with the concept of "codes" (Bernstein 1996:28), arguing that learners from advantaged backgrounds were more likely than disadvantaged children to perform better at schools where the standard language had a high affinity for those with high socio-economic statuses.

Among the aforementioned wide-ranging positive and negative functions of education, sociologists have particularly scrutinised the role of education within the extensive perspective of social stratification and mobility. In particular, one of the significant contributions of sociological research lies in its focus not only on the relationship among individual-level variables but also on the influence of societal-level conditions, including the interaction between individual-level and societal-level elements. That is, the vast sociological literature has attempted to elucidate 1) how

education affects the association between socio-economic backgrounds and outcomes, *and* 2) how such association varies in response to educational expansion as well as other societal conditions.

The gold standard for this line of research is the so-called "OED triangle," which sheds light on 1) parental education/occupations (origins: O), 2) children's education (education: E), and 3) children's labour market outcomes (destinations: D) (e.g. Bernardi and Ballarino 2016; Boudon 1974; Breen 2004; Bukodi and Goldthorpe 2019; Goldthorpe 2014; Ishida, Muller, and Ridge 1995). For example, if the association between origins and children's education (OE) deteriorates in response to educational expansion while the economic return to education (ED) is stable, the overall association between origins and destinations (OD) is expected to weaken. By contrast, should the OE association be maintained due to the strong impact of origins while the ED association is intensified because of the increasing demands for highly educated human resources in the labour market, the OD association is then considered to be intensified.[1]

Indeed, using this framework, on the one hand, evidence has suggested that the impact of origins on destinations has been decreasing in response to educational expansion in several societies (Breen 2004, 2010; Breen and Jonsson 2007; Breen and Luijkx 2007; Devine and Li 2013; Gil-Hernández, Marqués-Perales, and Fachelli 2017; Marks 2013; Pfeffer and Hertel 2015). On the other hand, in the case of Great Britain, researchers have argued that intergenerational inequality in terms of the link between parental statuses and children's outcomes has not weakened despite the increasing educational opportunity (Bukodi and Goldthorpe 2019; Goldthorpe and Jackson 2007; Goldthorpe and Mills 2008; Sturgis and Buscha 2015).

Thus, sociological studies have significantly progressed our understanding of the function of education within wider perspectives of social stratification and mobility.

[1] It is important to note that, as discussed in the following chapters, the OED association, including the direct effect of origins on destinations, is shaped in more nuanced ways through the interaction between origins, education, destinations, and societal level educational conditions.

However, there remain two essential aspects that have been largely overlooked by previous research. Put differently, by addressing these research gaps, it becomes possible to better elucidate not only the function of education but also the broader structure of the OED triangle and social mechanisms.

Firstly, the distinction between educational attainment and actual skills should be accounted for. Traditionally, the premium for education has been demonstrated by comparing highly educated people (i.e. those with higher educational attainment) with less educated people on the assumption that higher levels of credentials/longer years of schooling signify high skills, regardless of whether educational attainment genuinely nurtures skills or merely signifies them. Based on this premise, the OE association has also been investigated via utilising children's educational attainment. However, as research has argued, credentials and schooling do not necessarily reflect actual skills (i.e. a highly educated person is not always a highly skilled person) (e.g. Dore 1976; Hanushek and Woessmann 2015). At the same time, evidence has suggested that skills operate as significant determinants of the economic benefits (e.g. Belfield et al. 2015; Carbonaro 2007; Hanushek et al. 2015; Kerckhoff, Raudenbush, and Glennie 2001; Lane and Conlon 2016; Vogtenhuber 2018). This means that, in elucidating the function of education properly, it is essential to pay close attention to both educational attainment and skills. Nevertheless, the literature has generally focused on one dimension (educational attainment *or* skills) whilst disregarding the other facet or merely operationalising it as a control variable. This paper thus sheds light on how the combination of educational attainment and skills operates in forming the OED triangle.

Secondly and more importantly, the degree of skills diffusion at a societal level should be considered as a different societal condition from that of educational expansion. Provided that individual high educational attainment does not automatically guarantee high skills, the increase in access to higher levels of education in a given society (i.e. educational expansion) does not necessarily mean the accumulation of

highly skilled people (i.e. skills diffusion). It is crucial to distinguish these two phenomena especially because they determine the scarcity of individual educational attainment and skills respectively. Put differently, economic returns to education as a relative/positional good may differ depending on the degree of educational expansion *and* skills diffusion at a societal level. At the same time, the influence of origins on the acquisition of educational attainment and skills may vary in accordance with these two different societal conditions. However, while the vast literature has accounted for educational expansion, the other dimension (skills diffusion) has been largely overlooked for decades.

Against such a background, this research empirically investigates the OED triangle with particular focus on the distinction between educational attainment (educational expansion) and skills (skills diffusion). Through this sociological study, it becomes possible to better understand the nuanced economic returns to education (ED), the association between origins and education (OE), and the impact of origins on destinations with/without indirect effects mediated by education (OD).

2. Research Question and Scope of Analysis

To elucidate the OED triangle with the said perspectives, the following research question (RQ) should be answered.[2]

RQ: How does the relationship between origins, education, and destinations vary in association with societal-level educational expansion and skills diffusion?

More specifically, as Figure I-1 illustrates, the OED triangle can be decomposed into the OE, ED, and OD associations. Among them, should the ED association yield different pictures from the ones shown by conventional approaches that have merely

[2] As discussed earlier, "education" in RQ includes not only educational attainment but also skills.

taken account of educational attainment at both individual and societal levels, the investigation of the OE association via distinguishing between educational attainment and skills becomes more significant from the perspective of social stratification and mobility. Moreover, as long as the ED and OE associations are influenced by skills as well as educational attainment, the OD association also needs to be examined with these perspectives.[3] Therefore, this paper breaks RQ down into the following three sub research questions (SRQ), which are addressed in three chapters respectively.

SRQ1 (Chapter 2: ED association)

- *How are individual educational attainment and skills associated with destinations?*
- *How does the relationship vary in association with societal-level educational expansion and skills diffusion?*

SRQ2 (Chapter 3: OE association)

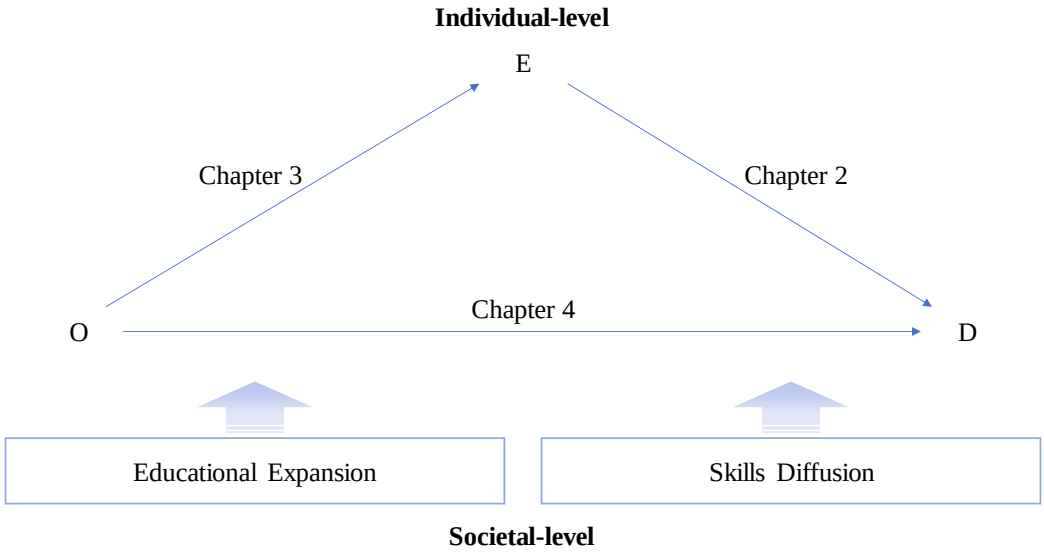
- *How are individual origins associated with educational attainment/skills acquisition?*
- *How does the relationship vary in association with societal-level educational expansion and skills diffusion?*

SRQ3 (Chapter 4: OD association)

- *How are individual origins associated with destinations?*
- *How does the relationship vary in association with societal-level educational expansion and skills diffusion?*

[3] Even if the ED and OE associations are not significantly affected by skills (diffusion), the OD association may differ depending on the degree of skills diffusion if this societal condition affects the direct effect of origins on destinations. It is therefore important to investigate the OD association with close attention to the distinction between educational attainment (expansion) and skills (diffusion).

Figure I-1 Scope of Analysis



Note: O, E, and D stand for origins, education (educational attainment and skills), and destinations respectively. Chapter 2 investigates the ED association in consideration of societal educational expansion and skills diffusion. Likewise, Chapter 3 and Chapter 4 examine the OE and OD associations.

Herein, educational attainment has been quantified by levels/types of educational credentials or years of schooling, among which economists have preferred to use the latter from the perspective of human capital theory. That is, years of schooling have been regarded as an appropriate indicator of actual skills especially since Mincer (1958, 1974) suggested his well-cited earnings function to calculate the economic premium for education. With the development of internationally comparable standardised assessments (see the following chapters for details), however, it is currently possible to utilise more appropriate measures that reflect skills levels rather than relying on alternative measures (i.e. the length of schooling). In the meantime, sociologists have detected the function of educational credentials not only as signals of skills but also as socially-sanctioned positional goods, which lead to economic rewards whilst excluding those without such credentials (Bills 2016; Bol 2015; Ortiz and Rodriguez-Menés

2016; Di Stasio, Bol, and Van de Werfhorst 2016; Triventi et al. 2016; Van de Werfhorst 2009, 2011b). This research therefore employs credentials to quantify educational attainment whilst using skills data as another important facet of E (education).

As regards skills, the vast literature has argued what skills are and how they are linked with labour market outcomes as well as origins. For example, in a section titled "A taxonomy of skills," OECD (2017) referred to several economic studies such as Heckman, Stixrud, and Urzua (2006) and Kautz et al. (2014), introducing two types of skills (i.e. cognitive skills and non-cognitive skills) as important determinants of socio-economic outcomes as follows (OECD 2017:76):

> Cognitive skills involve conscious intellectual effort and include long- and short-term memory, auditory and visual processing, processing speed, and logic and reasoning. Non-cognitive skills, also known as soft skills, social and emotional skills or personality traits, involve the intellect in a more indirect and less conscious fashion than cognitive skills, and relate to individuals' personality, temperament, attitudes, integrity and personal interaction.

More specifically, cognitive skills are often quantified by standardised assessments of literacy, numeracy, and ICT skills (OECD 2017). Among them, general information processing abilities such as literacy and numeracy have proved to operate as the foundation for other types of skills and short/long-term socio-economic prosperity at individual, institutional, and societal levels (Abrassart 2013; Carroll 1993; Ferrer, Green, and Riddell 2004; Finnie and Meng 2007; Green and Riddell 2003; Hanushek et al. 2015; Hanushek and Woessmann 2015; Himmler and Jackle 2018; OECD 2013b, 2016; Rocha and Ponczek 2011; Tippins and Sohi 2003).

Meanwhile, one of the most well-cited frameworks of non-cognitive skills is the "Big Five," which has been developed primarily in the field of psychology, consisting

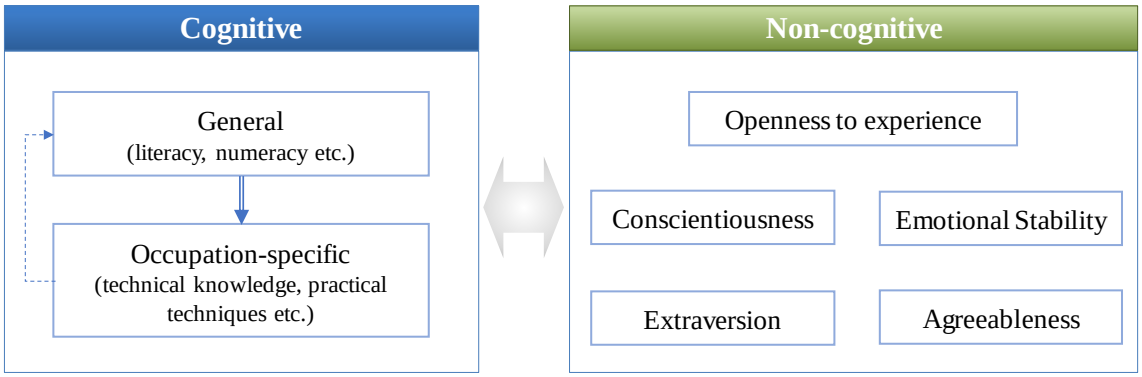
of extraversion, agreeableness, conscientiousness, neuroticism/emotional stability, and openness to experience (e.g. Barrick and Mount 1991; Goldberg 1990). These traits include wide-ranging elements, such as perseverance, ambition, sociability, caring, self-control, self-esteem, and optimism, which are frequently measured by psychological assessments, self-reported answers to questionnaires, past experience/behaviour, and observations among other things (OECD 2015c, 2017). As with cognitive-skills, evidence has also suggested that non-cognitive skills are significant determinants of socio-economic success (Belfield et al. 2015; Deming 2017; Esping-Andersen and Cimentada 2018; Heckman et al. 2010, 2006; Heckman and Kautz 2012; Kautz et al. 2014; OECD 2015b).

In addition, as far as labour market outcomes are concerned, occupation-specific skills qualify as important assets of individuals. Besides technical knowledge and practical techniques related to particular jobs, physical skills as well as some of non-cognitive skills such as management, communication, and logical thinking are more required in some sectors/positions as compared with others (OECD 2016, 2017). Figure I-2 illustrates the overview of these wide-ranging skills.

Given the aforementioned broad scope of skills, one ideal approach here is to incorporate every single dimension, including cognitive, non-cognitive, and occupation-specific skills, into empirical analyses. However, as detailed in the following sections, the existing datasets do not provide adequate information on non-cognitive and occupation-specific skills especially at a societal level. This means that it is not possible to investigate the function of skills in consideration of their scarcity that varies depending on the degree of societal-level skills diffusion. In the meantime, general cognitive abilities such as literacy and numeracy, which are currently evaluable at both individual and societal levels in an internationally comparable way, are considered to operate as the foundation for other types of skills and labour market outcomes as discussed above. In light of this, as the first step towards further

elaboration, this paper focuses on literacy and numeracy as fundamental cognitive skills to elucidate the OED association.

Figure I-2 Key Dimensions of Skills



Note: This figure shows the overall concept of skills with particular focus on the position of general information processing skills such as literacy and numeracy, and hence it does not necessarily include all types of specific skills including physical ones. Also, it is important to note that, while occupation-specific skills are illustrated in "cognitive" skills, some occupations require particular "non-cognitive" skills more significantly than other jobs/positions (i.e. one may define occupation-specific non-cognitive skills).
Source: Author based on OECD (2015c, 2017).

In terms of destinations, sociologists have traditionally used occupations whereas economists have favoured monetary rewards such as earnings and incomes (Torche 2015). While there has been much discussion about which indicator is superior to investigate social mobility as well as returns to education, one general consensus is that both of them are important (albeit not necessarily equally). This research therefore employs both occupations and earnings as essential outcomes in analysing the ED and OD associations (Chapter 2 and Chapter 4). As indicated in the following chapters, the comparison between the occupation analysis and the earnings analysis provides insights into social mechanisms behind the allocation of economic assets in a society.

Likewise, research on social mobility/inequality has long paid attention to parental

education, occupations, and economic statuses as measures of origins. Among them, recent research has revealed that parental education significantly affects not only parental social and economic class but also children's education, occupations, and monetary rewards, although there is a variation in its impact (Erola, Jalonen, and Lehti 2016; Gugushvili, Bukodi, and Goldthorpe 2017; Kariya 2017). This means that, despite the fact that there are no internationally comparable datasets that include all the variables relating to parental occupations, incomes/earnings, and education in conjunction with children's educational attainment and skills, analyses using parental education qualify as appropriate approaches to scrutinise the impact of origins. Thus, as detailed in the following chapters, this paper utilises mother's education and father's education respectively as key metrics for socio-economic statuses.

With regard to societal educational conditions, educational expansion and skills diffusion are quantified by the share of population who meet certain conditions for educational attainment and skills respectively (see Chapter 2 for more details). Here it is an idea to follow the chronological (longitudinal) change in these figures in specific societies and to analyse how the OED triangle has shifted over time. However, considering the generalisability of analysis results as well as the limitation of data, this paper employs a cross-country multilevel modelling by taking the difference in the share of population with particular educational attainment and skills as the degree of educational expansion and skills diffusion. The advantages and disadvantages of this approach are further discussed in the following chapter.

On the basis of these conceptualisation and operationalisation, the ED, OE, and OD associations are examined in Chapter 2, Chapter 3, and Chapter 4 respectively. Incorporating these three empirical chapters, Chapter 5 summarises the key findings and proposes some theoretical development and policy implications. In addition to the significance of this research, challenges and potential for future research are also discussed in the final chapter.

II. Education and Destinations

1. Introduction

The association between education and labour market outcomes has been a central focus of social science research for decades. In addition to elucidating the mechanisms whereby education generates benefits such as occupations and income, sociologists have paid attention to the dynamics of this relationship within the wider phenomenon of educational expansion at a societal level. On the one hand, research has argued that the premium for education is expected to decrease in response to its proliferation and progressive advancement of credential inflation, given that economic rewards are linked with education as a scarce good. (Brown 2001, 2003; Collins 1979; Van Der Meer 2011; Olneck and Kim 1989; Ortiz and Rodriguez-Menés 2016; Tholen 2017). On the other hand, from the perspective of social closure, findings have also suggested that the relative value of education can increase in conjunction with the exacerbated negative impact of not possessing a certain level of educational qualification amidst educational expansion (Bills 2016; Bol 2015; Olneck and Kim 1989; Smyth and McCoy 2011). In addition, with the concept like skill-biased technological change (Autor, Levy, and Murnane 2003; Berman, Bound, and Machin 1998; Katz and Murphy 1992), economists have revealed that returns to education have increased over time in response to the growing demand for highly educated human resources in the labour market (Acemoglu and Autor 2011; Goldin and Katz 2008; Lemieux 2008).

Despite progressively more nuanced understandings of the relationship between education and economic rewards, one critical aspect has not been adequately accounted for: the distinction between educational credentials and skills at both individual and societal levels. That is, most research has examined economic returns to education based on the premise that high credentials signify high skills regardless of whether skills have been actually developed in the process of acquiring credentials or credentials just send signals of skills. However, individual educational credentials do

not automatically guarantee graduates' high skills, as the theory of credentialism would suggest (e.g. Dore 1976; Flisi et al. 2017). Likewise, growth in educational opportunity (i.e. educational expansion) does not necessarily mean the saturation of highly skilled people (i.e. skills diffusion) in a given society. It is imperative to pay attention to this discrepancy because economic returns to education (individual credentials and skills) may differ in accordance with its scarcity, which is significantly influenced by the degree of educational expansion and skills diffusion at a societal level.

Indeed, the result of the empirical analysis (detailed in the following sections) reveals that there is a variation in the degree of educational expansion and skills diffusion across countries, and that the return to education varies depending on such societal-level educational conditions. Specifically, the impact of high educational credentials on occupational attainment and earnings becomes smaller in societies where educational expansion has progressed faster than other societies. Furthermore, the contribution of credentials to obtaining monetary rewards becomes much smaller when the degree of skills diffusion in a society is relatively high. Nevertheless, high skills do not lose their occupational and monetary returns even in highly skilled societies where the scarcity of skills is low due to the relatively large share of population with high skills. This implies that, unlike credentials, high skills might operate as absolute goods.

This paper would argue that this heterogeneous (de)valuation of credentials and skills can be detected only when the distinction between educational credentials and skills at both individual and societal levels are properly taken into account. Further, combining the OE association (Chapter 3) and the OD association (Chapter 4), it becomes possible to elucidate a new dimension of the OED triangle and social mechanisms that form such nuanced structures.

The following sections first review the relevant literature, and then describe the key concepts of analysis. Subsequently, data and methods are explained, followed by analysis results and conclusion.

2. Economic Returns to Education

A large volume of literature has confirmed the economic value of education. Through higher educational attainment and/or longer years of schooling, one may expect better occupations and/or greater monetary rewards compared to those with lower levels of education. One of the well-cited explanations of this phenomenon is human capital theory, whereby higher returns to education are considered to reflect higher productivity cultivated via schooling (Becker 1975; Mincer 1958, 1974; Schultz 1961). From this perspective, education is considered to have an absolute value that persists even when the scarcity of educated people declines within a society.

While human capital theory has advocated education as an absolute good, the relative/positional value of education has also been elucidated, starting with the notions of signalling and social closure. Signalling theory suggests that higher levels of educational credentials signify relatively higher levels of skills, regardless of their real effects on human capital formation, hence functioning as a proof of higher productivity favoured by employers (Spence 1973). This perspective is aligned with the idea that educational attainment is used as a proxy for trainability in the labor queue (Thurow 1975). Meanwhile, closure theory argues that educational credentials lead to economic benefits by excluding others (less-educated people) from taking part in the select community where rewards are allocated (Bills 2016; Bol 2015; Bukodi and Goldthorpe 2016; Collins 1979; Hirsch 1977; Murphy 1988; Olneck and Kim 1989; Ortiz and Rodriguez-Menés 2016; Di Stasio et al. 2016; Tholen 2017; Triventi et al. 2016; Weeden 2002).

Although the preferable relationship between education and economic rewards seems to be self-evident, regardless of theories attempting to detail its mechanism, the association is not static. Indeed, numerous sociological studies have revealed that the relative value of education changes in response to societal-level educational conditions, yielding two different perspectives on these dynamics.

Firstly, the premium for education decreases as its scarcity diminishes in association with educational expansion. This can happen when the average ability of those with higher levels of educational credentials declines as an issue of labour supply and/or when the amount of opportunities in the labour market cannot expand at the same pace with (or faster than) the increase of educated people as a problem of labour demand (Brown 2001, 2003; Hanushek 2016; Ortiz and Rodriguez-Menés 2016; Tholen 2017). This phenomenon has been termed as credential inflation, and in particular the latter issue (i.e. the excessive supply of highly educated people) has been investigated through the concept of overeducation (e.g. Nieto and Ramos 2017; Di Stasio 2017; Di Stasio et al. 2016; Verhaest and Van Der Velden 2013).

Secondly, there is the perspective that the impact of education can persist or even strengthen if the possession of a certain level of education functions as a form of social closure that prevents less-educated people from enjoying economic rewards (Bills 2016; Bol 2015; Olneck and Kim 1989; Smyth and McCoy 2011). This tendency may escalate amidst educational expansion, once the privileged group attempts to secure rewards by establishing new screening systems that require a further higher level of education and/or other types of capital (including additional educational experiences) as prerequisites to join the select group (Brown 2013; Posselt and Grodsky 2017; Rivera 2011; Tholen 2017). Likewise, economic research has also argued that the premium for education has not decreased, but rather increased, because the demand for educated people in the world of work has grown over time (Acemoglu and Autor 2011; Goldin and Katz 2008; Lemieux 2008).

Another important sociological finding is that education and labour systems, as well as the degree of educational expansion, in each society determine the effect of education on occupational attainment. For example, Di Stasio, Bol, and Van de Werfhorst (2016) revealed that the relative value of education in terms of occupational rewards was influenced by the extent to which vocational education systems had been

developed within a country. Similarly, Levels, van der Velden, and Di Stasio (2014), Di Stasio (2017), and Bol et al. (2019), among others, have demonstrated that returns to education differ in association with the degree of stratification of education system and its linkage with the labour market's reward allocation.

While previous research has markedly clarified the complicated association between education and labour market outcomes, there is one essential aspect that has been largely overlooked: the distinction between educational credentials and skills at both individual and societal levels. One of the underlying assumptions, which made it subsequently difficult to distinguish these two dimensions, is that a high-level credential automatically signifies high-level skills at an individual level, regardless of whether credentials genuinely nurture high skills or merely function as signals of high skills. This perspective has also underpinned an idea that educational expansion (i.e. the increase of highly educated people) naturally leads to skills diffusion (i.e. the accumulation of highly skilled people) in a given society. However, as concepts like "diploma disease" (Dore 1976) suggest, the association between credentials and actual skills, as well as their link to economic rewards, is not axiomatic. Accordingly, even though a society succeeds in enhancing the proportion of population with a higher level of educational attainment, this does not automatically mean a larger share of highly skilled people. This distinction is crucial given that economic returns to education may depend on the combination of credentials and skills that individuals possess, rather than merely one dimension of them. More importantly, their economic values may vary in accordance with their scarcity, which is considered to be influenced by the extent of societal-level educational expansion *and* skills diffusion respectively. Without paying close attention to this inconsistency, there is a risk that we misunderstand the values of education and the influence of societal educational condition, leading to inappropriate theoretical and practical implications.

Indeed, in a revised model of human capital theory, Hanushek and colleagues shed

light on cognitive skills as a more appropriate parameter of human capital to reveal that a higher level of skills, rather than quantity of education in the form of years of schooling, had significant impacts on economic benefits at both individual and societal levels (Hanushek et al. 2015; Hanushek and Woessmann 2008, 2015, 2016). Some sociological studies have also suggested that skills, as well as credentials, play important roles in achieving socio-economic success at an individual level (Barone and van de Werfhorst 2011; Doren and Grodsky 2016; Flisi et al. 2017; Gesthuizen, Solga, and Künster 2011; Kerckhoff et al. 2001; Vogtenhuber 2018). Nonetheless, that body of research has largely overlooked the possibility that economic returns might differ depending on specific combinations of credentials and skills that individuals possess. Further, with the exception of Gesthuizen et al. (2011) and Vogtenhuber (2018), their focus has fallen on the relationship among individual-level variables, meaning that the association between education and economic rewards across different societal educational conditions have not been considered adequately.

One interesting discussion here is Brown (2003, 2013), which advocated the concept of "opportunity trap," arguing that the positive impact of skills on rewards would decline once the number of people taking part in the competition for acquiring high skills increases more rapidly than the pace of the expansion of opportunities (i.e. decent occupations with high income). Brown, Green, and Lauder (2001) earlier pointed out that the difference in the association between high skills and rewards further derived from socio-economic structures including education and labour systems in each society, implying that skills did not necessarily exist as absolute goods. Nevertheless, this line of research still utilised "high skills" as an interchangeable term with high credentials (say, college graduates), consequently failing to distinguish the difference between educational attainment and skills at both individual and societal levels.

In sum, the sociological literature in conjunction with economic research has progressed a better understanding of the economic value of education in multiple

contexts. However, the distinction between educational expansion and skills diffusion at a societal level has been largely disregarded with the assumption that these two societal conditions emerge hand in hand. Further, the difference in impact across the combination of (not) possessing high credentials and high skills has not been investigated. Accordingly, the more nuanced relationship between education and labour market outcomes has been obscured under the weight of influential concepts like credential inflation and social closure.

Against such a backdrop, this paper analyses economic returns to education in consideration of societal-level educational expansion and skills diffusion. Through this investigation, it becomes possible to better understand the economic value of education as well as one dimension of the broader concept of the OED triangle.

3. Data and Method

To elucidate the association between education and labour market outcomes in consideration of educational expansion and skills diffusion, it is indispensable to take account of both individual-level and societal-level variables. One potential approach here is to conduct a time-series analysis in a particular society using longitudinal data. However, the existing datasets are not adequate for such analysis primarily because of the lack of data on societal-level skills diffusion. Further, given that the association between skills, educational credentials, and economic rewards is significantly influenced by specific education and labour systems as well as macroeconomic performance in each society (Bol and van de Werfhorst 2013; DiPrete et al. 2017; Levels, van der Velden, et al. 2014; Smyth and McCoy 2011; Di Stasio 2017; Di Stasio et al. 2016; Vogtenhuber 2018), the result of country-specific analysis is not necessarily applicable to other societies. In contrast, a cross-county multilevel analysis would lead to more generalisable implications via appropriately controlling for societal-level

variables as well as individual-level factors.[4]

In light of this, this paper adopts a multilevel modelling using some country-level data in conjunction with individual data of the Programme for the International Assessment of Adult Competencies (PIAAC), an international standardised assessment conducted by the Organisation for Economic Co-operation and Development (OECD). PIAAC is a large-scale international survey for adults aged from 16 to 65, consisting of questionnaires and a standardised assessment of cognitive skills. This survey is designed to obtain a nationally representative sample in each participating country using the multistage stratified cluster method with census data (or other data collected nationwide), while international comparability is ensured through expert linguistic inputs as well as statistical verification (see OECD 2013b, particularly sections 4.4 and 14.5, for more details). Thus far, the survey has been conducted three times as part of the First Cycle: Round 1 (2008-2013), Round 2 (2012-2016), and Round 3 (2016-2019).[5]

The available data include educational attainment, test scores of information-processing skills such as literacy and numeracy, and socio-economic backgrounds. The survey is administered by national authorities and/or research institutes in each participating country, and respondents are required to answer the assessments and questionnaires in their home via computer and/or pencil-and-paper through interviews. Cognitive assessments of literacy and numeracy here are created based on item response theory in consideration of linkage with other surveys such as the International Adult Literacy Survey (IALS) and the Adult Literacy and Lifeskills Survey (ALL) (see also OECD 2013b, section 17.4). Indeed, Levels, Van Der Velden, and Allen (2014) demonstrated the validity of using PIAAC in comparison with other skills data to

[4] Nonetheless, the difference across countries should not be completely disregarded in order to better understand the nuanced associations between education and labour market outcomes. Thus, while multilevel analyses are used in the main manuscript in this chapter, the results of country-specific analyses are also shown in Appendix for reference.
[5] The Second Cycle has started in 2018, and its results are expected to be published in 2023.

analyse the association between education, skills, and labour market outcomes. Likewise, PIAAC data have been widely utilised by recent research to provide empirical evidence in analyses of returns to education/skills (Hanushek et al. 2015; Hanushek, Schwerdt, Wiederhold, et al. 2017), education/skills mismatches (Flisi et al. 2017; Nieto and Ramos 2017; Perry, Wiederhold, and Ackermann-Piek 2014), and social inequality and mobility (Jerrim and Macmillan 2015), among others.

The target of analysis in this paper is people aged 30 to 39 of all OECD countries as given in available data from the OECD's website (http://vs-web-fs-1.oecd.org/piaac/puf-data) with the exception of Estonia, for which country-level data on tracking are not available as explained below. Here it is important to focus on people aged 30 to 39 for primarily two reasons. Firstly, the function of education may differ across generations even within a country, and hence different generations should not be incorporated in the same modelling unless data are adequate for analysing the age/cohort effects respectively. Secondly, considering that skills are not static but rather dynamic assets in the sense that they are developed through work/life histories (e.g. Cunha and Heckman 2007; OECD 2015c), younger generations are more appropriate than older generations, who are likely to have more life/work experience, to accurately examine the impact of education (credentials and skills) on labour market outcomes (not the other way round).[6] Yet, in many societies, a certain number of people have not completed their education in their twenties. Therefore, people aged 30 to 39 qualify as an ideal target to investigate the ED association.[7] Specific countries and the number of samples in this analysis are shown in Table II-1.

[6] As long as longitudinal data are available to carry out more robust causal analyses, it is not essential to narrow samples based on their age. However, as mentioned below, the multilevel modelling using cross-country data does not necessarily provide robust evidence of causality. The current paper therefore sheds light on younger generations to minimise the reverse influence as much as possible.

[7] It is also important to note that the analysis results that follow are stable even if different age ranges are adopted (say, between 25 and 35 or between 25 and 45).

Table II-1 Target Countries and the Number of Samples (aged 30 to 39)

Country	Round	Samples	
		Occupations	Earnings
Austria	1	909	751
Belgium	1	855	713
Canada	1	4,659	3,869
Chile	2	889	693
Czech Republic	1	1,144	801
Denmark	1	1,112	906
Finland	1	989	863
France	1	1,151	946
Germany	1	871	717
Greece	2	887	467
Ireland	1	1,475	1,093
Israel	2	1,009	746
Italy	1	895	628
Japan	1	981	884
South Korea	1	1,217	991
Netherlands	1	835	718
New Zealand	2	1,085	849
Norway	1	872	782
Poland	1	799	581
Slovak Republic	1	1,068	769
Slovenia	2	954	675
Spain	1	1,264	815
Sweden	1	787	701
Turkey	2	970	729
United Kingdom	1	1,714	1,438
United States	1	893	715
Total Number of Respondents		30,284	23,840

Note: “Round” in the table indicates the round of PIAAC in which each country participated. The number of “Respondents” is limited to valid cases among people aged 30 to 39 for the analysis of occupations and that of earnings respectively. This means that the number of actual participants of PIAAC is larger than that in this table. Also, several participating countries of PIAAC are excluded due to the lack of societal-level data.

In terms of dependent variables, two representative measures of economic rewards are used: occupations and earnings. In PIAAC, individual occupations are indicated by various variables including the four categories based on the International Standard Classification of Occupations (ISCO) (International Labour Office 2012), namely, skilled, semi-skilled white collar, semi-skilled blue collar, and elementary.[8] Using this variable, a "skilled occupations dummy" is created (i.e. those whose job is a skilled occupation is assigned 1, whereas 0 is provided for others), rather than merely focusing on whether individuals are employed or unemployed. Given that the primary focus of this paper is the premium for high skills and credentials, this operationalisation is important because the employment per se is not necessarily a prestigious status.[9] Here it is important to note that, from the viewpoint of mathematical elegance and transparency, one preferable approach is to use continuous measures of occupations instead of categorical ones like ISCO. Nevertheless, as the discussion on class schema and structure has demonstrated for decades (e.g. Erikson and Goldthorpe 1992; Erikson, Goldthorpe, and Portocarero 1979; Goldthorpe 1980; Western and Wright 1994; Wright 1979), occupations, particularly as positional goods in the real society, do not necessarily function continuously as we can analyse mathematically. Put differently, whereas it is valuable to calculate the extent to which continuous measures of occupations would change in association with an increase/decrease of predictors, it is also meaningful to examine the probability of obtaining specific types of jobs including "skilled occupations" as mentioned above. This paper thus primarily focuses on the

[8] Skilled occupation includes managers, professionals, and technicians. Semi-skilled white collar includes clerical support workers, service and sales workers. Semi-skilled blue collar includes skilled agricultural, forestry and fishery workers, craft workers, and plant and machine operators. Elementary includes cleaners, workers in mining, construction, manufacturing and transport, and food preparation assistants. For more details, see the website of the International Labour Organization (ILO) (http://www.ilo.org/public/english/bureau/stat/isco/index.htm) [Accessed: 11 December 2017].

[9] It is also important to pay attention to the variation in impact of education across different types of occupation (i.e. semi-skilled white collar, semi-skilled blue collar, and elementary), which could be another topic for future research.

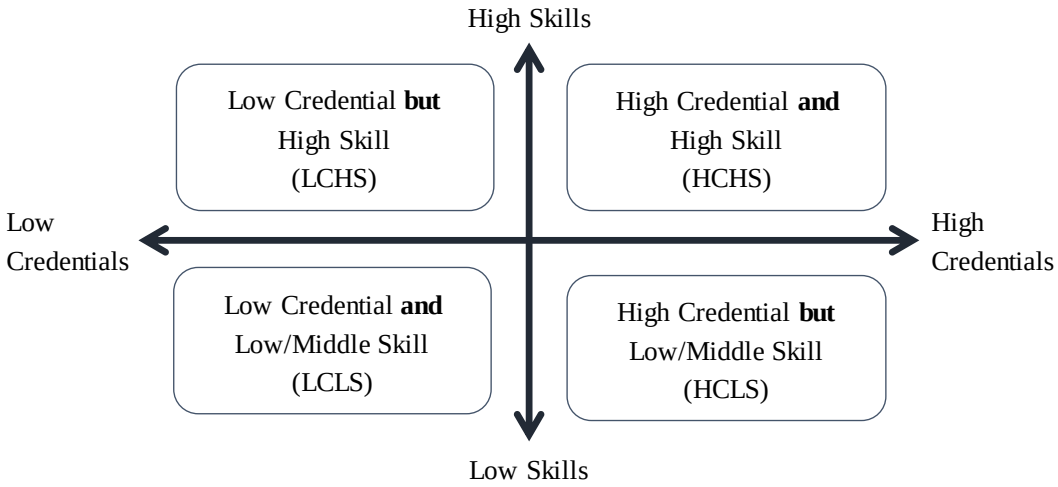
categorical concept of occupations in the main manuscript, yet a supplementary analysis using a continuous measure for occupations (International Socio-Economic Index of Occupational Status: ISEI) is also indicated in Appendix.

Meanwhile, PIAAC provides individual data on quintiles of earnings as well as their absolute amounts, among which the vast economic literature has traditionally used a logarithm of earnings as an outcome of education. However, absolute amounts of earnings are not available for some participating countries of PIAAC, while categorical data including quintiles are provided. From a technical point of view, this is not necessarily unfavourable as recent economic research has argued that categorical earnings data with some thresholds are appropriate to relax the assumption of linearity (Bloome, Dyer, and Zhou 2018; Chetty et al. 2014; Zimmerman 2019). In other words, while linear models using continuous measures are preferable as long as we analyse the association between education and earnings on the assumption that they are linearly related, non-linear models with categorical outcomes may provide more realistic findings in accordance with the actual distribution of monetary rewards. This also means that, by paying attention not only to the extent to which earnings are expected to increase/decrease when educational variables change per unit but also to how quintiles of earnings are linked with credentials and skills within a society, it becomes possible to offer insights into social stratification, which are hardly detectable as long as continuous measures are used in a linear model. Thus, as with occupations, this chapter primarily focuses on earnings quintiles as another economic outcome of education, whilst discussing the analysis using the logarithm of earnings in Appendix.

With regard to independent variables related to education at an individual level, both educational credentials and skills need to be accounted for to precisely investigate their values. Specifically, as illustrated in Figure II-1, this paper defines four educational specifications of individuals based on the levels of credentials and skills: 1) those with high educational credentials and high skills (HCHS), 2) those with high

educational credentials unaccompanied by high skills (HCLS), 3) those with high skills unaccompanied by high educational credentials (LCHS), and 4) those without high educational credentials or high skills (LCLS). By comparing returns to each specification, it becomes possible to examine the net effect of credentials and skills.

Figure II-1 The Conceptual Framework of Educational Specifications



Here high educational credentials are quantified by whether individuals possess tertiary degrees (International Standard Classification of Education: ISCED 2011 Level 5 and above). It is important to note that ISCED 2011 Level 5 includes short-cycle tertiary education, whose economic value is considered to be more significant in societies where the vocational training system is well-developed and valued by the labour market as compared to societies that focus on general education at the tertiary level (Di Stasio 2017). In addition, some pioneering research has argued that economic returns to educational qualifications diverge in accordance with specific fields of study as well as education levels including the prestige of institutions between and within countries (Ashworth and Ransom 2018; Bills 2016; Bol et al. 2019; Borgen and Mastekaasa 2018; DiPrete et al. 2017; Hanushek, Schwerdt, Woessmann, et al. 2017; Ortiz and Rodriguez-Menés 2016; Posselt and Grodsky 2017; Di Stasio 2017; Sullivan

et al. 2018a; Tholen 2017).

However, one of the primary aims of the current analysis is to provide an insight into the association between credentials, skills, and economic rewards via paying attention to societal educational conditions, rather than digging into the detailed linkage of types of educational qualifications and returns. Furthermore, ISCED 2011 Level 5 is clearly distinguished from post-secondary non-tertiary as well as secondary education (Rotman, Shavit, and Shalev 2016; UNESCO Institute for Statistics 2011). This means that a credential obtained at this stage enables its holders to signify superiority over less-educated people (regardless of their actual skills). Therefore, while recognising the dispersion in ISCED 2011 Level 5 and above within/between countries as an important question for future research, the current paper utilises this educational stage as a common metric for high credentials.

Meanwhile, high skills refer to the definition of proficiency level in PIAAC. Specifically, PIAAC public use data provide 10 plausible values (PV)[10] of literacy and numeracy scores ranging from 0 to 500, of which 326 points and above are equivalent to proficiency level 4 or 5 that signify high skills (OECD 2013c).[11] Although there has been a debate on the appropriate operationalisation of the PIAAC PV (OECD 2013c), some recent research has employed the first PV to examine the economic value of skills given that the analysis results are generally consistent between the one with the first PV and the one with 10 PVs despite heavy workloads to incorporate all 10 PVs (e.g. Hanushek et al. 2015; Levels, et al. 2014). Thus, this paper also uses the first PV to calculate the mean score of literacy and numeracy for individuals,[12] and a "high skills

[10] Plausible values are multiple imputations calculated based on item response theory, using not only raw scores but also other socio-economic characteristics of respondents, to increase the accuracy of proficiency estimations.

[11] The correspondence between proficiency levels and scores are defined as follows: below level 1 (below 176 points), level 1 (176 to less than 226 points), level 2 (226 to less than 276 points), level 3 (276 to less than 326 points), level 4 (326 to less than 376 points), and level 5 (equal to or higher than 376 points). For the definitions of each proficiency level, see the technical report (OECD 2013c).

[12] Nevertheless, considering the risk of biased estimation by merely adopting one PV or the mean

dummy" is assigned to a respondent whose score is equal to or higher than 326 points.[13]

It is important to note that, as discussed in Chapter 1 (see Figure I-2), the aforementioned skills are general information-processing competences, which do not automatically signify other key dimensions of skills such as occupation-specific and non-cognitive skills. This means that returns to each educational specification in this analysis might reflect the premium for skills that are not necessarily quantified by PIAAC. Nevertheless, in addition to the fact that PIAAC is the only dataset that makes it possible to examine the effect of skills as well as credentials at both individual and societal levels, evidence has suggested that literacy and numeracy operate as the foundations for other types of skills and economic prosperity (Abrassart 2013; Carroll 1993; Ferrer et al. 2004; Finnie and Meng 2007; Green and Riddell 2003; Hanushek et al. 2015; Hanushek and Woessmann 2015; Himmler and Jackle 2018; OECD 2013b, 2016; Rocha and Ponczek 2011; Tippins and Sohi 2003). Thus, cognitive skills assessed by PIAAC qualify as valuable measures to investigate the ED association in consideration of societal conditions.

As with outcomes (occupations and earnings), another approach here is to use literacy and numeracy scores as continuous measures instead of a dummy variable based on proficiency levels. However, OECD (2013c) pointed out that PIAAC raw scores as such were not necessarily interpretable as substantive values due to measurement errors. That is, although the range of analysis might be reduced by dichotomising the variables, categorical proficiency levels would be appropriate to

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of 10 PVs (OECD 2013b; Perry et al. 2014; Rutkowski et al. 2010), I conducted multilevel analyses 10 times using 10 PVs respectively and calculated their average to check the robustness of the analysis. As with many earlier studies, the results are consistent between the one with the first PV and the one with 10 PVs.

[13] It is technically possible to use data on literacy and numeracy respectively rather than combining them. However, considering both skills have a strong correlation, it is more appropriate to create a composite indicator to avoid multicollinearity. In addition, although PIAAC assesses not only literacy and numeracy but also "problem solving skills in technology-rich environments," the number of respondents who took part in the assessment is much smaller than those with available data on literacy and numeracy. Problem solving skills are therefore excluded from the present analysis to secure a sufficient number of samples.

evaluate information-processing skills that individuals possess. In addition, one important advantage of employing a "high skills dummy" is that, as detailed below, the relative impact of credentials and skills can be assessed even in a non-linear multilevel modelling. This examination contributes not only to sociological research but also to economics, given that the significance of cognitive skills have been aggressively advocated by some recent economic research (e.g. Hanushek et al. 2015; Hanushek and Woessmann 2015) whilst overlooking the possibility that the contribution of skills is in reality significantly smaller than that of credentials, which are assumed to operate as social closure.

Meanwhile, it is also important to pay attention to the relative value of skills in a given society (i.e. the extent to which the possession of a certain level of skills is scarce within a society) in addition to the absolute distinction (i.e. proficiency levels defined by OECD). It is therefore an option to calculate the relative rank/percentile of individuals' skills level in accordance with the distribution in each country. Yet, one of the essential characteristics of proficiency levels is international comparability, which should be ensured to evaluate returns to high skills in a multilevel analysis using cross-country data. This operationalisation is indispensable when the premium for skills is investigated in comparison to credentials, which are internationally defined by absolute criteria (i.e. ISCED). Nonetheless, as discussed earlier, the elasticity of the value of skills associated with their scarcity within a society is an important perspective. Thus, while using a "high skills dummy" in conjunction with a "high credentials dummy" (i.e. ISCED 2011 Level 5 and above) to define educational specifications at an individual level,[14] the relative value of skills is further examined via adopting interaction terms between individuals' skills and societal-level skills diffusion as detailed below. Furthermore, to examine the difference in impact between categorical

[14] Combining two dummy variables, four educational specifications are defined (i.e. HCHS, HCLS, LCHS, and LCLS).

educational specifications and continuous measures, I also describe the analysis result using raw scores of skills as predictors in Appendix for reference.

Other individual-level independent variables include a gender dummy (women=0, men=1), a late-thirties dummy (aged between 35 and 39=1, others=0)[15], an immigrant dummy (first generation immigrant=1, others=0), mother's education (tertiary educated mother=1, others=0), father's education (tertiary educated father=1, others=0), and years of paid work experience. Furthermore, only for the analysis of earnings, occupation dummies (elementary=0, skilled, semi-skilled white collar, semi-skilled blue collar=1 respectively) are also employed in the final model as detailed below.

In the meantime, key country-level independent variables are the degree of educational expansion and skills diffusion, both of which are considered to determine the relative value of credentials and skills via influencing their scarcity. In delineating societies in relation to education, the literature has traditionally focused on the degree of expansion of access. Trow (1973), for example, conceptualised how the characteristics and functions of higher education would change in response to its diffusion by indicating three stages based on the enrolment ratio, namely, elite (0-15%), mass (16-50%), and universal (over 50%). Further, in many studies that have analysed the influence of educational expansion on socio-economic outcomes, societies have been described depending on the extent of participation in higher levels of education (Bar Haim and Shavit 2013; Bol 2015; Breen 2010; Breen and Jonsson 2007; Klein 2016; Meyer et al. 1977; Pfeffer and Hertel 2015; Rotman et al. 2016; Sandefur and Park 2007; Thomsen 2015).

However, the increase of access to higher education does not necessarily imply the accumulation of highly skilled human resources (i.e. a highly qualified society is not always a highly skilled society). This distinction is crucial lest we misunderstand

[15] Ideally, the absolute value of age and its squared term should be employed instead of this dummy variable. However, five countries do not provide continuous measures for age and only cohort data are available. Thus, this research adopts a cohort dummy as an independent variable.

various phenomena as consequences of educational expansion when, in fact, they are caused by skills diffusion, and vice versa. Figure II-2 illustrates this variation.

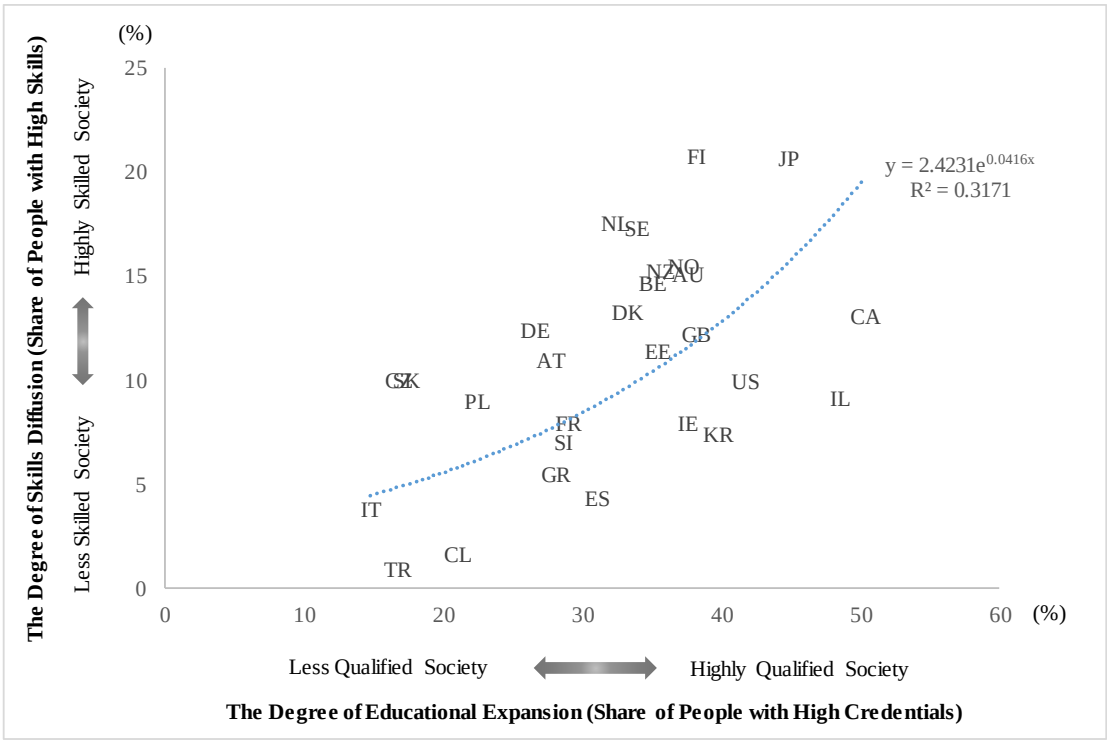
In Figure II-2, the horizontal axis indicates the share of population (aged from 25 to 64) who completed tertiary education in each country, while the vertical axis describes the proportion of people (aged from 16 to 65) who showed high performance in PIAAC. As a general trend, there is a positive association between two variables with a moderate correlation coefficient (r=0.54), meaning that countries with a higher proportion of population who have attained tertiary education (highly qualified societies) are more likely than other countries to achieve a larger share of highly skilled people (highly skilled societies).

Indeed, some countries, such as Japan, Finland, the Netherlands, and Sweden, have achieved both highly qualified and highly skilled societies (upper right). Meanwhile, less qualified societies have hardly realised a large share of highly skilled people albeit its dispersion (lower left), implying that the expansion of access is generally a necessary precondition to achieve highly skilled societies. However, several highly qualified countries, including Israel, the United States, Ireland, and South Korea, have merely promoted access to higher education without an explicit accumulation of highly skilled people (lower right). Herein, one may assume that returns to individual educational specifications might differ depending on these societal educational conditions. It is therefore essential to take into account the influence of educational expansion and skills diffusion respectively in elucidating the economic value of education.

Table II-2 (the share of individual educational specifications in each country) also suggests the importance to pay close attention to the variation in the accumulation of high credentials and high skills across countries. In highly qualified and highly skilled societies in Figure II-2 (e.g. Japan, Finland, the Netherlands, and Sweden), the proportion of those with high skills regardless of whether they also possess high

credentials (HCHS) or not (LCHS) is relatively large as compared with highly qualified but less skilled societies (e.g. Israel, the United States, Ireland, and South Korea) as well as less qualified societies (e.g. Turkey, Chile, and Italy).

Figure II-2 The Share of Tertiary Education Graduates and Highly Skilled People in OECD Countries



Note: The horizontal axis indicates the degree of educational expansion: the proportion of adults (aged from 25 to 64) who possess tertiary degrees. The vertical axis shows the degree of skills diffusion: a mean of the percentage of adults (aged from 16 to 65) with literacy proficiency level 4 or 5 and that with numeracy proficiency level 4 or 5 in PIAAC. The reference year of educational expansion is 2010, whereas that of skills diffusion varies across PIAAC round 1 countries (between 2008 and 2013) and PIAAC round 2 countries (between 2012 and 2016). Each abbreviation means as follows. AU:Australia, AT:Austria, BE:Belgium, CA:Canada, CL:Chile, CZ:Czech Republic, DK:Denmark, EE:Estonia, FI:Finland, FR:France, DE:Germany, GR:Greece, IE:Ireland, IL:Israel, IT:Italy, JP:Japan, KR:South Korea, NL:Netherlands, NZ:New Zealand, NO:Norway, PL:Poland, SK:Slovak Republic, SI:Slovenia, ES:Spain, SE:Sweden, TR:Turkey, GB:United Kingdom, US:United States.
Source: OECD.Stat (http://stats.oecd.org/) [Accessed: 1 August 2018] and OECD (2016)

Table II-2 The Share of Individual Educational Specifications in OECD Countries

Country	LCLS	LCHS	HCLS	HCHS	Total
Austria	3,791 (75.4%)	299 (6.0%)	676 (13.5%)	259 (5.2%)	5,025
Belgium	3,082 (61.8%)	226 (4.5%)	1,158 (23.2%)	518 (10.4%)	4,984
Canada	14,931 (56.0%)	650 (2.4%)	9,116 (34.2%)	1,986 (7.4%)	26,683
Chile	3,933 (75.8%)	18 (0.3%)	1,202 (23.2%)	39 (0.8%)	5,192
Czech Republic	4,607 (75.8%)	276 (4.5%)	902 (14.8%)	296 (4.9%)	6,081
Denmark	4,258 (58.4%)	255 (3.5%)	2,183 (30.0%)	590 (8.1%)	7,286
Estonia	4,573 (60.3%)	280 (3.7%)	2,270 (29.9%)	463 (6.1%)	7,586
Finland	2,913 (53.3%)	404 (7.4%)	1,415 (25.9%)	732 (13.4%)	5,464
France	4,750 (68.8%)	126 (1.8%)	1,619 (23.4%)	412 (6.0%)	6,907
Germany	3,433 (63.8%)	279 (5.2%)	1,262 (23.5%)	405 (7.5%)	5,379
Greece	3,612 (73.5%)	78 (1.6%)	1,109 (22.6%)	117 (2.4%)	4,916
Ireland	3,670 (61.5%)	102 (1.7%)	1,817 (30.5%)	374 (6.3%)	5,963
Israel	3,196 (59.8%)	120 (2.2%)	1,774 (33.2%)	254 (4.8%)	5,344
Italy	3,735 (81.4%)	95 (2.1%)	682 (14.9%)	77 (1.7%)	4,589
Japan	2,509 (48.5%)	297 (5.7%)	1,605 (31.0%)	762 (14.7%)	5,173
South Korea	4,051 (60.9%)	143 (2.2%)	2,186 (32.9%)	271 (4.1%)	6,651
Netherlands	3,168 (62.3%)	382 (7.5%)	1,037 (20.4%)	496 (9.8%)	5,083
New Zealand	3,429 (56.5%)	311 (5.1%)	1,814 (29.9%)	520 (8.6%)	6,074
Norway	2,827 (57.1%)	260 (5.3%)	1,306 (26.4%)	554 (11.2%)	4,947
Poland	6,695 (71.5%)	464 (5.0%)	1,797 (19.2%)	410 (4.4%)	9,366
Slovak Republic	4,454 (78.1%)	265 (4.6%)	782 (13.7%)	201 (3.5%)	5,702
Slovenia	3,807 (71.9%)	156 (2.9%)	1,145 (21.6%)	185 (3.5%)	5,293
Spain	4,242 (71.0%)	58 (1.0%)	1,513 (25.3%)	158 (2.6%)	5,971
Sweden	2,676 (59.9%)	311 (7.0%)	961 (21.5%)	521 (11.7%)	4,469
Turkey	4,224 (81.3%)	8 (0.2%)	940 (18.1%)	22 (0.4%)	5,194
United Kingdom	5,282 (60.0%)	262 (3.0%)	2,621 (29.8%)	641 (7.3%)	8,806
United States	2,906 (59.3%)	107 (2.2%)	1,502 (30.7%)	383 (7.8%)	4,898
Total	114,754 (64.1%)	6,232 (3.5%)	46,394 (25.9%)	11,646 (6.5%)	179,026

Note: The share of individual educational specifications is based on the available individual-level data from the OECD's website, including younger and older than people aged 30 to 39. Therefore, the aggregate value in this table is not necessarily consistent with the value in Figure II-2 as well as Table II-1.
Source: PIAAC country data (http://vs-web-fs-1.oecd.org/piaac/puf-data) [Accessed: 1 June 2017]

With this dispersion in mind, in line with the individual-level variable (educational specifications), educational expansion is quantified by the percentage of the population who attained tertiary education (i.e. ISCED 2011 Level 5 and above), whereas skills diffusion is measured by the proportion of those with high skills (i.e. the mean score of literacy and numeracy is 326 and higher). As indicated above, time-series analyses focused on the change in the share of population with tertiary degrees and that with high skills in a particular society would provide country-specific insights. Nonetheless, this paper adopts the difference in these measures across countries as the degree of educational expansion and skills diffusion in a multilevel model to lead to more generalisable implications.

In addition to educational expansion and skills diffusion, GDP (per capita, purchasing power parities: PPP), economic structures (the share of manufacturing and service industry as percent of GDP), union density, and the strength of tracking in education system are employed as country-level independent variables. GDP and economic structures are used provided that the amount and allocation of economic rewards are significantly affected by macro-economic performance and structures in each society. Indeed, for example, Smyth and McCoy (2011) concluded that the relative value of credentials and high skills differed in association with country-specific economic conditions that would change over time. In addition, union density is considered to affect the situation in which highly/less educated/skilled people are protected/excluded in the labour market, hence having an influence over the economic value of education (e.g. Bol and Weeden 2015; Weeden 2002).[16]

At the same time, tracking as well as vocational orientation of education systems may have a significant impact on the relationship between education and economic

[16] These country-level data are derived from OECD.Stat (http://stats.oecd.org/) [Accessed: 1 September 2018] except for economic structures, which are from World Development Indicators (http://wdi.worldbank.org/table/4.2) [Accessed: 10 January 2019]. For reference years, see Note in Table II-3.

rewards in association with labour market structures (e.g. Bol and van de Werfhorst 2013; Diprete et al. 2017; Levels et al. 2014; Di Stasio 2017; Di Stasio et al. 2016). That is, the effect of education on occupational and monetary outcomes may partially rely on the extent to which education and labour systems are stratified and connected to each other. More specifically, there is the possibility that credentials are closely linked with occupation-specific skills, rather than general cognitive skills that are assessed by PIAAC, in some countries where tracking is relatively strong. In this case, for example, returns to HCLS (i.e. those with high credentials unaccompanied by high skills) might be relatively large due to the contribution of occupation-specific skills that are not reflected in high skills as defined in this analysis. Even though individuals with high credentials do not actually possess high occupation-specific skills, a strong tracking and vocation-oriented system is assumed to enhance rewards for HCLS via intensifying the signalling power of credentials (i.e. employers are likely to take credentials as signals of occupation-specific skills and to favour individuals with such qualification) in a society (Van de Werfhorst 2011a).

To minimise this potential divergence associated with societal-level education and labour market systems, it is imperative to take account of their difference across countries. In other words, by controlling for country-level variables on education system and economic structures in a multilevel modelling, it becomes possible to precisely examine the economic return to credentials and cognitive skills that are evaluable by PIAAC.[17] Thus, in addition to macroeconomic conditions, this paper derives an indicator of the relative strength of tracking in OECD countries from Bol and van de Werfhorst (2013), which conducted a comparative analysis of the impact of

[17] Nonetheless, to conclude that returns are attributed to credentials per se, every single dimension of skills (as well as general information-processing skills) needs to be controlled for. Also, one may also argue that returns to non-tertiary (especially post-secondary) credentials, rather than tertiary education degrees, are likely to be large in societies that have strong tracking systems. To examine this perspective, the variation in labour market outcomes between ISCED 2011 Level 4 (post-secondary non-tertiary education) and tertiary levels should be investigated. This is an important topic for future research.

tracking and vocational orientation of education systems on economic outcomes. [18]

Using the PIAAC individual data and other country-level statistics, multilevel logistic regression analyses are conducted to reveal how individual educational specifications affect economic benefits in association with societal educational expansion and skills diffusion (see Table II-3 for descriptive statistics).[19] In so doing, particular attention is paid to two dimensions: 1) how returns to education (i.e. the ED association) vary depending on educational specifications, and 2) how the ED association differs in accordance with the degree of societal-level educational expansion and skills diffusion. Specific analytical models are as follows (see also Figure II-3 for the analytical framework).

In Model 1, only individual-level independent variables are used to examine the main effects of educational specifications on the acquisition of skilled occupations and earnings by focusing on the coefficients of three dummy variables (HCHS, HCLS, and LCHS with LCLS as reference) (see equations (1a) and (1b) below). Here it is important to consider the possibility of reverse causation between education and economic rewards, that is, people may enhance their skills and credentials through their work experience and/or investment of their financial resources. Although both directions of influence seem to operate in reality, the existing cross-section data are not adequate to precisely examine this relationship. Thus, as a first step for more elaborate investigations, this article employs the assumption that the possession of high skills

[18] It is important to note that this measure of tracking includes secondary education and also does not take account of the variation across different cohorts in each society. However, the relative strength of tracking across countries is stable (e.g. Vogtenhuber 2018), and among other things, it is better to incorporate some aspects of tracking rather than completely disregarding it. Thus, the current article employs the indicator introduced by Bol and van de Werfhorst (2013). The data are extracted from Appendix A (available online).

[19] A multilevel binary logistic regression is adopted for the analysis of skilled occupations, whereas a multilevel ordered logistic regression is conducted for earnings quintiles. Although some researchers argue that random slopes need to be incorporated in multilevel analyses with cross-level interactions (e.g. Heisig and Schaeffer 2019), the analytical models that follow employ only random intercepts primarily because 1) random slopes models might also lead to biased estimations (e.g. Grueber et al. 2011) especially when the sample size is not large enough and 2) the analysis result shown in the current paper is consistent with that of models incorporating random slopes.

and/or high credentials affects the probability of attaining skilled occupations and better earnings.[20]

Skilled Occupations

$$\log\left(\frac{p_{ij}}{1-p_{ij}}\right) = b_{0j} + b_1 M_{ij} + b_2 A_{ij} + b_3 I_{ij} + b_4 ME_{ij} + b_5 FE_{ij} + b_6 W_{ij} + b_7 HCHS_{ij} + b_8 HCLS_{ij} + b_9 LCHS_{ij} + \varepsilon_{ij} \cdots (1a)$$

where *i*=level one (individual), *j*=level two (country), p_{ij}=the probability of obtaining skilled occupations for individual i in country j, b_n=coefficient of individual level independent variables, M_{ij}=men dummy, A_{ij}=late-thirties dummy, I_{ij}=immigrant dummy, ME_{ij}=mother's education (tertiary dummy), FE_{ij}=father's education (tertiary dummy), W_{ij}=years of paid work, $HCHS_{ij}$=HCHS dummy, $HCLS_{ij}$=HCLS dummy, and $LCHS_{ij}$=LCHS dummy, and ε_{ij}=residual for individual *i* in country *j*. In this model, I simply focus on b_7, b_8, and b_9 (and their marginal effects)[21] that imply the main effect of each educational specification on the probability of obtaining skilled occupations (as compared with those without high credentials or high skills: LCLS).

Earnings

$$Y_{ij}^* = \beta_{0j} + \beta_1 M_{ij} + \beta_2 A_{ij} + \beta_3 I_{ij} + \beta_4 ME_{ij} + \beta_5 FE_{ij} + \beta_6 W_{ij} + b_7 HCHS_{ij} + b_8 HCLS_{ij} + b_9 LCHS_{ij} + \varepsilon_{ij} \cdots (1b)$$

where β_n=coefficient of individual level independent variables, Y_{ij}^*=latent response for

[20] It is also important to note that, as discussed in the previous section, samples are limited to people aged 30 to 39 in this analysis in order to minimise the reverse causation.

[21] Hereafter I simply use the term "coefficients," unless otherwise noted, to explain parameters to be focused on in each model. However, "marginal effects" are also focused on in the following sections given that coefficients of nonlinear models are not substantively interpretable (Breen, Karlson, and Holm 2018).

individual i in country j, and an observed response Y_{ij} (earnings quintiles) can be determined by thresholds (τ_n) as following. Other abbreviations are the same as equation (1a).

$$Y_{ij} = \begin{cases} 1 \text{ if } & Y_{ij}^* \leq \tau_1 \\ 2 \text{ if } & \tau_1 < Y_{ij}^* \leq \tau_2 \\ 3 \text{ if } & \tau_2 < Y_{ij}^* \leq \tau_3 \\ 4 \text{ if } & \tau_3 < Y_{ij}^* \leq \tau_4 \\ 5 \text{ if } & \tau_4 < Y_{ij}^* \end{cases}$$

Model 2 adds six cross-level interaction terms as well as country-level variables to Model 1 in order to analyse how the impact of three educational specifications differs in association with educational expansion and tracking. Interaction terms are generated by multiplying two country-level variables (the degree of educational expansion and the index of tracking) and three individual-level dummy variables for educational specifications (HCHS, HCLS, and LCHS).

Skilled Occupations

$$b_{0j}(\text{in equation (1a)}) = \gamma_{00} + \gamma_{01}E_j + \gamma_{02}T_j + \gamma_{03}G_j + \gamma_{04}Em_j + \gamma_{05}Es_j + \gamma_{06}U_j + u_{0j} \cdots (2a)$$

where γ_{00}=average intercept, γ_{0n}=coefficient of country level independent variables, E_j=the degree of educational expansion, T_j=the index of tracking, G_j=GDP per capita, Em_j=the share of manufacturing (as percentage of GDP), Es_j=the share of service (as percentage of GDP), U_j=union density, and u_{0j}=country (j) dependent deviation. Here I substitute equation (2a) into equation (1a) and denote b_n by γ_{n0} whilst adding six interaction terms between educational specifications and societal educational conditions (E and T). Coefficients γ_{71}, γ_{81}, and γ_{91} in tandem with γ_{70}, γ_{80}, and γ_{90} explain the variation in returns to each educational specification in association with educational expansion.

$$\log\left(\frac{p_{ij}}{1-p_{ij}}\right) = \gamma_{00} + \gamma_{10}M_{ij} + \gamma_{20}A_{ij} + \gamma_{30}I_{ij} + \gamma_{40}ME_{ij} + \gamma_{50}FE_{ij} + \gamma_{60}W_{ij} + \gamma_{70}HCHS_{ij}$$
$$+ \gamma_{80}HCLS_{ij} + \gamma_{90}LCHS_{ij} + \gamma_{01}E_j + \gamma_{02}T_j + \gamma_{03}G_j + \gamma_{04}Em_j + \gamma_{05}Es_j + \gamma_{06}U_j$$
$$+ \gamma_{71}HCHS_{ij}E_j + \gamma_{81}HCLS_{ij}E_j + \gamma_{91}LCHS_{ij}E_j + \gamma_{72}HCHS_{ij}T_j + \gamma_{82}HCLS_{ij}T_j$$
$$+ \gamma_{92}LCHS_{ij}T_j + u_{0j} + \varepsilon_{ij} \cdots (3a)$$

Earnings

$$\beta_{0j}(\text{in equation 1b}) = \gamma_{00} + \gamma_{01}E_j + \gamma_{02}T_j + \gamma_{03}G_j + \gamma_{04}Em_j + \gamma_{05}Es_j + \gamma_{06}U_j + u_{0j} \cdots (2b)$$

Taking the same steps as the occupation analysis, Model 2 of the earnings analysis can be described as follows.

$$Y_{ij}^* = \gamma_{00} + \gamma_{10}M_{ij} + \gamma_{20}A_{ij} + \gamma_{30}I_{ij} + \gamma_{40}ME_{ij} + \gamma_{50}FE_{ij} + \gamma_{60}W_{ij} + \gamma_{70}HCHS_{ij} + \gamma_{80}HCLS_{ij}$$
$$+ \gamma_{90}LCHS_{ij} + \gamma_{01}E_j + \gamma_{02}T_j + \gamma_{03}G_j + \gamma_{04}Em_j + \gamma_{05}Es_j + \gamma_{06}U_j + \gamma_{71}HCHS_{ij}E_j$$
$$+ \gamma_{81}HCLS_{ij}E_j + \gamma_{91}LCHS_{ij}E_j + \gamma_{72}HCHS_{ij}T_j + \gamma_{82}HCLS_{ij}T_j + \gamma_{92}LCHS_{ij}T_j$$
$$+ u_{0j} + \varepsilon_{ij} \cdots (3b)$$

Model 3 further employs another country-level variable (the degree of skills diffusion: *S*) and three cross-level interaction terms between the degree of skills diffusion and three individual educational specifications. The result of this model, especially γ_{71}, γ_{81}, γ_{91}, γ_{73}, γ_{83}, and γ_{93} as well as γ_{70}, γ_{80}, and γ_{90}, provides evidence for the difference in economic rewards for education in consideration of both educational expansion and skills diffusion.[22]

[22] Although the estimation could be biased by incorporating many country-level and cross-level variables as compared to the number of countries, the analysis results shown in the current paper are consistent with the ones using only two country-level variables (educational expansion and skills diffusion) and six cross-level interactions (two country-level variables * three educational specifications).

Skilled Occupations

$$\log\left(\frac{p_{ij}}{1-p_{ij}}\right) = \gamma_{00} + \gamma_{10}M_{ij} + \gamma_{20}A_{ij} + \gamma_{30}I_{ij} + \gamma_{40}ME_{ij} + \gamma_{50}FE_{ij} + \gamma_{60}W_{ij} + \gamma_{70}HCHS_{ij} + \gamma_{80}HCLS_{ij} + \gamma_{90}LCHS_{ij} + \gamma_{01}E_j + \gamma_{02}T_j + \gamma_{03}S_j + \gamma_{04}G_j + \gamma_{05}Em_j + \gamma_{06}Es_j + \gamma_{07}U_j + \gamma_{71}HCHS_{ij}E_j + \gamma_{81}HCLS_{ij}E_j + \gamma_{91}LCHS_{ij}E_j + \gamma_{72}HCHS_{ij}T_j + \gamma_{82}HCLS_{ij}T_j + \gamma_{92}LCHS_{ij}T_j + \gamma_{73}HCHS_{ij}S_j + \gamma_{83}HCLS_{ij}S_j + \gamma_{93}LCHS_{ij}S_j + u_{0j} + \varepsilon_{ij} \cdots (4a)$$

Earnings

$$Y_{ij}^{*} = \gamma_{00} + \gamma_{10}M_{ij} + \gamma_{20}A_{ij} + \gamma_{30}I_{ij} + \gamma_{40}ME_{ij} + \gamma_{50}FE_{ij} + \gamma_{60}W_{ij} + \gamma_{70}HCHS_{ij} + \gamma_{80}HCLS_{ij} + \gamma_{90}LCHS_{ij} + \gamma_{01}E_j + \gamma_{02}T_j + \gamma_{03}S_j + \gamma_{04}G_j + \gamma_{05}Em_j + \gamma_{06}Es_j + \gamma_{07}U_j + \gamma_{71}HCHS_{ij}E_j + \gamma_{81}HCLS_{ij}E_j + \gamma_{91}LCHS_{ij}E_j + \gamma_{72}HCHS_{ij}T_j + \gamma_{82}HCLS_{ij}T_j + \gamma_{92}LCHS_{ij}T_j + \gamma_{73}HCHS_{ij}S_j + \gamma_{83}HCLS_{ij}S_j + \gamma_{93}LCHS_{ij}S_j + u_{0j} + \varepsilon_{ij} \cdots (4b)$$

Finally, only for the analysis of earnings, three dummy variables related to occupations (skilled: *So*, semi-skilled white collar: *Sw*, and semi-skilled blue collar: *Sb*, with elementary as reference) are controlled for in Model 4 to re-examine the result of Model 3. [23]

$$Y_{ij}^{*} = \gamma_{00} + \gamma_{10}M_{ij} + \gamma_{20}A_{ij} + \gamma_{30}I_{ij} + \gamma_{40}ME_{ij} + \gamma_{50}FE_{ij} + \gamma_{60}W_{ij} + \gamma_{70}HCHS_{ij} + \gamma_{80}HCLS_{ij} + \gamma_{90}LCHS_{ij} + \gamma_{100}So_{ij} + \gamma_{110}Sw_{ij} + \gamma_{120}Sb_{ij} + \gamma_{01}E_j + \gamma_{02}T_j + \gamma_{03}S_j + \gamma_{04}G_j + \gamma_{05}Em_j + \gamma_{06}Es_j + \gamma_{07}U_j + \gamma_{71}HCHS_{ij}E_j + \gamma_{81}HCLS_{ij}E_j + \gamma_{91}LCHS_{ij}E_j + \gamma_{72}HCHS_{ij}T_j + \gamma_{82}HCLS_{ij}T_j + \gamma_{92}LCHS_{ij}T_j + \gamma_{73}HCHS_{ij}S_j + \gamma_{83}HCLS_{ij}S_j + \gamma_{93}LCHS_{ij}S_j + u_{0j} + \varepsilon_{ij} \cdots (5b)$$

[23] As noted, the primary focus of these multilevel models is on generalisable findings. Yet, considering the importance to pay attention to the variation across societies, the results of country-specific analyses are also shown in Appendix for reference.

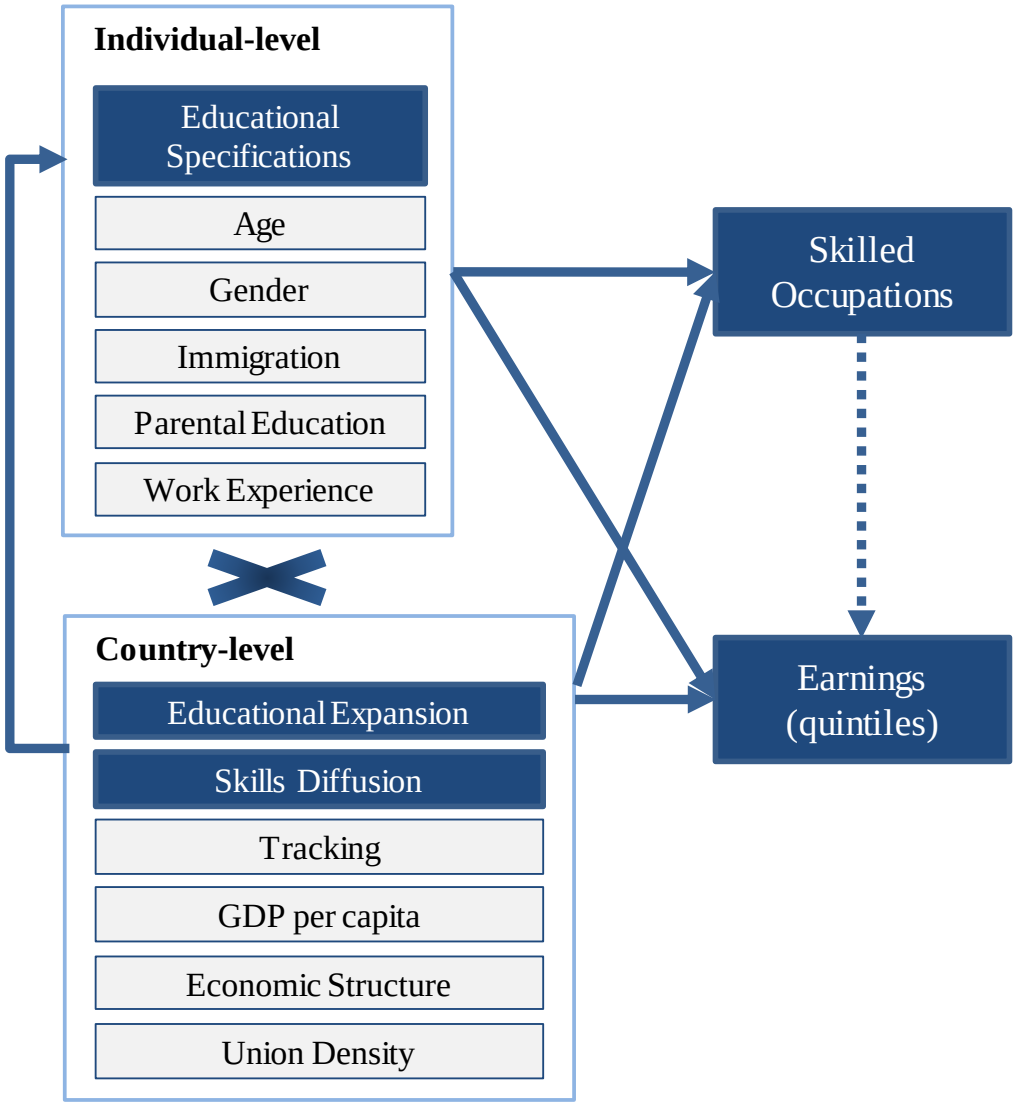
Table II-3 Descriptive Statistics

Variables	Skilled Occupations				Earnings Quintiles			
	Mean	S.D.	Min.	Max.	Mean	S.D.	Min.	Max.
Individual Level								
High Credential and High Skills	0.11	0.32	0.00	1.00	0.13	0.34	0.00	1.00
High Credential without High Skills	0.36	0.48	0.00	1.00	0.37	0.48	0.00	1.00
High Skills without High Credential	0.03	0.18	0.00	1.00	0.04	0.19	0.00	1.00
Neither High Credential nor High Skills	0.49	0.50	0.00	1.00	0.46	0.50	0.00	1.00
Gender (men dummy)	0.49	0.50	0.00	1.00	0.51	0.50	0.00	1.00
Age (35-39 years old)	0.51	0.50	0.00	1.00	0.51	0.50	0.00	1.00
First Generation Immigrant	0.14	0.34	0.00	1.00	0.13	0.34	0.00	1.00
Tertiary Educated Mother	0.19	0.39	0.00	1.00	0.20	0.40	0.00	1.00
Tertiary Educated Father	0.22	0.41	0.00	1.00	0.23	0.42	0.00	1.00
Years of Paid Work	12.36	5.29	0.00	25.00	12.81	5.11	0.00	25.00
Skilled Occupation	0.47	0.50	0.00	1.00	0.51	0.50	0.00	1.00
Semi-skilled White Collar	-	-	-	-	0.26	0.44	0.00	1.00
Semi-skilled Blue Collar	-	-	-	-	0.17	0.38	0.00	1.00
Elementary Occupation	-	-	-	-	0.06	0.23	0.00	1.00
Earnings Quintiles	-	-	-	-	3.19	1.35	1.00	5.00
Country Level								
Educational Expansion	31.44	9.58	13.12	50.31	31.44	9.58	13.12	50.31
Index of Tracking	-0.01	0.97	-1.31	1.79	-0.01	0.97	-1.31	1.79
Skills Diffusion	10.75	5.20	0.99	20.81	10.75	5.20	0.99	20.81
GDP per capita (USD, PPP)	35080.98	9065.94	20562.26	57998.85	35080.98	9065.94	20562.26	57998.85
Economic Structure (Manufacturing)	14.58	4.88	7.00	28.00	14.58	4.88	7.00	28.00
Economic Structure (Service)	63.12	6.48	52.80	76.00	63.12	6.48	52.80	76.00
Union Density	28.48	17.96	7.74	68.61	28.48	17.96	7.74	68.61
Observations	Individuals=30,284 Countries=26				Individuals=23,840 Countries=26			

Note: The reference years of "GDP per capita" are 2010 for PIAAC round 1 countries and 2013 or 2014 for PIAAC round 2 countries. "Educational Expansion," "Economic Structure" and "Union Density" are based on the data in 2010, while "Skills Diffusion" as well as individual-level variables refers to years in which each country participated in PIAAC. For "Index of Tracking," see Bol and van de Werfhorst (2013). The number of observations and descriptive statistics are inconsistent between the dataset for skilled occupations and that for earnings quintiles because the samples are limited to valid cases respectively.

Source: The PIAAC data (http://vs-web-fs-1.oecd.org/piaac/puf-data), OECD.Stat (http://stats.oecd.org/) [Accessed: 1 September 2018], World Development Indicators (http://wdi.worldbank.org/table/4.2) [Accessed: 10 January 2019] and Bol and van de Werfhorst (2013)

Figure II-3 The Analytical Framework



Note: To precisely describe a multilevel modelling, individual-level variables should be drawn within the country-level box. However, these variables are illustrated separately in this figure for brevity.

4. Results

Table II-4 summarises the results of Model 1 to Model 3 of the occupation analysis. Firstly, Model 1 shows that three educational specifications (HCHS, HCLS, and LCHS dummies with LCLS as reference) significantly demonstrate positive effects at 0.1% level (b_7=2.793, b_8=2.105, and b_9=0.990). This means that the chance of obtaining prestigious jobs is expected to be higher if one possesses at least high credentials or high skills. Even after controlling for country-level variables and cross-level interaction terms (Model 2 and Model 3), the significance of the main effects of these educational specifications are robust.

However, as far as the magnitude of impact of each specification is concerned, there is a notable difference between credentials and skills. Figure II-4 illustrates the marginal effects of educational specifications, revealing that the estimated probability of obtaining skilled occupations is above 80% for those who possess high credentials regardless of skills level (HCHS and HCLS), whereas the probability is approximately 40% for those with only high skills (LCHS).[24] This suggests that tertiary graduates can enjoy a high chance of prestigious occupations even though credentials are unaccompanied by high cognitive skills, while high skills per se modestly enhance occupational rewards only when individuals do not possess high credentials. These results indicate that the impact of credentials on occupational attainment far outweighs that of high skills.

Nevertheless, their impact is not static, but rather significantly influenced by the degree of societal-level educational expansion and skills diffusion. In Model 2, six cross-level interaction terms (educational expansion/tracking * three individual educational specifications) as well as country-level variables are added to investigate

[24] The differences in the marginal effect across educational specifications are statistically significant at 5% level except for the one between HCLS and HCHS. The significance is tested by simply replacing the reference with other educational specifications. Hereafter, the description of the (in)significance of differences in coefficients (marginal effects) are based on the same approach (using the 5% significance level) unless otherwise stated.

the heterogeneity in impact of educational specifications in association with the degree of societal-level educational expansion. The coefficients of two interaction terms between educational expansion and high credentials, including both HCHS and HCLS, are significantly negative (γ_{71}=-0.032 and γ_{81}=-0.040 respectively), suggesting that occupational returns to high credentials, regardless of the possession of high skills, are likely to be smaller in societies where the share of tertiary graduates is relatively large. Meanwhile, other interaction terms with the index of tracking do not demonstrate any significant effects. This result does not support the idea that the occupational value of credentials is larger in strong tracking systems, which may promote occupation-specific skills that are not necessarily reflected in high skills assessed here or at least strengthen the signalling power of credentials.[25]

Model 3 further sheds light on societal-level skills diffusion in addition to educational expansion and tracking via adopting another three cross-level interaction terms (skills diffusion * individual educational specifications). The negative impact of educational expansion on the occupational return to HCHS and HCLS is confirmed even after controlling for skills diffusion (γ_{71}=-0.034 and γ_{81}=-0.038). By contrast, LCHS does not face its devaluation in association with educational expansion or skills diffusion. In particular, considering that high skills per se (i.e. LCHS) maintain their occupational premium despite their smaller scarcity due to the higher degree of skills diffusion (i.e. γ_{93} is not significant), one may assume that skills might operate as absolute goods whose economic value is not significantly determined by the extent to which they are rare in a given society.[26] This is markedly different characteristics of credentials as positional goods, which are depreciated due to the higher degree of

[25] As discussed, this might be because the occupational return to secondary and/or post-secondary non-tertiary education, rather than tertiary education, is intensified in strong tracking systems. To examine this, further research focused on the variation within credentials is required.

[26] It is important to note that γ_{93} is negative albeit not significant with the relatively large standard error. Further investigation is therefore necessary to conclude that skills operate as absolute goods. Yet, this statement seems reasonable given that the analysis using continuous skills measures also suggests that skills are not significantly devalued due to skills diffusion (see Appendix A).

educational expansion (i.e. γ_{71} and γ_{81} are both significantly negative).

Here it is also important to note that the difference in the magnitude of devaluation between HCHS (γ_{71}) and HCLS (γ_{81}) is not statistically significant. This means that, as with their main effects, high cognitive skills do not necessarily contribute to highly educated people in a way to mitigate the depreciation of high credentials associated with the higher degree of educational expansion.

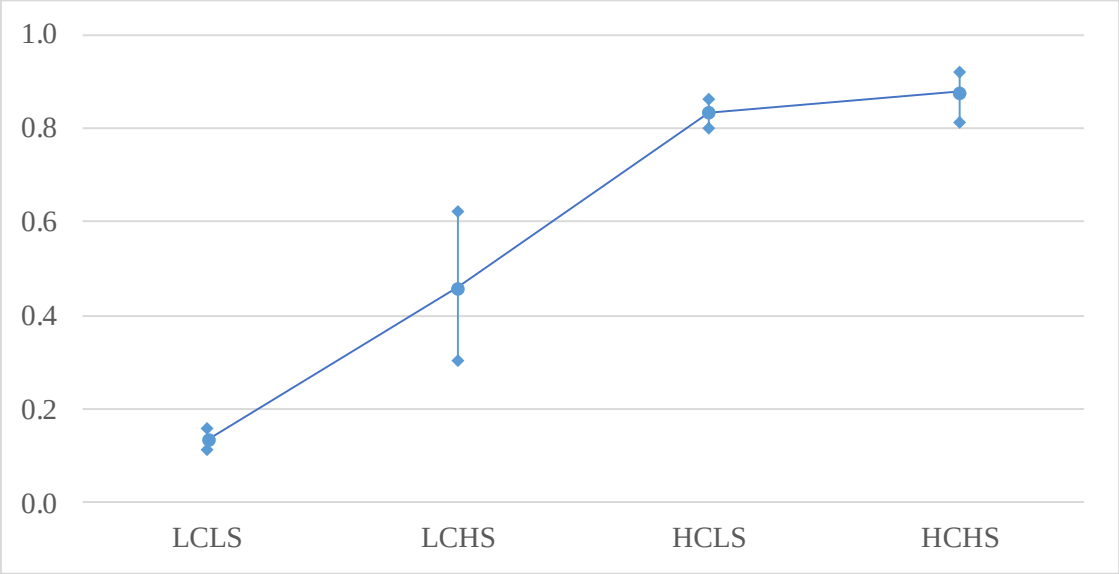
Table II-4 Multilevel Binary Logistic Regression of Skilled Occupations

Independent Variable		Model 1			Model 2			Model 3		
		B		S.E.	B		S.E.	B		S.E.
Intercept		-1.556	***	0.093	-1.626		0.901	-1.575		0.928
Level One (Individual)	Men (dummy)	-0.027		0.028	-0.026		0.028	-0.026		0.028
	Age (35-39 years old dummy)	0.007		0.030	0.008		0.030	0.008		0.030
	First Generation Immigrant (dummy)	-0.554	***	0.043	-0.484	***	0.043	-0.484	***	0.043
	Tertiary Educated Mother (dummy)	0.267	***	0.041	0.270	***	0.040	0.270	***	0.040
	Tertiary Educated Father (dummy)	0.502	***	0.038	0.502	***	0.038	0.502	***	0.038
	Years of Paid Work	0.021	***	0.003	0.023	***	0.003	0.023	***	0.003
	Educational Specifications (Reference = Neither High Credential nor High Skills: LCLS)									
	High Credential & High Skills (HCHS)	2.793	***	0.054	3.878	***	0.277	3.826	***	0.282
	Only High Credential without High Skills (HCLS)	2.105	***	0.032	3.470	***	0.140	3.478	***	0.141
	Only High Skills without High Credential (LCHS)	0.990	***	0.067	1.590	***	0.328	1.698	***	0.343
Cross-Level Interactions	Educational Expansion * HCHS				-0.032	***	0.008	-0.034	***	0.008
	Educational Expansion * HCLS				-0.040	***	0.004	-0.038	***	0.005
	Educational Expansion * LCHS				-0.019		0.010	-0.014		0.011
	Tracking * HCHS				-0.131		0.074	-0.131		0.075
	Tracking * HCLS				-0.083		0.047	-0.080		0.047
	Tracking * LCHS				-0.006		0.087	0.000		0.088
	Skills Diffusion * HCHS							0.008		0.012
	Skills Diffusion * HCLS							-0.005		0.008
	Skills Diffusion * LCHS							-0.021		0.018
Level Two (Country)	Educational Expansion				0.012		0.012	0.009		0.013
	Index of Tracking				0.256	*	0.110	0.249	*	0.113
	Skills Diffusion							0.011		0.020
	GDP per capita (USD, PPP)/10,000				0.211	*	0.096	0.189		0.109
	Economic Structure (Share of Manufacturing)				-0.035		0.018	-0.036		0.019
	Economic Structure (Share of Service)				-0.009		0.013	-0.009		0.013
	Union Density				-0.001		0.004	-0.001		0.004
Variance	Random Effect Covariance Structure (Intercept)	0.171 **			0.126 **			0.132 **		
Model Fit	-2LL	139688.149			139931.220			139977.727		
	AIC	139690.149			139933.220			139979.727		

(*** p<0.001, ** p<0.01, * p<0.05) [two tailed] [N: Individual=30,284, Country=26］

Note: Data are unweighted.

Figure II-4 Probability of Obtaining Skilled Occupations by Educational Specifications



Note: Marginal effects in this figure are calculated based on Model 3. Diamonds indicate the 95% confidence interval.

Table II-5 illustrates the result of the earnings analysis. Model 1 reveals the similar pattern between monetary rewards and occupational attainment as returns to education. Three dummy variables related to individual educational specifications (HCHS, HCLS, and LCHS with LCLS as reference) demonstrate significant positive effects (β_7=1.976, β_8=1.332, and β_9=0.725), meaning that those with at least high credentials or high skills are likely to enjoy better earnings. Comparing the magnitude across educational specifications, those who possess both high credentials and high skills (HCHS) can expect the highest earnings, followed by those with only high credentials (HCLS), while the contribution of high skills unaccompanied by high credentials (LCHS) is relatively limited.[27] Indeed, Figure II-5 demonstrates that, whereas the marginal effects of HCHS and HCLS on lower quintiles are small, they become larger on the fourth and fifth quintiles (i.e. the probability of falling into higher earnings quintiles is large).

[27] The difference in coefficients across these educational specifications is statistically significant regardless of analytical models.

Among them, the contribution of HCHS to reaching the highest earning quintile is significantly larger than that of HCLS (approximately 60% and 40% respectively). Meanwhile, the marginal effect of LCHS starts declining after passing the third quintile in line with LCLS. This suggests that, although high skills as such contribute to reducing the risk of falling into low quintiles, they do not necessarily improve the probability of reaching the fourth or fifth quintile as compared with those who possess neither high credentials nor high skills.

Model 2 sheds light on the variation in the monetary return to educational specifications in association with educational expansion via examining three cross-level interaction terms (educational expansion * three individual educational specifications). The coefficients of three interaction terms are all negative at 0.1% significance level (γ_{71}=-0.030, γ_{81}=-0.031, and γ_{91}=-0.021 respectively). This suggests that the impact of high credentials and high skills on earnings, regardless of their combination, becomes small due to a larger share of tertiary graduates in a given society.

In Model 3, another country-level variable (skills diffusion) and three cross-level interaction terms (skills diffusion * three individual educational specifications) are added. While the significant negative impact of educational expansion on the return to educational specifications is confirmed for HCHS and HCLS (γ_{71}=-0.019 and γ_{81}=-0.020), the devaluation of LCHS is no longer significant as with the occupation analysis. In the meantime, the coefficients of two interaction terms between skills diffusion and HCHS/HCLS are also significantly negative (γ_{73}=-0.047 and γ_{83}=-0.039), meaning that monetary rewards for high credentials, regardless of whether they are accompanied by high skills, are likely to be smaller in societies where the share of highly skilled people is relatively large. Nevertheless, high skills per se (LCHS) do not lose their premium even though their scarcity diminishes due to the higher degree of skills diffusion in a society (i.e. γ_{93} is not significant). Herein, however, it is important to note that γ_{93} is negative with the relatively large standard error, suggesting the necessity to further

scrutinize the absolute value of skills.

In any case, given the fact that high credentials are significantly devalued associated with the larger share of highly skilled people, one may assume that what we have understood as the devaluation of high credentials due to educational expansion (e.g. with the notion of credential inflation) is in reality substantially associated with skills diffusion. It is therefore imperative to pay attention to societal skills diffusion as well as educational expansion in conjunction with educational specifications. The potential social mechanism of this depreciation is discussed in the following section.

Model 4 further accounts for individual occupations to re-examine the result of Model 3. With regard to the main effects of high credentials and high skills (γ_{70}, γ_{80}, and γ_{90}), one interesting finding here is that, while the difference in coefficient between HCHS and HCLS (γ_{70} and γ_{80}) is significant, the one between HCLS and LCHS (γ_{80} and γ_{90}) becomes insignificant. That is, although the direct effect of HCHS on earnings after controlling for occupations is significantly larger than that of HCLS and LCHS, high credentials without high skills (HCLS) cannot necessarily promote the chance of better earnings as compared with high skills unaccompanied by high credentials (LCHS). Indeed, Figure II-6 illustrates that, whereas HCHS retains its high probability of attaining the top quintile (albeit smaller than that in Figure II-5), the marginal effect of HCLS diminishes from the fourth quintile to the fifth quintile in line with LCHS as well as LCLS. Meanwhile, the significant devaluation of high credentials (HCHS and HCLS) in association with educational expansion and skills diffusion is confirmed in Model 4 as with Model 3 (i.e. γ_{71}, γ_{81}, γ_{73}, and γ_{83} are significantly negative, among which γ_{73} and γ_{83} remain at 0.1% level). It is also worthy to note that high skills as such maintains their premium regardless of their scarcity (i.e. γ_{93} is still not significant).

One essential question here is what implications we can derive from the above-mentioned nuanced relationship between individual educational specifications, labour market outcomes, and societal educational expansion/skills diffusion. Paying close

attention to the difference in the allocation process between occupations and monetary benefits, the next section discusses the potential social mechanism that affects the economic value of education, after summarising main findings of the analysis.

Table II-5 Multilevel Ordered Logistic Regression of Earnings Quintiles

Independent Variable		Model 1			Model 2		
		B		S.E.	B		S.E.
Threshold	Cut point 1	0.060		0.057	-0.560		0.371
	Cut point 2	1.337	***	0.057	0.720		0.371
	Cut point 3	2.435	***	0.058	1.821	***	0.371
	Cut point 4	3.761	***	0.061	3.153	***	0.372
Level One (Individual)	Men (dummy)	1.175	***	0.025	1.177	***	0.025
	Age (35-39 years old dummy)	-0.140	***	0.026	-0.146	***	0.026
	First Generation Immigrant (dummy)	-0.473	***	0.037	-0.424	***	0.037
	Tertiary Educated Mother (dummy)	0.107	**	0.034	0.116	**	0.034
	Tertiary Educated Father (dummy)	0.251	***	0.032	0.258	***	0.032
	Years of Paid Work	0.072	***	0.003	0.075	***	0.003
	Educational Specifications (Reference = Neither High Credential nor High Skills: LCLS)						
	High Credential & High Skills (HCHS)	1.976	***	0.042	3.014	***	0.203
	Only High Credential without High Skills (HCLS)	1.332	***	0.029	2.392	***	0.121
	Only High Skills without High Credential (LCHS)	0.725	***	0.064	1.424	***	0.320
Cross-Level Interactions	Educational Expansion * HCHS				-0.030	***	0.006
	Educational Expansion * HCLS				-0.031	***	0.004
	Educational Expansion * LCHS				-0.021	*	0.009
	Tracking * HCHS				-0.096		0.053
	Tracking * HCLS				-0.077	*	0.039
	Tracking * LCHS				-0.060		0.083
Level Two (Country)	Educational Expansion				0.002		0.005
	Index of Tracking				0.062		0.047
	GDP per capita (USD, PPP)/10,000				-0.006		0.039
	Economic Structure (Share of Manufacturing)				-0.001		0.007
	Economic Structure (Share of Service)				-0.010		0.005
	Union Density				-0.003		0.002
Variance	Random Effect Covariance Structure (Intercept)	0.040 **			0.018 *		
Model Fit	-2LL	305368.840			306767.691		
	AIC	305370.840			306769.691		

(*** p<0.001, ** p<0.01, * p<0.05) [two tailed] [N: Individual=23,840, Country=26］

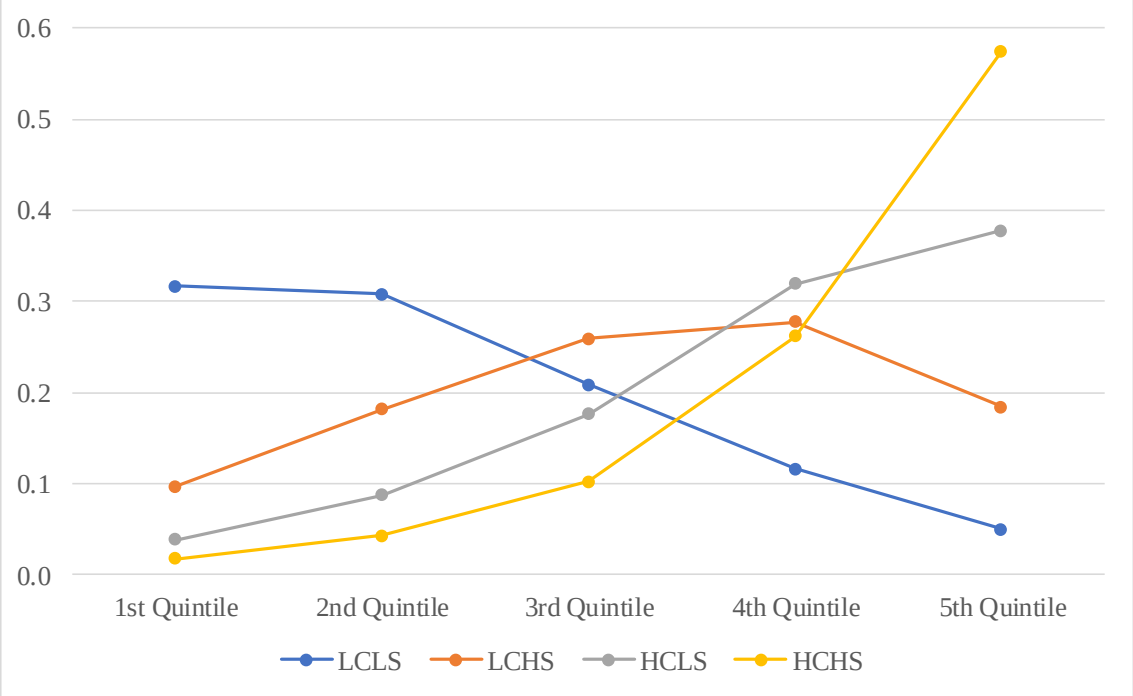
Note: Data are unweighted.

Table II-5 Multilevel Ordered Logistic Regression of Earnings Quintiles (cont.)

Independent Variable		Model 3			Model 4		
		B		S.E.	B		S.E.
Threshold	Cut point 1	-0.434		0.285	0.449		0.341
	Cut point 2	0.845	**	0.285	1.809	***	0.341
	Cut point 3	1.948	***	0.285	2.989	***	0.341
	Cut point 4	3.283	***	0.286	4.391	***	0.342
Level One (Individual)	Men (dummy)	1.175	***	0.025	1.205	***	0.026
	Age (35-39 years old dummy)	-0.146	***	0.026	-0.137	***	0.026
	First Generation Immigrant (dummy)	-0.430	***	0.037	-0.302	***	0.038
	Tertiary Educated Mother (dummy)	0.116	**	0.034	0.057		0.034
	Tertiary Educated Father (dummy)	0.257	***	0.032	0.163	***	0.033
	Years of Paid Work	0.074	***	0.003	0.070	***	0.003
	Educational Specifications (Reference = Neither High Credential nor High Skills: LCLS)						
	High Credential & High Skills (HCHS)	3.259	***	0.214	2.465	***	0.216
	Only High Credential without High Skills (HCLS)	2.448	***	0.121	1.662	***	0.123
	Only High Skills without High Credential (LCHS)	1.471	***	0.334	1.077	**	0.337
	Occupations (Reference = Elementary Occupations)						
	Skilled Occupation				1.899	***	0.058
	Semi-skilled White Collar				0.700	***	0.057
	Semi-skilled Blue Collar				0.916	***	0.059
Cross-Level Interactions	Educational Expansion * HCHS	-0.019	**	0.006	-0.014	*	0.006
	Educational Expansion * HCLS	-0.020	***	0.004	-0.012	**	0.004
	Educational Expansion * LCHS	-0.015		0.010	-0.011		0.010
	Tracking * HCHS	-0.074		0.053	-0.034		0.054
	Tracking * HCLS	-0.056		0.039	-0.024		0.040
	Tracking * LCHS	-0.038		0.083	-0.045		0.084
	Skills Diffusion * HCHS	-0.047	***	0.009	-0.048	***	0.010
	Skills Diffusion * HCLS	-0.039	***	0.006	-0.039	***	0.007
	Skills Diffusion * LCHS	-0.023		0.017	-0.018		0.017
Level Two (Country)	Educational Expansion	0.001		0.004	0.000		0.005
	Index of Tracking	0.053		0.038	0.003		0.044
	Skills Diffusion	-0.002		0.007	-0.008		0.008
	GDP per capita (USD, PPP)/10,000	0.044		0.033	0.011		0.039
	Economic Structure (Share of Manufacturing)	0.001		0.006	0.010		0.007
	Economic Structure (Share of Service)	-0.011	**	0.004	-0.008		0.005
	Union Density	-0.002		0.001	-0.001		0.001
Variance	Random Effect Covariance Structure (Intercept)	0.008 *			0.013 *		
Model Fit	-2LL	307208.608			320605.621		
	AIC	307210.608			320607.621		

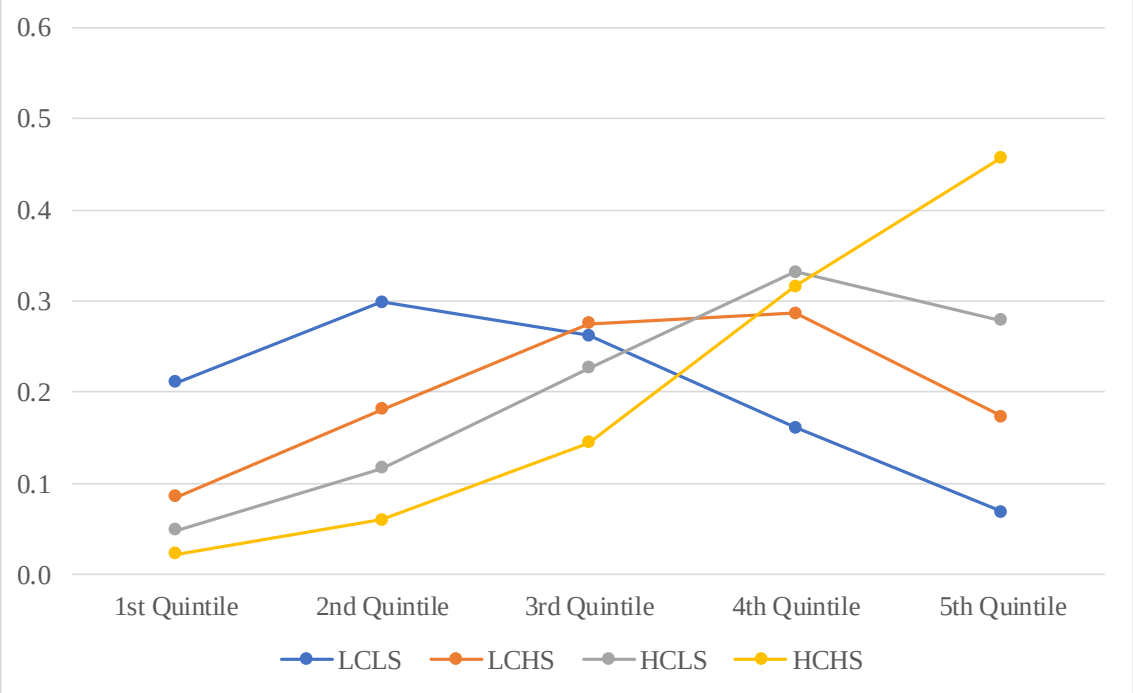
(*** p<0.001, ** p<0.01, * p<0.05) [two tailed] [N: Individual=23,840, Country=26]

Figure II-5 Probability of Attaining Earnings Quintiles by Educational Specifications



Note: Marginal effects in this figure are calculated based on Model 3.

Figure II-6 Probability of Attaining Earnings Quintiles by Educational Specifications



Note: Marginal effects in this figure are calculated based on Model 4.

5. Discussion and Conclusion

This chapter re-examines the economic value of high credentials and high skills. While a large volume of literature has investigated the ED association in consideration of societal-level educational expansion, this research is the first to shed light on the distinction between credentials and skills at an individual level (educational specifications: HCHS, HCLS, LCHS, and LCLS) and a societal level (the degree of educational expansion and skills diffusion). Among other things, the following two dimensions are focused on: 1) how economic returns to education vary across individual educational specifications, and 2) how such returns differ depending on their scarcity associated with societal educational expansion and skills diffusion.

The results of multilevel logistic regression analyses, using the PIAAC data for approximately 30,000 individuals in 26 countries, reveal that high credentials and high skills generally contribute to obtaining prestigious occupations and better earnings even after controlling for other variables. In particular, the premium for high credentials far outweighs that for high skills, meaning that credentials play relatively more significant roles in achieving economic success at an individual level. One may assume that this difference is partially attributed to occupation-specific skills that are reflected by or at least signalled by credentials (albeit not necessarily quantified as high skills in PIAAC). Should this be the case, returns to high credentials are expected to be larger in societies where the degree of tracking is relatively high, given that strong tracking systems are more likely than less tracked systems to cultivate occupation-specific skills or at least enhance the signalling power of credentials (e.g. Van de Werfhorst 2011a). However, the interaction terms between the index of tracking and high credentials (HCHS and HCLS) do not demonstrate significant effects, suggesting that high returns to credentials are generated by the economic value of educational qualifications per se. This interpretation is consistent with the concept of social closure, that is, credentials operate as the socially-sanctioned criteria to distinctively allocate labour market

outcomes to individuals who possess such qualifications whilst excluding less educated people regardless of their actual skills.[28]

Nevertheless, their impact is not static, but rather significantly influenced by societal-level educational expansion and skills diffusion. Specifically, while credentials progressively lose their economic values in association with educational expansion (i.e. a larger share of highly educated people), high skills as such maintain their rewards despite their diminishing scarcity due to skills diffusion (i.e. a larger share of highly skilled people). This implies that skills operate as absolute goods whose economic values are not necessarily determined by their rarity in a given society. Furthermore, when it comes to the direct effect on earnings after accounting for occupations, the difference in premium between mere credentials unaccompanied by high skills (HCLS) and high skills per se without high credentials (LCHS) is no longer significant, whereas HCHS enjoys the high probability of better earnings as compared with HCLS and LCHS as well as LCLS (see Figure II-6).

Here it is important to note that, as far as earnings are concerned, the magnitude of depreciation of high credentials associated with educational expansion becomes smaller once the degree of skills diffusion is taken into account. In addition, the negative impact of skills diffusion on the premium for high credentials is more significant than that of educational expansion. This suggests that, while the vast literature has explained the devaluation of high credentials as the consequence of educational expansion with the notion of credential inflation, this depreciation might have been primarily caused by skills diffusion. Although further research is required to fully elucidate the social mechanisms that generate this phenomenon, one hypothetical interpretation is that a skills-based earnings distribution is accelerated as the

[28] Notwithstanding, it is also theoretically possible to argue that educational credentials reflect non-cognitive skills, which are not directly assessed by skills data in this paper. As described below, further analyses using data on other types of skills is therefore required to better elucidate the ED association.

number/share of highly skilled people becomes large in a given society,[29] and consequently making it difficult for credentials to retain their monetary benefits.[30] This transformation of distribution mechanisms is hard to occur for occupations, especially compared to monetary outcomes, primarily because skills are not tangible enough to enable employers to allocate jobs in accordance with actual skills. Put differently, at the stage of job allocation, employers still need to rely on credentials as signals of competences due to difficulty in identifying highly skilled human resources, allowing credentials to maintain their occupational rewards. This interpretation is still hypothetical, yet in the sense that actual skills retain their monetary rewards while high credentials are devalued, one may conclude that skills diffusion promotes the formation of a meritocratic society via influencing the association between individual credentials, skills, and earnings.

Herein, the contribution of this paper is significant as an ambitious empirical attempt to better understand the economic value of education with particular attention to the distinction between credentials and skills at both individual and societal levels, via adopting skilled occupations and earnings quintiles as outcomes. Nevertheless, to provide more robust evidence and implications, there are still ample rooms for elaboration.

Firstly, more detailed country-specific analyses should be conducted, considering that the difference in education and labour systems across countries might have significant influences on the ED association. Although this paper controls for country-

[29] The empirical evidence demonstrated in this chapter is based on cross-national analyses using the difference across countries as the degree of skills diffusion, and hence it does not necessarily imply a change within a specific country in the process of such societal conditions. However, as a theoretical discussion, terms that indicate changes are used in this section.

[30] Although the return to high skills per se may be intensified by skills diffusion in this case, the interaction term between LCHS and skills diffusion does not show a significant positive effect. One may discuss that this is a result of offset between the positive impact of the accelerated skills-based earnings distribution and the negative impact of the diminishing scarcity of skills as with credentials. This is still too hypothetical and not necessarily consistent with the idea that skills operate as absolute goods. To precisely elucidate this association, further empirical investigations are required.

level factors by employing a multilevel analysis with several key indicators, longitudinal analyses focused on specific cohorts within specific countries would provide reliable evidence to examine how, when and whether or not the above-mentioned social mechanisms operate in the process of educational expansion and skills diffusion in a given society.

Secondly, from a technical point of view, variables should be extended. While this research quantifies high credentials by the possession of a tertiary degree, some scholars have pointed out the "horizontal" difference in economic rewards across fields of study as well as "vertical" aspects including the difference between undergraduates and postgraduates (Bills 2016; Bol et al. 2019; Borgen and Mastekaasa 2018; Hanushek, Schwerdt, Woessmann, et al. 2017; Ortiz and Rodriguez-Menés 2016; Posselt and Grodsky 2017; Di Stasio 2017; Sullivan et al. 2018a; Tholen 2017). Moreover, although the indicator of skills is based on standardised test scores in the present paper, the impact of occupation-specific skills and non-cognitive skills need to be investigated as significant determinants of labour market outcomes. In addition, the utilisation of continuous measures for both predictors (skills and credentials) and outcomes (occupations and earnings) is expected to yield different pictures from the analysis of categorical variables. Furthermore, in terms of societal-level variables, demand-side measures including the mismatch and overeducation/skilling could be further incorporated to scrutinize the interaction of supply and demand.

Thirdly, it is meaningful to pay attention to the reverse causation: the impact of economic rewards on skills formation and educational attainment. This paper minimises this problem by focusing on people aged 30 to 39. However, given that some evidence has revealed that workers' productivity is significantly influenced by the use of skills rather than proficiency levels themselves (e.g. OECD 2013b) and that skills are developed over the life cycle (e.g. Cunha and Heckman 2007; OECD 2015c), the interaction between skills, credentials, and work/life histories should be examined

carefully. This approach can be extended to further research on skills mismatch as well as education mismatch as discussed above (e.g. Allen and van der Velden 2001; Bol et al. 2019; Flisi et al. 2017; Nieto and Ramos 2017; OECD 2016; Perry, Wiederhold, and Ackermann-Piek 2014).

Fourthly, while this research captures one dimension of social stratification focused on the link between education and economic rewards, one pivotal argument remains: the function of education in respect of social mobility and (in)equality. Here it becomes imperative to analyse the variation in returns to educational specifications across individuals with different social backgrounds, provided that the relationship between individual-level education and economic benefits as well as societal-level educational conditions varies across different age, gender, and social origin of individuals (e.g. Charles and Bradley 2009; Kerckhoff, Raudenbush, and Glennie 2001). In so doing, not only skills levels as such but also skills utilization is another important element to be investigated (e.g. Horowitz 2018).

Finally, as another stream of social science research including "welfare regime" (Esping-Andersen 1990) and "varieties of capitalism" (Hall and Soskice 2001), broader perspectives on the typology of societies would be useful to better understand the social mechanisms that affect the (de)valuation of credentials and skills. Although this paper employs the degree of educational expansion and skills diffusion on the assumption that each societal condition operates independently, one may assume that returns to educational specifications differ depending on types of society as defined by the compound of educational expansion and skills diffusion. These investigations also contribute to elucidating the mechanisms that determine the extent of (in)consistency between educational expansion and skills diffusion (i.e. how these two societal conditions are (de)coupled) in a given society.

In sum, this research illuminates a variation in the (de)valuation of high credentials and high skills in consideration of educational expansion and skills diffusion. As a

result, it is revealed that 1) the return to high skills is significantly smaller than that to high credentials although recent economic research has advocated the importance of skills, but 2) high skills as such maintain their rewards despite their diminishing scarcity due to skills diffusion, while credentials progressively lose their economic values in association with educational expansion, and 3) the devaluation of high credentials in the form of earnings, which has been conceptualised as a consequence of educational expansion (i.e. credential inflation), is in reality significantly influenced by skills diffusion. Despite several limitations and potential for future development, these findings and analytical frameworks provide important implications for social science research and related policies.

Appendix

A. Multilevel Logistic Regression of Skilled Occupations and Earnings (using continuous skills measures: PIAAC raw scores)

The tables below illustrate the results of multilevel logistic regression of skilled occupations and earnings quintiles, using a high credential dummy (i.e. tertiary graduates are assigned 1) and a continuous skills measure (i.e. the mean score of literacy and numeracy in PIAAC) respectively instead of educational specifications. The skills score is standardised in each country, and an interaction term between a high credential dummy and the continuous measure of skills is also employed as a predictor. Other independent variables include gender, cohort, immigrant background, parental education, work experience, societal educational conditions (the degree of educational expansion, skills diffusion, and tracking), economic conditions (GDP and its share in manufacturing and service sectors), and union density. Equations are as follows.

Skilled Occupations

$$\begin{aligned}\log\left(\frac{p_{ij}}{1-p_{ij}}\right) = {} & \gamma_{00} + \gamma_{10}M_{ij} + \gamma_{20}A_{ij} + \gamma_{30}I_{ij} + \gamma_{40}ME_{ij} + \gamma_{50}FE_{ij} + \gamma_{60}W_{ij} + \gamma_{70}HC_{ij} \\ & + \gamma_{80}Skill_{ij} + \gamma_{90}HC * Skill_{ij} + \gamma_{01}E_j + \gamma_{02}T_j + \gamma_{03}S_j + \gamma_{04}G_j + \gamma_{05}Em_j \\ & + \gamma_{06}Es_j + \gamma_{07}U_j + \gamma_{71}HC_{ij}E_j + \gamma_{81}Skill_{ij}E_j + \gamma_{91}HC * Skill_{ij}E_j + \gamma_{72}HC_{ij}T_j \\ & + \gamma_{82}Skill_{ij}T_j + \gamma_{92}HC * Skill_{ij}T_j + \gamma_{73}HC_{ij}S_j + \gamma_{83}Skill_{ij}S_j + \gamma_{93}HC * Skill_{ij}S_j \\ & + u_{0j} + \varepsilon_{ij}\end{aligned}$$

Earnings

$$\begin{aligned}Y_{ij}^{*} = {} & \gamma_{00} + \gamma_{10}M_{ij} + \gamma_{20}A_{ij} + \gamma_{30}I_{ij} + \gamma_{40}ME_{ij} + \gamma_{50}FE_{ij} + \gamma_{60}W_{ij} + \gamma_{70}HC_{ij} + \gamma_{80}Skill_{ij} \\ & + \gamma_{90}HC * Skill_{ij} + \gamma_{01}E_j + \gamma_{02}T_j + \gamma_{03}S_j + \gamma_{04}G_j + \gamma_{05}Em_j + \gamma_{06}Es_j + \gamma_{07}U_j \\ & + \gamma_{71}HC_{ij}E_j + \gamma_{81}Skill_{ij}E_j + \gamma_{91}HC * Skill_{ij}E_j + \gamma_{72}HC_{ij}T_j + \gamma_{82}Skill_{ij}T_j \\ & + \gamma_{92}HC * Skill_{ij}T_j + \gamma_{73}HC_{ij}S_j + \gamma_{83}Skill_{ij}S_j + \gamma_{93}HC * Skill_{ij}S_j + u_{0j} + \varepsilon_{ij}\end{aligned}$$

where HC_{ij}=high credential dummy, $Skill_{ij}$=the mean score of literacy and numeracy (standardised in each country), and $HC*Skill_{ij}$= the interaction between HC and Skill for individual i in country j, and other parameters are the same as equations (4a) and (4b) in the main manuscript. Also, as with equation (5b), three dummy variables concerning occupations ($\gamma_{100}So_{ij}, \gamma_{110}Sw_{ij},$ and $\gamma_{120}Sb_{ij}$) are added only for the earnings analysis.

The result of the occupation analysis reveals that, at an individual level, both a high credential dummy and skills significantly demonstrate positive effects (γ_{70}=3.273 and γ_{80}=0.540). This is consistent with the analysis using categorical measures for predictors (see Table II-4), in which three educational specifications show significant positive coefficients.

With regard to cross-level interactions, the table below indicates the significant negative coefficient between the degree of educational expansion and a high credential dummy (γ_{71}=-0.042), whereas the interaction between the extent of skills diffusion and skills (γ_{83}) is not significant. These are also aligned with the result in the main manuscript where the coefficients of two interaction terms between the extent of educational expansion and HCHS/HCLS are significantly negative, while the one between skills diffusion and LCHS is insignificant.

Multilevel Logistic Regression of Skilled Occupations

Independent Variable		Model 3'		
		B		S.E.
Intercept		-1.518		0.952
Level One (Individual)	Men (dummy)	-0.060	*	0.028
	Age (35-39 years old dummy)	0.036		0.031
	First Generation Immigrant (dummy)	-0.238	***	0.045
	Tertiary Educated Mother (dummy)	0.211	***	0.041
	Tertiary Educated Father (dummy)	0.426	***	0.038
	Years of Paid Work	0.017	***	0.003
	High Credential (dummy)	3.273	***	0.145
	Skills (mean score of literacy and numeracy)	0.540	***	0.097
	High Credential * Skills	-0.243		0.150
Cross-Level Interactions	Educational Expansion * High Credential	-0.042	***	0.005
	Educational Expansion * Skills	-0.001		0.003
	Educational Expansion * High Credential * Skills	0.007		0.005
	Tracking * High Credential	-0.087		0.048
	Tracking * Skills	0.033		0.031
	Tracking * High Credential * Skills	-0.063		0.049
	Skills Diffusion * High Credential	0.006		0.008
	Skills Diffusion * Skills	0.002		0.006
	Skills Diffusion * High Credential * Skills	-0.005		0.008
Level Two (Country)	Educational Expansion	0.010		0.013
	Index of Tracking	0.250	*	0.115
	Skills Diffusion	0.021		0.020
	GDP per capita (USD, PPP)/10,000	0.186		0.111
	Economic Structure (Share of Manufacturing)	-0.037		0.019
	Economic Structure (Share of Service)	-0.008		0.014
	Union Density	-0.002		0.004
Variance	Random Effect Covariance Structure (Intercept)	0.139 **		
Model Fit	-2LL	141460.096		
	AIC	141462.096		

(*** p<0.001, ** p<0.01, * p<0.05) [two tailed] [N: Individual=30,284, Country=26］

Note: Data are unweighted.

Likewise, the earnings analysis using a continuous skills measure demonstrates the significant positive effects of a high credential dummy and skills at an individual level (γ_{70}=2.237, γ_{80}=0.539 in a model without controlling for occupations, and γ_{70}=1.568, γ_{80}=0.492 in a model with occupations). This is consistent with the result shown in Table II-5 where the coefficients of three educational specifications are significantly positive.

In addition, as confirmed in the main manuscript that shows the significant negative coefficients of interaction terms between the degree of educational expansion/skills diffusion and HCHS/HCLS, the table below also indicates that the coefficients of interaction terms between the two societal educational conditions and a high credential dummy are significantly negative even after accounting for individual occupations (γ_{71}=-0.023, γ_{73}=-0.031 in Model 3', and γ_{71}=-0.015, γ_{73}=-0.033 in Model 4'). Furthermore, as with the insignificant coefficient of the interaction between skills diffusion and LCHS in the main manuscript, the monetary value of skills measured by the continuous indicator is not significantly devalued in association with the larger share of highly skilled people in this analysis (i.e. γ_{83} is not significant).

Thus, the results demonstrated here are consistent with the ones using educational specifications in the sense that high credentials are devalued by educational expansion (for both occupations and earnings) and skills diffusion (for earnings) whereas skills retain their rewards despite their diminishing scarcity due to skills diffusion. Meanwhile, one interesting result here is that the interaction between high credentials, skills, and educational expansion shows a positive coefficient in Model 3' (γ_{91}=0.008). This means that, given that the interaction between educational expansion and high credentials is significantly negative, highly educated people can mitigate the diminishing monetary returns associated with educational expansion as long as they possess higher skills. Likewise, in Model 4', the three-way interaction terms between high credentials, skills, and both educational expansion and skills diffusion

demonstrate positive coefficients (γ_{91}=0.008, γ_{93}=0.015 in Model 4') in conjunction with the negative coefficient of the interaction between high credentials and skills (γ_{90}=-0.254). That is, although the combination of credentials and skills operates downwardly when it comes to the direct impact on earnings after accounting for occupations, higher skills undermine the depreciation of high credentials associated with educational expansion/skills diffusion.

The mechanisms behind the aforementioned nuanced structure is an important topic for future research. In so doing, considering the narrow scope of analyses that are available with the PIAAC data, it is also worthwhile to continue to examine the (in)consistency between the analysis using dichotomised educational specifications and continuous measures as predictors of labour market outcomes.

Multilevel Logistic Regression of Earnings Quintiles

Independent Variable		Model 3'			Model 4'		
		B		S.E.	B		S.E.
Threshold	Cut point 1	-0.545		0.304	0.269		0.338
	Cut point 2	0.761	**	0.304	1.645	***	0.339
	Cut point 3	1.890	***	0.304	2.843	***	0.339
	Cut point 4	3.249	***	0.305	4.259	***	0.339
Level One (Individual)	Men (dummy)	1.166	***	0.025	1.184	***	0.026
	Age (35-39 years old dummy)	-0.127	***	0.026	-0.124	***	0.027
	First Generation Immigrant (dummy)	-0.204	***	0.038	-0.141	***	0.039
	Tertiary Educated Mother (dummy)	0.074	*	0.034	0.032		0.034
	Tertiary Educated Father (dummy)	0.189	***	0.033	0.120	***	0.033
	Years of Paid Work	0.071	***	0.003	0.068	***	0.003
	High Credential (dummy)	2.237	***	0.130	1.568	***	0.132
	Skills (mean score of literacy and numeracy)	0.539	***	0.076	0.492	***	0.076
	High Credential * Skills	-0.233		0.126	-0.254	*	0.127
	Occupations (Reference = Elementary Occupations)						
	Skilled Occupation				1.740	***	0.058
	Semi-skilled White Collar				0.592	***	0.057
	Semi-skilled Blue Collar				0.861	***	0.060
Cross-Level Interactions	Educational Expansion * High Credential	-0.023	***	0.004	-0.015	***	0.004
	Educational Expansion * Skills	-0.002		0.003	-0.004		0.003
	Educational Expansion * High Credential * Skills	0.008	*	0.004	0.008	*	0.004
	Tracking * High Credential	-0.087	*	0.041	-0.063		0.041
	Tracking * Skills	0.003		0.024	-0.016		0.024
	Tracking * High Credential * Skills	0.030		0.040	0.067		0.040
	Skills Diffusion * High Credential	-0.031	***	0.007	-0.033	***	0.007
	Skills Diffusion * Skills	-0.007		0.004	-0.008		0.004
	Skills Diffusion * High Credential * Skills	0.012		0.007	0.015	*	0.007
Level Two (Country)	Educational Expansion	0.001		0.004	0.000		0.005
	Index of Tracking	0.052		0.039	0.004		0.042
	Skills Diffusion	0.003		0.007	-0.004		0.007
	GDP per capita (USD, PPP)/10,000	0.047		0.035	0.017		0.038
	Economic Structure (Share of Manufacturing)	0.002		0.006	0.010		0.007
	Economic Structure (Share of Service)	-0.011	*	0.004	-0.009		0.005
	Union Density	-0.002		0.001	-0.002		0.001
Variance	Random Effect Covariance Structure (Intercept)	0.010 *			0.013 *		
Model Fit	-2LL	311804.028			323406.364		
	AIC	311806.027			323408.364		

(*** p<0.001, ** p<0.01, * p<0.05) [two tailed] [N: Individual=23,840, Country=26]

Note: Data are unweighted.

B. Multilevel Linear Regression of Occupations (ISEI)

This table illustrates the result of a multilevel linear regression analysis of occupations, using a continuous measure for the dependent variable (International Socio-Economic Index of Occupational Status: ISEI), which was proposed by Ganzeboom (2010).[31] In line with Model 3 of the multilevel binary logistic regression of skilled occupations, independent variables include gender, cohort, immigrant background, parental education, work experience, educational specifications, societal educational conditions (the degree of educational expansion, skills diffusion, and tracking), economic conditions (GDP and its share in manufacturing and service sectors), and union density. Equation is as follows.

$$
\begin{aligned}
Y_{ij} = {} & \gamma_{00} + \gamma_{10}M_{ij} + \gamma_{20}A_{ij} + \gamma_{30}I_{ij} + \gamma_{40}ME_{ij} + \gamma_{50}FE_{ij} + \gamma_{60}W_{ij} + \gamma_{70}HCHS_{ij} + \gamma_{80}HCLS_{ij} \\
& + \gamma_{90}LCHS_{ij} + \gamma_{01}E_j + \gamma_{02}T_j + \gamma_{03}S_j + \gamma_{04}G_j + \gamma_{05}Em_j + \gamma_{06}Es_j + \gamma_{07}U_j \\
& + \gamma_{71}HCHS_{ij}E_j + \gamma_{81}HCLS_{ij}E_j + \gamma_{91}LCHS_{ij}E_j + \gamma_{72}HCHS_{ij}T_j + \gamma_{82}HCLS_{ij}T_j \\
& + \gamma_{92}LCHS_{ij}T_j + \gamma_{73}HCHS_{ij}S_j + \gamma_{83}HCLS_{ij}S_j + \gamma_{93}LCHS_{ij}S_j + u_{0j} + \varepsilon_{ij}
\end{aligned}
$$

where Y_{ij}=ISEI score for individual i in country j, and other parameters are the same as equation (4a) in the main manuscript.

The result below reveals that, as with the multilevel binary logistic regression of skilled occupations, three educational specifications demonstrate significant positive effects on ISEI. Among them, the magnitude of high credentials, regardless of the possession of high skills, is significantly larger than that of high skills per se (γ_{70}=25.613, γ_{80}=23.671, and γ_{90}=9.406).[32] However, the interaction terms between high credentials (both HCHS and HCLS) and the degree of educational expansion show significant negative coefficients (γ_{71}=-0.177 and γ_{81}=-0.222), whereas the interaction

[31] In this analysis, ISEI is generated based on one-digit code of the International Standard Classification of Occupations (ISCO), given that a large number of samples do not have information on two digits code in the PIAAC dataset.

[32] The difference in coefficient is significant between HCHS/HCLS and LCHS, whereas there is no significant difference between the coefficient of HCHS and that of HCLS.

between high skills per se and the degree of educational expansion/skills diffusion is not significant. These results are consistent with the findings in the main manuscript.

Meanwhile, two interaction terms between the degree of tracking and high credentials (both HCHS and HCLS) demonstrate significant negative coefficients (γ_{72}=-0.782 and γ_{82}=-0.609), which are not confirmed in the analysis focused on the categorical measure for skilled occupations. As discussed, according to previous research, strong tracking systems are considered to promote occupation-specific skills of credential holders and/or at least intensify the signalling power of credentials, and consequently enhancing economic returns to credentials. However, this analysis result indicates the opposite relationship between high credentials and tracking, suggesting that high credentials examined here are rather penalised by a stronger tracking system. This also supports the aforementioned idea that the relatively large return to high credentials, as compared with high skills, are attributed to credentials as such rather than occupation-specific skills that could be reflected in educational qualifications. One hypothetical interpretation here is that occupational rewards for non-tertiary degrees are likely to be large in strong tracking systems. Although the impact of tracking is not the primary focus of this research, this line of investigation is another important topic for future research.

In addition, the coefficient of the interaction term between HCLS and the degree of skills diffusion is significantly negative (γ_{83}=-0.098). This means that, as far as the continuous occupational outcome is concerned, those who merely possess high credentials unaccompanied by high skills are penalised due to the larger share of highly skilled people in a given society. Although this specific association is not confirmed in the multilevel binary logistic regression analysis of skilled occupations, it also supports the main discussion of this paper in the sense that the devaluation of high credentials, which has been explained as a consequence of educational expansion with some concepts like credential inflation, is in reality significantly associated with skills

diffusion. In particular, the fact that only HCLS is depreciated by skills diffusion is aligned with the hypothetical argument that the accumulation of highly skilled people promotes a skills-based distribution of economic rewards in a way to protect the economic value of individuals' high skills.[33]

Thus, while the difference in impact of several variables needs to be further explored, one may argue that the said results generally indicate the consistency between the analysis using the categorical outcome (skilled occupations) and the one with the continuous measure (ISEI).

[33] Although the reward allocation based on skills is considered to emerge primarily at the stage of earnings distribution because of the visibility of skills, this could apply to occupations as far as they are quantified as the continuous measure (i.e. ISEI) rather than actual types of jobs. This is probably because, unlike skilled occupations, ISEI is not real occupations that are allocated by employers but one conceptual/analytical proxy of socio-economic statuses that reflect not only occupations per se but also monetary assets. To test this interpretation, however, more empirical analyses are essential.

Multilevel Linear Regression of ISEI

Independent Variable		Model 3''		
		B		S.E.
Intercept		33.453	***	4.848
Level One (Individual)	Men (dummy)	-0.494	**	0.147
	Age (35-39 years old dummy)	-0.159		0.159
	First Generation Immigrant (dummy)	-3.163	***	0.225
	Tertiary Educated Mother (dummy)	1.783	***	0.213
	Tertiary Educated Father (dummy)	3.005	***	0.201
	Years of Paid Work	0.159	***	0.016
	Educational Specifications (Reference = Neither High Credential nor High Skills: LCLS)			
	High Credential & High Skills (HCHS)	25.613	***	1.286
	Only High Credential without High Skills (HCLS)	23.671	***	0.720
	Only High Skills without High Credential (LCHS)	9.406	***	2.054
Cross-Level Interactions	Educational Expansion * HCHS	-0.177	***	0.037
	Educational Expansion * HCLS	-0.222	***	0.024
	Educational Expansion * LCHS	-0.050		0.063
	Tracking * HCHS	-0.782	*	0.333
	Tracking * HCLS	-0.609	*	0.244
	Tracking * LCHS	0.439		0.525
	Skills Diffusion * HCHS	-0.061		0.059
	Skills Diffusion * HCLS	-0.098	*	0.040
	Skills Diffusion * LCHS	-0.076		0.107
Level Two (Country)	Educational Expansion	0.073		0.066
	Index of Tracking	1.514	*	0.591
	Skills Diffusion	0.067		0.102
	GDP per capita (USD, PPP)/10,000	0.794		0.567
	Economic Structure (Share of Manufacturing)	-0.156		0.099
	Economic Structure (Share of Service)	-0.030		0.070
	Union Density	0.000		0.022
Variance	Random Effect Covariance Structure (Intercept)	3.605 **		
Model Fit	-2LL	238966.145		
	AIC	238970.145		

(*** p<0.001, ** p<0.01, * p<0.05) [two tailed] [N: Individual=30,284, Country=26]

Note: Data are unweighted.

C. Multilevel Linear Regression of Earnings (Logarithm of Earnings)

This table illustrates the result of a multilevel linear regression analysis of earnings, using a continuous measure for the dependent variable (logarithm of the absolute amount of monthly earnings). Independent variables are the same as the ones used in Model 3 and Model 4 of the multilevel ordered logistic regression analysis of earnings quintiles. Equation is as follows.

$$
\begin{aligned}
Y_{ij} = {} & \gamma_{00} + \gamma_{10}M_{ij} + \gamma_{20}A_{ij} + \gamma_{30}I_{ij} + \gamma_{40}ME_{ij} + \gamma_{50}FE_{ij} + \gamma_{60}W_{ij} + \gamma_{70}HCHS_{ij} + \gamma_{80}HCLS_{ij} \\
& + \gamma_{90}LCHS_{ij} + \gamma_{01}E_j + \gamma_{02}T_j + \gamma_{03}S_j + \gamma_{04}G_j + \gamma_{05}Em_j + \gamma_{06}Es_j + \gamma_{07}U_j \\
& + \gamma_{71}HCHS_{ij}E_j + \gamma_{81}HCLS_{ij}E_j + \gamma_{91}LCHS_{ij}E_j + \gamma_{72}HCHS_{ij}T_j + \gamma_{82}HCLS_{ij}T_j \\
& + \gamma_{92}LCHS_{ij}T_j + \gamma_{73}HCHS_{ij}S_j + \gamma_{83}HCLS_{ij}S_j + \gamma_{93}LCHS_{ij}S_j + u_{0j} + \varepsilon_{ij}
\end{aligned}
$$

where Y_{ij}=the logarithm of earnings for individual i in country j, and other parameters are the same as equation (4b) in the main manuscript. Also, in line with equation (5b), the following three dummy variables concerning occupations are added to the above model: $\gamma_{100}So_{ij}, \gamma_{110}Sw_{ij}$, and $\gamma_{120}Sb_{ij}$.

While it is important to note that approximately 7,500 individuals in six countries[34] are omitted from the analysis of earnings quintiles due to the lack of individual data, the result of multilevel linear regression of continuous earnings reveals a similar pattern to that of earnings quintiles, including the significant positive effects of educational specifications (γ_{70}=0.715, γ_{80}=0.669, and γ_{90}=0.405) and the significant negative coefficients of interaction terms between high credentials and the degree of skills diffusion (γ_{73}=-0.022 and γ_{83}=-0.012). Meanwhile, in addition to the insignificant main effect of LCHS in Model 4, one interesting inconsistency between the two analyses is that two interaction terms between high credentials (both HCHS and HCLS) and the degree of educational expansion (γ_{71} and γ_{81}) do not show significant negative coefficients in this analysis.

[34] Six countries include Austria, Canada, Germany, Sweden, Turkey, and the United States.

To conclude why this difference occurs and which is more precisely reflecting the actual situation, further research with more individual-level and country-level data is required. However, considering that earnings quintiles are relative indicators that reflect the distribution of total monetary rewards in a given society whereas the logarithm of earnings is an absolute measure that is not necessarily influenced by the distribution (i.e. it is theoretically possible that everyone enjoys high earnings or suffers from low earnings when it comes to the absolute measure), one supposition can be generated: high credentials maintain their contribution to better earnings in absolute terms regardless of scarcity, while the impact of credentials on attaining higher tiers of earnings distributions in relative terms is undermined due to their smaller rarity. This difference might have caused the gap between sociologists and economists in describing the relationship between education and monetary outcomes in association with educational expansion. That is, whereas the former has a tendency to pay attention to the allocation of limited rewards and hence tend to emphasise the devaluation of education in conjunction with the unequal distribution that benefits the advantaged, the latter favours continuous measures and consequently is likely to find the positive link that has been conceptualised as skill-biased technological change among others. In either case, based on the result indicated here, one may argue that the depreciation of high credentials (particularly in absolute terms) is significantly influenced not (only) by educational expansion but by skills diffusion, which has long been overlooked by the literature.

Multilevel Linear Regression of the Logarithm of Earnings

Independent Variable		Model 3''			Model 4''		
		B		S.E.	B		S.E.
Intercept		5.439	***	0.366	5.178	***	0.383
Level One (Individual)	Men (dummy)	0.377	***	0.012	0.357	***	0.013
	Age (35-39 years old dummy)	-0.078	***	0.013	-0.074	***	0.013
	First Generation Immigrant (dummy)	-0.076	***	0.020	-0.032		0.020
	Tertiary Educated Mother (dummy)	0.004		0.018	-0.015		0.018
	Tertiary Educated Father (dummy)	0.095	***	0.017	0.064	***	0.017
	Years of Paid Work	0.029	***	0.001	0.026	***	0.001
	Educational Specifications (Reference = Neither High Credential nor High Skills: LCLS)						
	High Credential & High Skills (HCHS)	0.715	***	0.101	0.469	***	0.100
	Only High Credential without High Skills (HCLS)	0.669	***	0.062	0.399	***	0.062
	Only High Skills without High Credential (LCHS)	0.405	*	0.158	0.299		0.155
	Occupations (Reference = Elementary Occupations)						
	Skilled Occupation				0.537	***	0.027
	Semi-skilled White Collar				0.207	***	0.027
	Semi-skilled Blue Collar				0.271	***	0.028
Cross-Level Interactions	Educational Expansion * HCHS	0.005		0.003	0.006		0.003
	Educational Expansion * HCLS	-0.004		0.002	-0.001		0.002
	Educational Expansion * LCHS	-0.007		0.006	-0.007		0.006
	Tracking * HCHS	-0.012		0.028	0.000		0.027
	Tracking * HCLS	-0.002		0.021	0.004		0.020
	Tracking * LCHS	-0.072		0.048	-0.078		0.047
	Skills Diffusion * HCHS	-0.022	***	0.004	-0.021	***	0.004
	Skills Diffusion * HCLS	-0.012	***	0.003	-0.011	***	0.003
	Skills Diffusion * LCHS	0.001		0.009	0.003		0.008
Level Two (Country)	Educational Expansion	0.005		0.005	0.005		0.005
	Index of Tracking	-0.014		0.052	-0.033		0.054
	Skills Diffusion	0.001		0.007	-0.001		0.008
	GDP per capita (USD, PPP)/10,000	0.279	***	0.042	0.271	***	0.044
	Economic Structure (Share of Manufacturing)	0.011		0.007	0.013		0.007
	Economic Structure (Share of Service)	0.002		0.005	0.003		0.005
	Union Density	0.003	*	0.002	0.003		0.002
Variance	Random Effect Covariance Structure (Intercept)	0.015 *			0.017 *		
Model Fit	-2LL	36968.391			36349.086		
	AIC	36972.391			36353.086		

(*** p<0.001, ** p<0.01, * p<0.05) [two tailed] [N: Individual=16,208, Country=20］

Note: Data are unweighted.

D. Logistic Regression of Occupations and Earnings by Country

As discussed earlier, each country has its own education and socio-economic systems, and hence it is assumed that there is a difference in the association between educational specifications and economic rewards across countries. I therefore conduct country-specific analyses (binary logistic regression for skilled occupations and ordered logistic regression for earnings quintiles) using individual-level data. In line with the multilevel analyses, independent variables include gender, cohort, immigrant background, parental education, work experience, and educational specifications. Equations are the same as (1a) and (1b) as follows.

Skilled Occupations

$$\log\left(\frac{p_i}{1-p_i}\right) = b_0 + b_1 M_i + b_2 A_i + b_3 I_i + b_4 ME_i + b_5 FE_i + b_6 W_i + b_7 HCHS_i + b_8 HCLS_i + b_9 LCHS_i + \varepsilon_i$$

where p_j=the probability of obtaining skilled occupations for individual i.

Earnings

$$Y_i^* = \beta_0 + \beta_1 M_i + \beta_2 A_i + \beta_3 I_i + \beta_4 ME_i + \beta_5 FE_i + \beta_6 W_i + b_7 HCHS_i + b_8 HCLS_i + b_9 LCHS_i + \varepsilon_i$$

where Y_i^* =latent response for individual i, and an observed response Y_i (earnings quintiles) can be determined by thresholds (τ_n) as following.

$$Y_i = \begin{cases} 1 \text{ if } & Y_i^* \le \tau_1 \\ 2 \text{ if } & \tau_1 < Y_i^* \le \tau_2 \\ 3 \text{ if } & \tau_2 < Y_i^* \le \tau_3 \\ 4 \text{ if } & \tau_3 < Y_i^* \le \tau_4 \\ 5 \text{ if } & \tau_4 < Y_i^* \end{cases}$$

After investigating the total effect on earnings quintiles including the indirect impact mediated by occupations, occupational variables are controlled for in accordance with Model 4 in the multilevel analysis.

The figures below illustrate the average marginal effects of educational specifications on occupational attainment and earnings (i.e. the probability of obtaining skilled occupations and earnings quintiles by educational specifications) in each country. Although a thorough examination of each country, including the comparison across different cohorts/gender and the longitudinal analyses, is a subject for future research, these results suggest several patterns of the ED association.[35]

With regard to occupational attainment, while high credentials and high skills (particularly credentials) generally contribute to improving the chance of acquiring skilled occupations, the differences in impact across educational specifications (including their significance) markedly vary depending on countries. For example, some countries, such as Belgium, Finland, France, the Netherlands, and Norway, show a similar tendency to the multilevel analysis in the sense that the effect of high credentials (HCHS and HCLS) is significantly larger than that of high skills per se (LCHS) and that high skills moderately contribute to occupational attainment only when individuals do not possess high credentials (or sometimes LCHS does not demonstrate a significant positive impact primarily due to the large standard error). In the meantime, other countries including Canada, Denmark, and the United Kingdom reveal the distinctive effects across four educational specifications; HCHS is most likely to enjoy skilled occupations, followed by HCLS and then LCHS. By contrast, the significant difference in the marginal effect is not confirmed across LCHS, HCLS, and HCHS in Czech Republic (i.e. those who possess only high skills unaccompanied by high credentials are rewarded as with tertiary graduates). Meanwhile, in New

[35] Abbreviations are the same as Figure II-2. Some countries are omitted because of the data limitation (i.e. the number of samples in specific cells is too small to precisely calculate the average marginal effects).

Zealand, the contribution of high skills is notable; although the chance of HCHS obtaining skilled occupations is significantly high as compared with other educational specifications, there is no significant difference in impact between LCHS and HCLS.

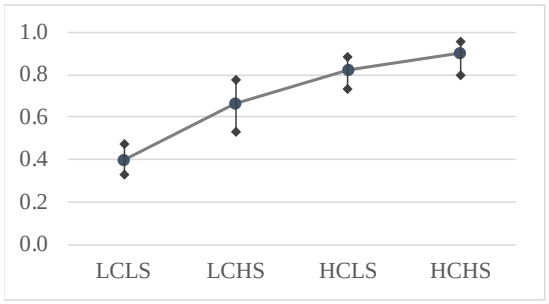
In terms of earnings quintiles, as with the multilevel analysis, HCHS is more likely than other educational specifications to enjoy the high probability of achieving better earnings (particularly the fifth quintile), followed by HCLS in all countries.[36] Meanwhile, as far as HCLS is concerned, the chance of obtaining the fifth quintile is lower than that of the fourth quintiles in many countries, whereas the contribution of HCLS to the highest tier of earnings distributions is larger than that to the fourth quintile in some countries such as Czech Republic, Poland, Slovak Republic, and Turkey. Among them, in Check Republic, the probability of falling into each quintile is almost equal between HCHS and HCLS. Here, one unique country is Japan, in which even HCHS witnesses the diminishing probability from the fourth quintile to the fifth quintile.

Paying attention to the analysis without occupations as control variables, in some countries such as Slovak Republic and Turkey, the high probability of obtaining higher earnings quintiles is generally maintained even after controlling for occupations. This implies that, in these countries, monetary returns to educational specifications (particularly high credentials) are considerably generated regardless of occupational attainment. As with occupation analyses, the socio-economic mechanism that affects the aforementioned variation across countries is an important question for future research.

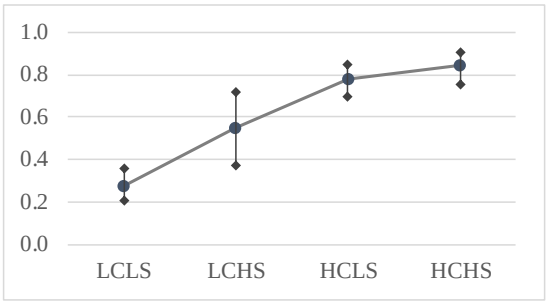
[36] It is important to note that the difference in the marginal effect between HCHS and HCLS is significant in many countries, whereas some countries including Czech Republic and Japan show no significant difference between them.

Skilled Occupations

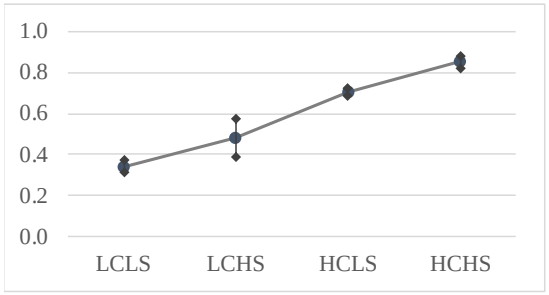
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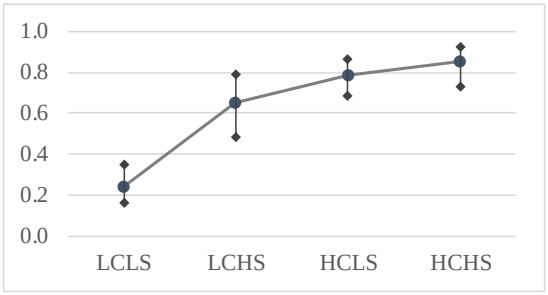
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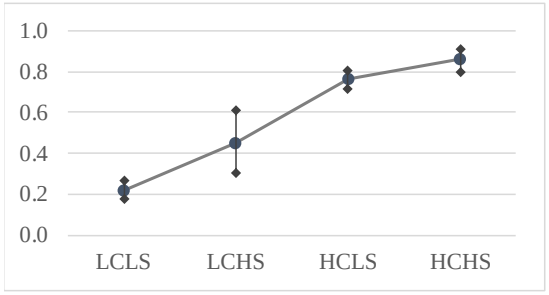
CA



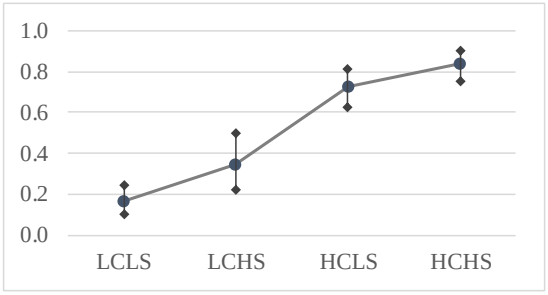
CZ



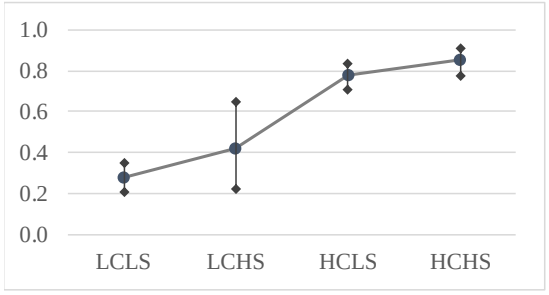
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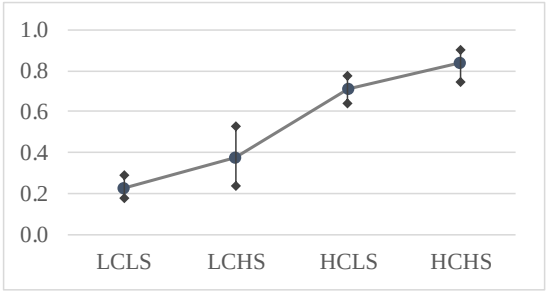
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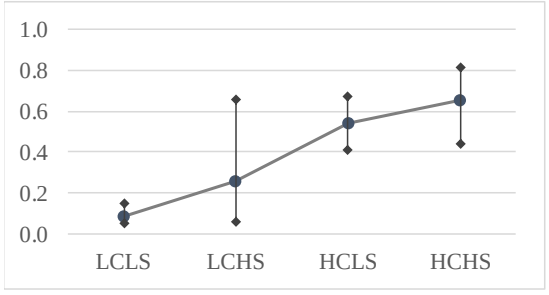
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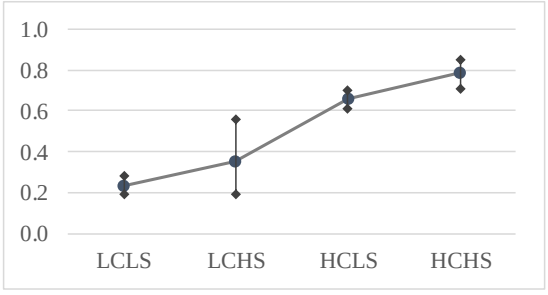
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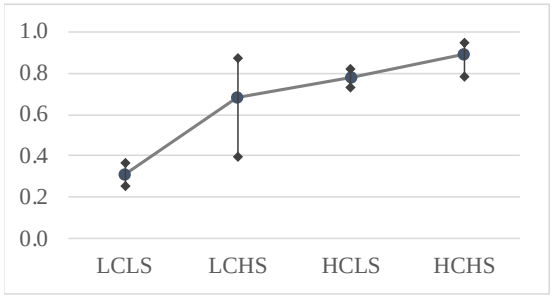
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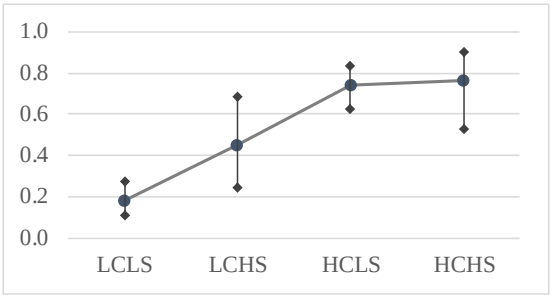
IE



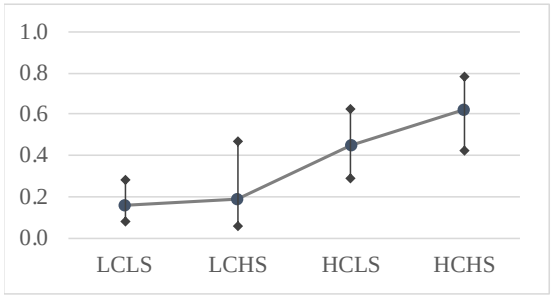
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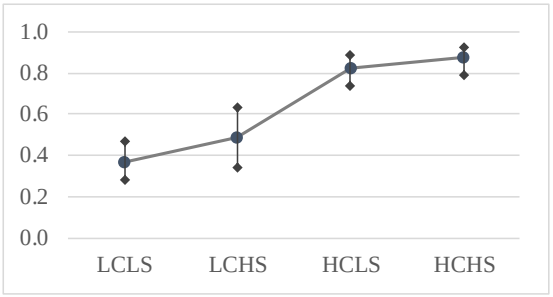
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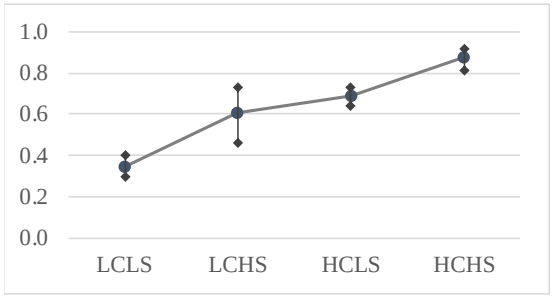
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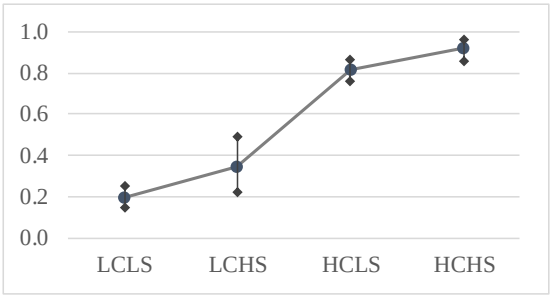
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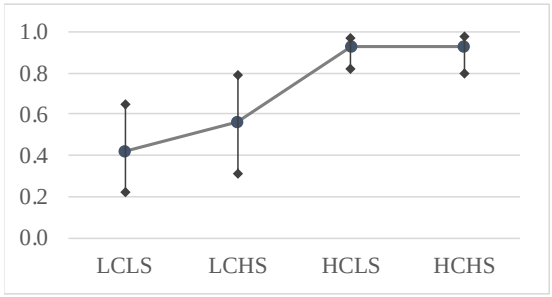
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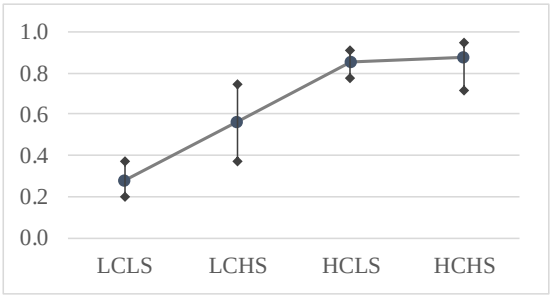
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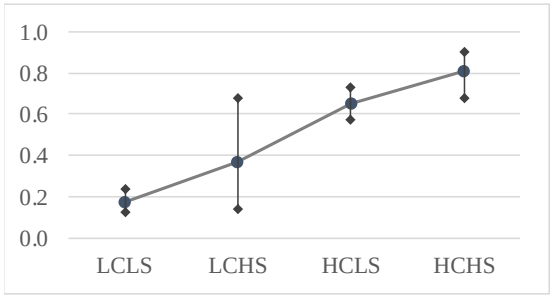
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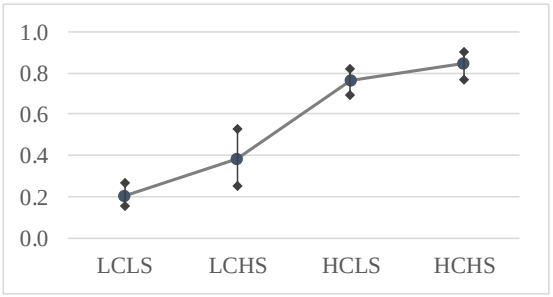
SI



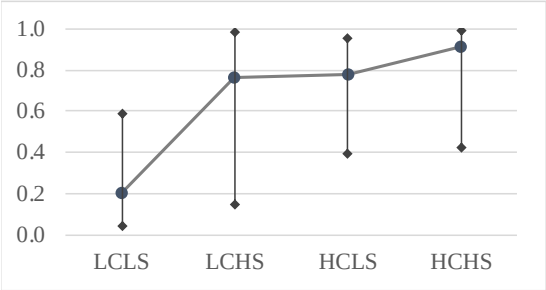
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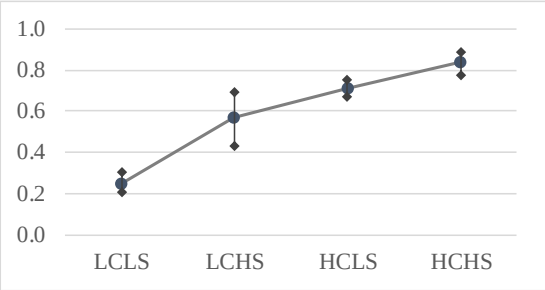
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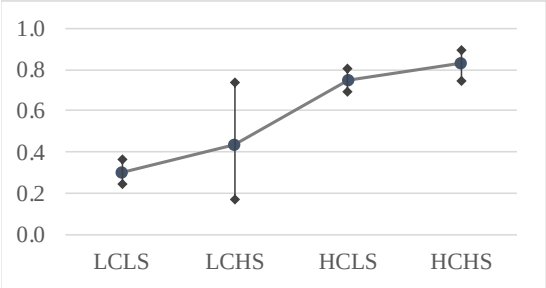
TR


1.0
0.8
0.6
0.4
0.2
0.0
LCLS
LCHS
HCLS
HCHS

GB

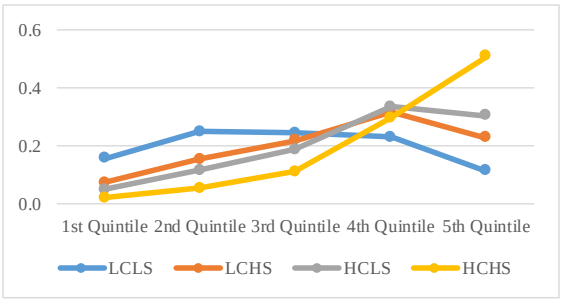

1.0
0.8
0.6
0.4
0.2
0.0
LCLS
LCHS
HCLS
HCHS

US

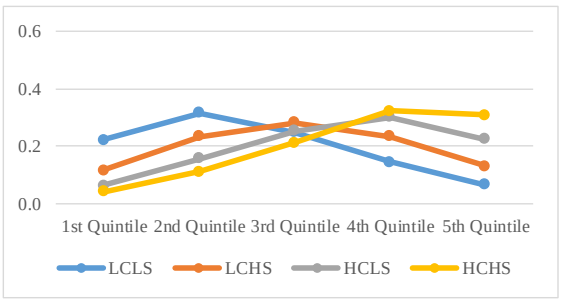

1.0
0.8
0.6
0.4
0.2
0.0
LCLS
LCHS
HCLS
HCHS

Earnings Quintiles (without occupations as control variables)

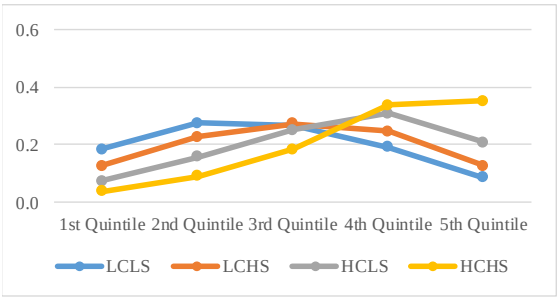
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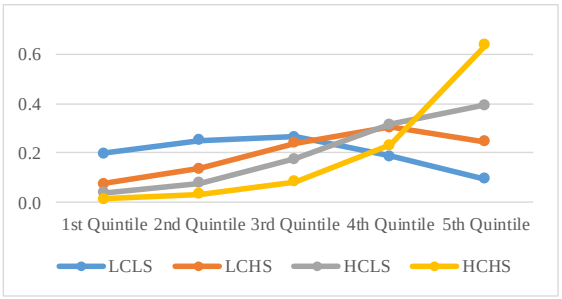
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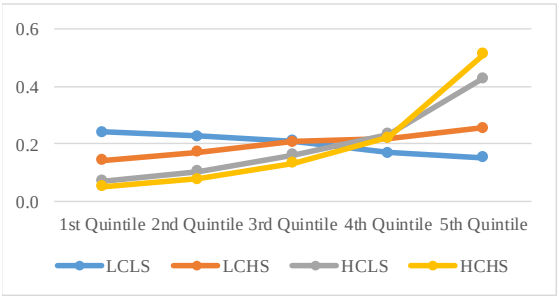
CA



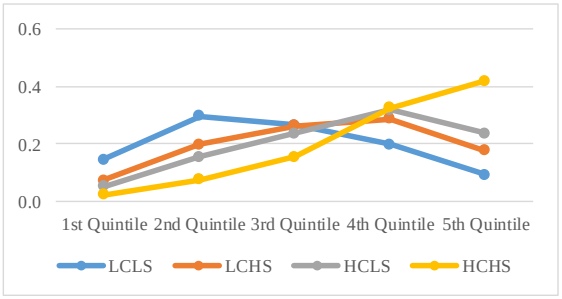
CL



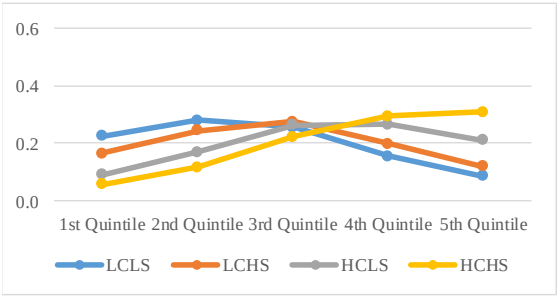
CZ



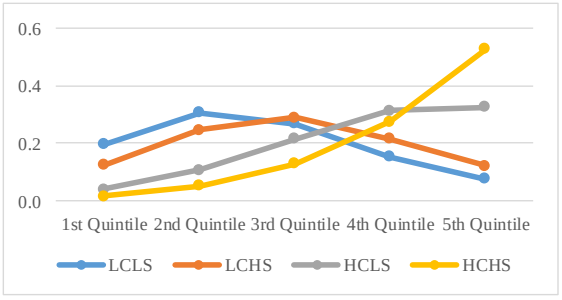
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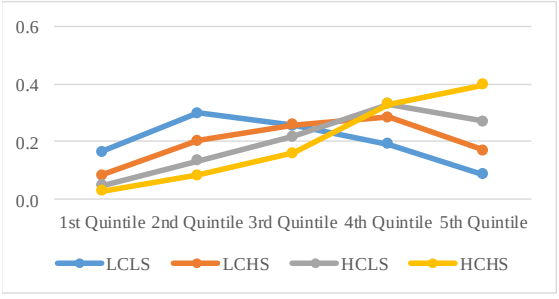
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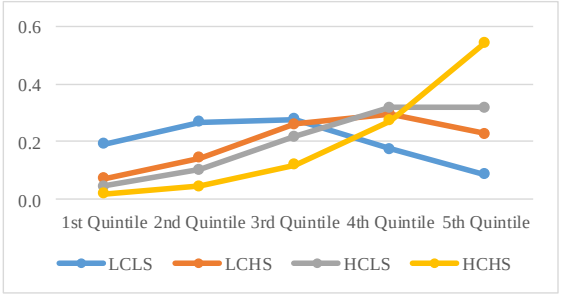
FR



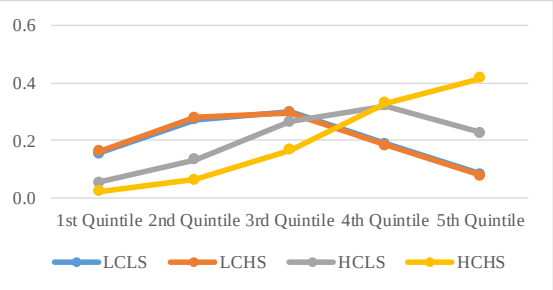
DE



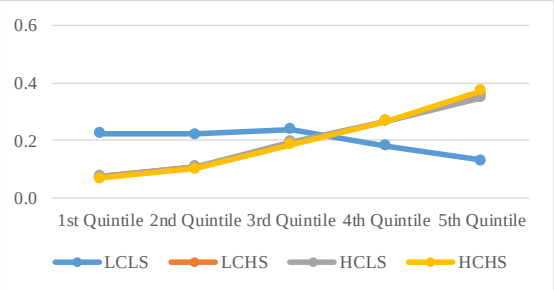
IE



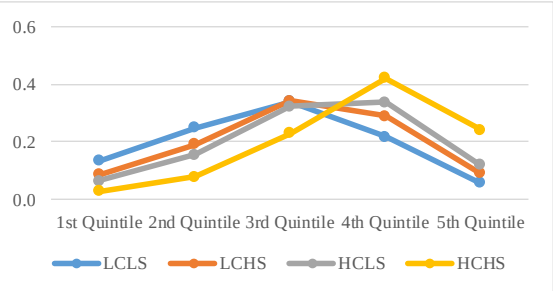
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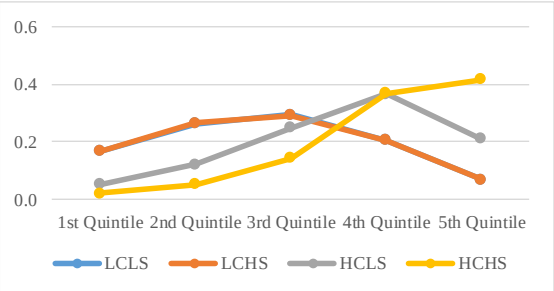
IT



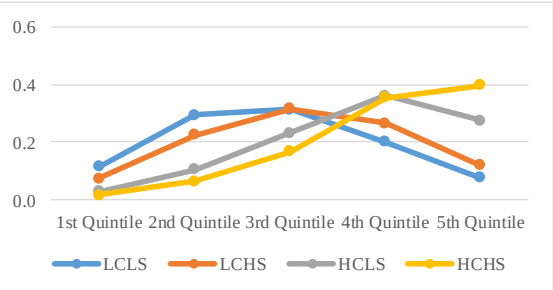
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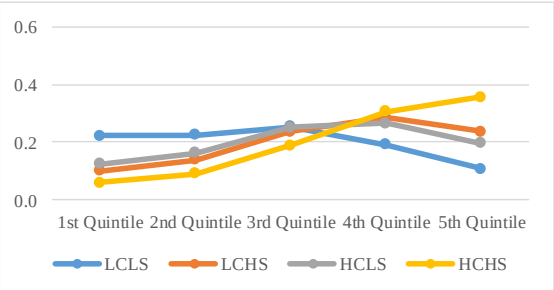
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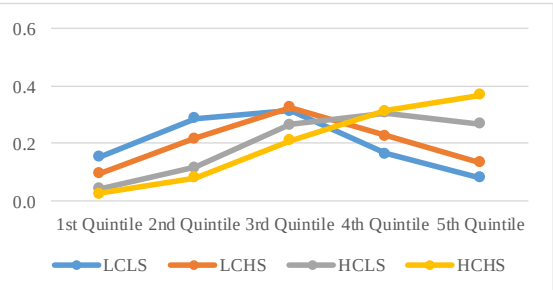
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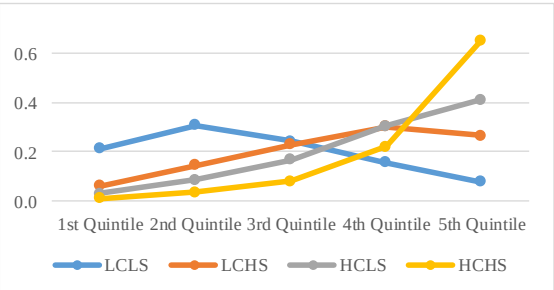
NZ



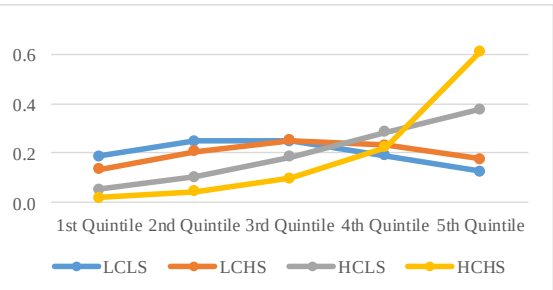
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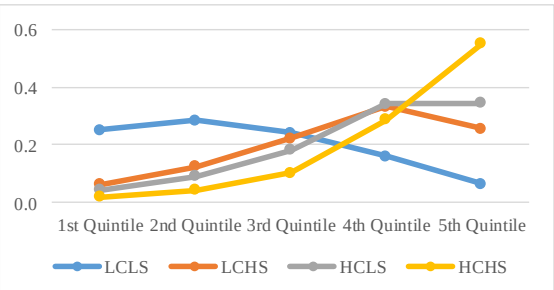
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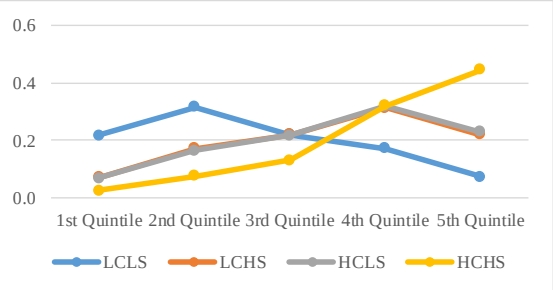
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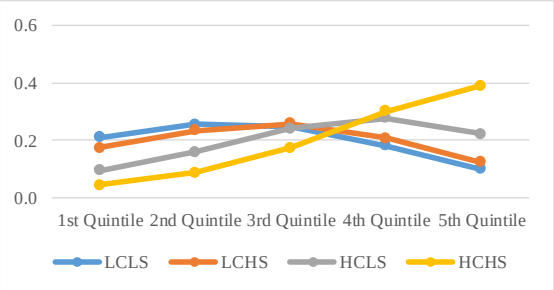
SI



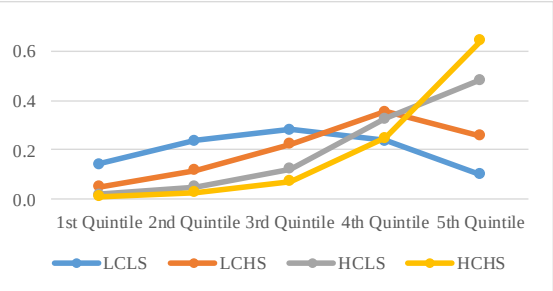
ES


0.6
0.4
0.2
0.0
1st Quintile
2nd Quintile
3rd Quintile
4th Quintile
5th Quintile
LCLS
LCHS
HCLS
HCHS

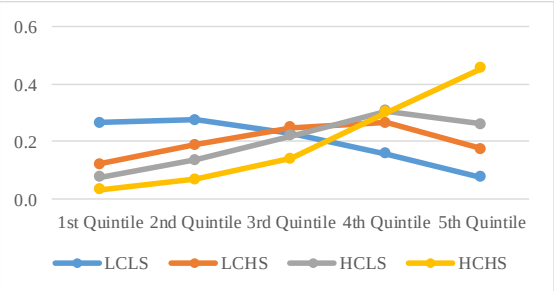
SE


0.6
0.4
0.2
0.0
1st Quintile
2nd Quintile
3rd Quintile
4th Quintile
5th Quintile
LCLS
LCHS
HCLS
HCHS

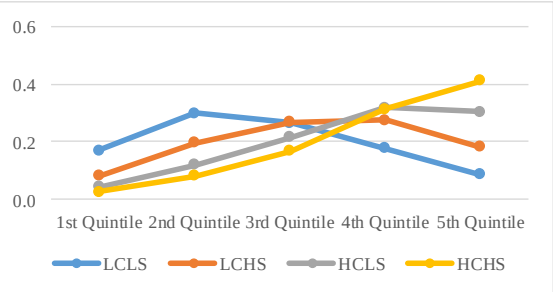
TR


0.6
0.4
0.2
0.0
1st Quintile
2nd Quintile
3rd Quintile
4th Quintile
5th Quintile
LCLS
LCHS
HCLS
HCHS

GB

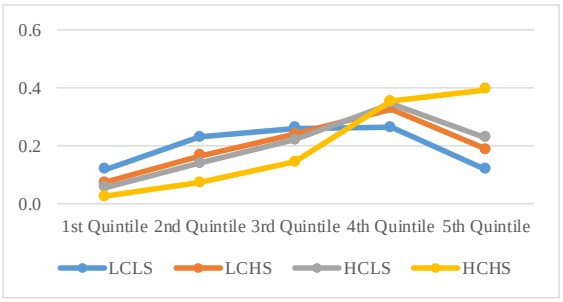

0.6
0.4
0.2
0.0
1st Quintile
2nd Quintile
3rd Quintile
4th Quintile
5th Quintile
LCLS
LCHS
HCLS
HCHS

US

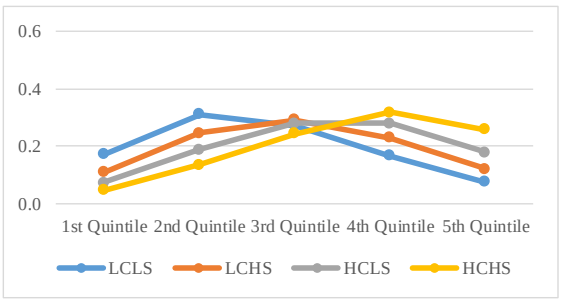

0.6
0.4
0.2
0.0
1st Quintile
2nd Quintile
3rd Quintile
4th Quintile
5th Quintile
LCLS
LCHS
HCLS
HCHS

Earnings Quintiles (with occupations as control variables)

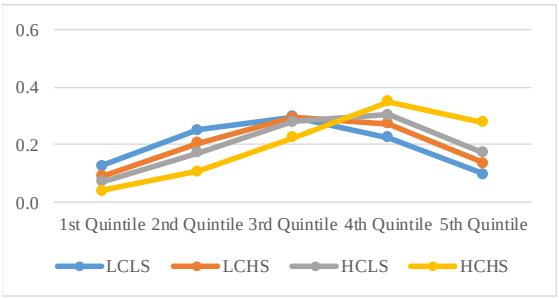
AT



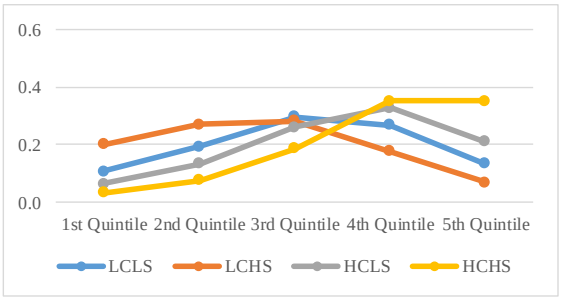
BE



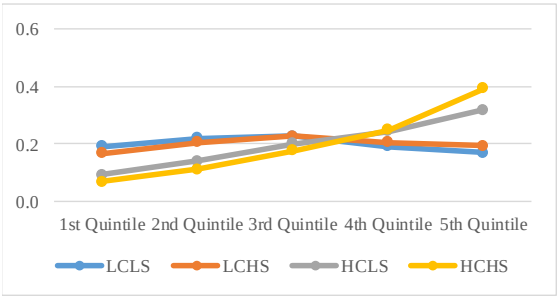
CA



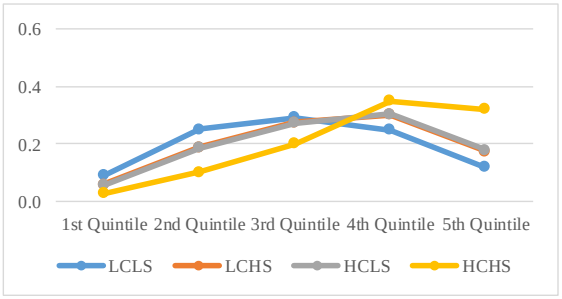
CL



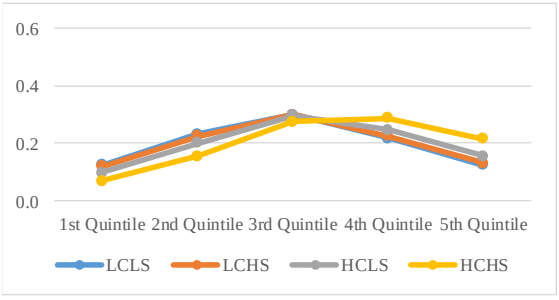
CZ



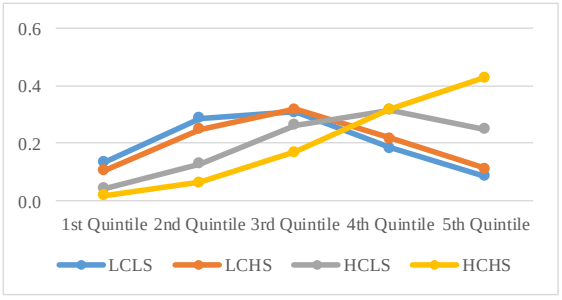
DK



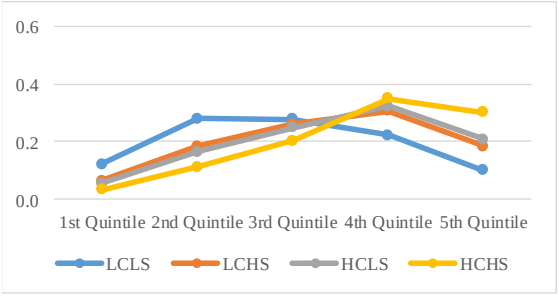
FI



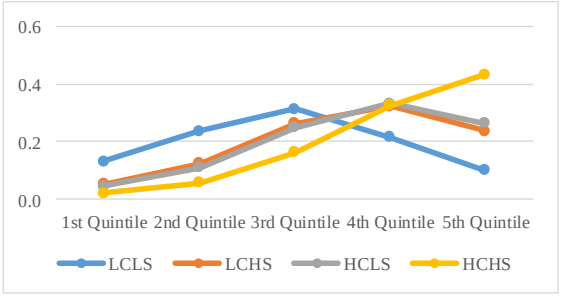
FR



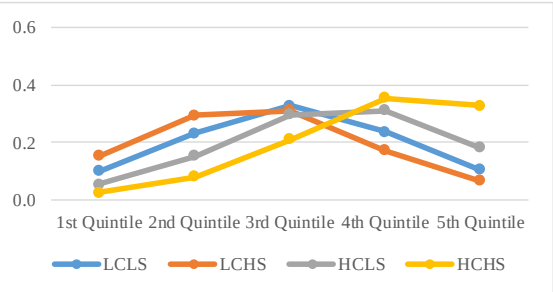
DE



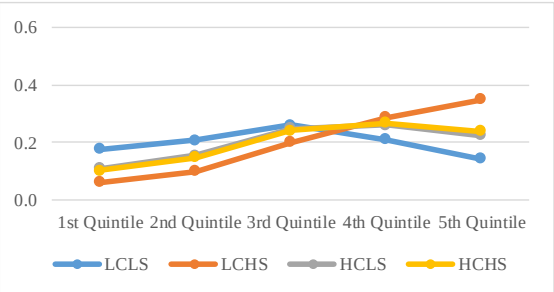
IE



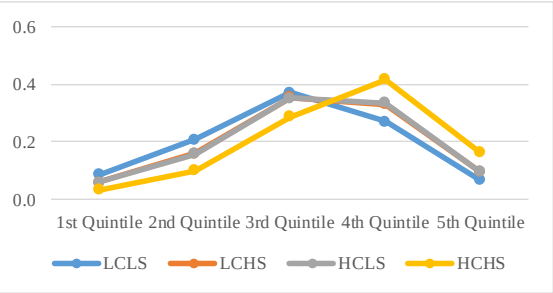
IL



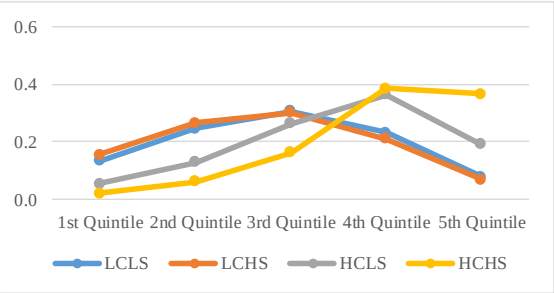
IT



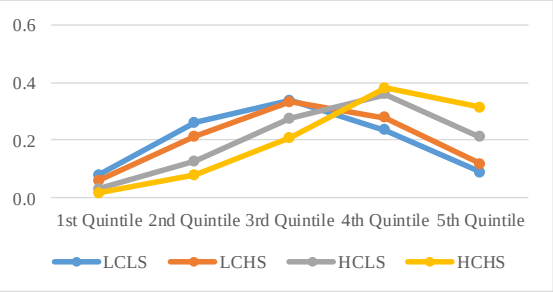
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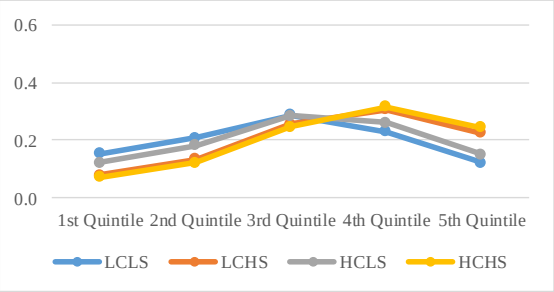
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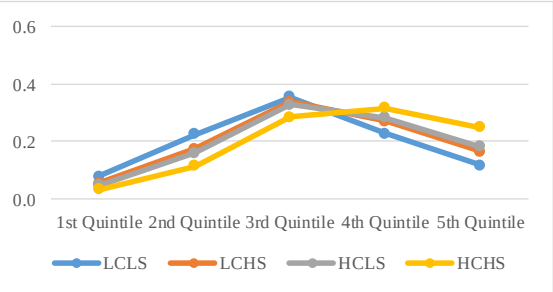
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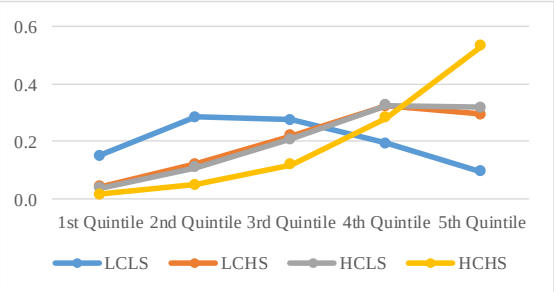
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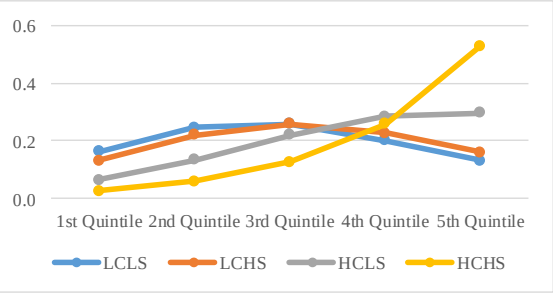
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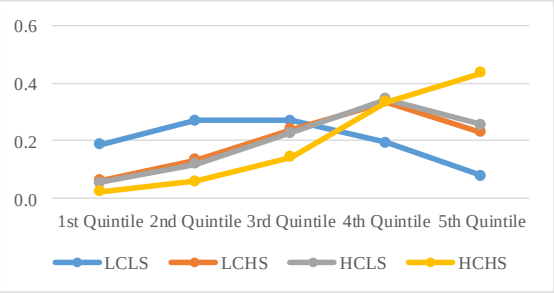
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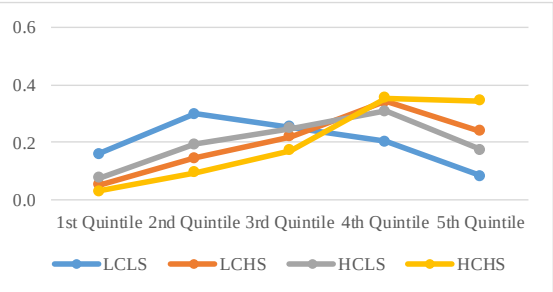
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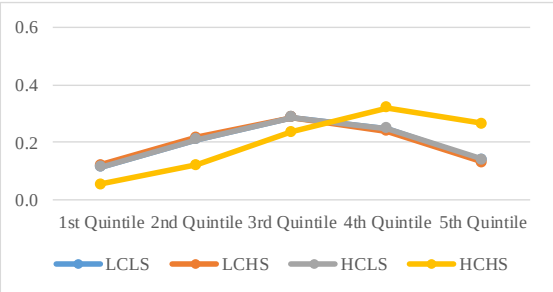
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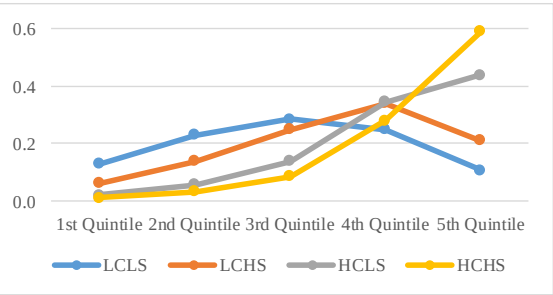
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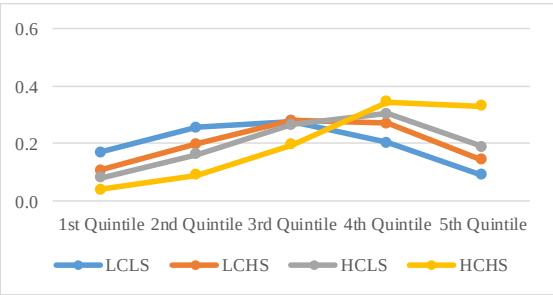
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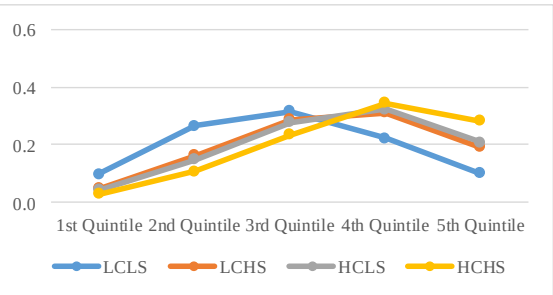
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III. Origins and Education

1. Introduction

Inequality of educational opportunity (IEO) has been a popular topic of social science research. Sociologists have markedly contributed to elucidating not only the association between social backgrounds and educational attainment for specific cohorts but how the extent of inequality has changed in the process of educational expansion. While evidence has suggested that the significant relationship between origins and children's education is persistent despite the growing opportunity of education (e.g. Shavit and Blossfeld 1993), researchers have also argued that educational expansion has operated as an equaliser and consequently inequality has been declining over time (e.g. Breen et al. 2009).

Although the trend as well as mechanisms of IEO in many societies has been considerably investigated, two essential perspectives have been largely overlooked. Firstly, societal-level skills diffusion (i.e. a larger share of highly skilled people) should be examined as a different societal condition from educational expansion (i.e. a larger share of highly educated people). As the term "IEO" literally indicates, most sociological research has focused primarily on access to educational opportunity and analysed the impact of its expansion on the association between individual origins and educational attainment (i.e. the OE association). As long as educational expansion and skills diffusion advance hand in hand and/or they have the same influence on IEO, this is not necessarily a critical research gap.

However, as confirmed in Figure II-2, there is a discrepancy between the degree of educational expansion and that of skills diffusion across countries, despite a moderate positive correlation, suggesting that growth in educational opportunity does not automatically guarantee the accumulation of highly skilled people. More critically, the preceding chapter reveals that these two societal conditions have different influences on social stratification. This implies one possibility that what we have

understood as a consequence of educational expansion is, in reality, significantly influenced by skills diffusion. Thus, in analysing the OE association in consideration of societal educational conditions, it is also imperative to pay attention to the difference in impact between societal educational expansion and skills diffusion.

Another important aspect, which has been inadequately accounted for, is the level of actual skills that individuals possess. One of the factors that have urged sociologists to investigate IEO is the function of education as a mediator between origins and destinations. That is, in addition to focusing merely on educational attainment in itself, the vast literature has investigated IEO within the broader concept of social mobility/fluidity (e.g. Boudon 1974; Breen 2010; Breen and Jonsson 2005, 2007; Bukodi and Goldthorpe 2016; Fujihara and Ishida 2016; Goldthorpe 2014; Ishida et al. 1995; Pfeffer and Hertel 2015; Thompson and Simmons 2013). In light of this, one basic condition should be met for traditional IEO research: educational attainment is the key to socio-economic destinations such as occupations and incomes. However, recent economic work has advocated actual skills, rather than mere educational attainment, as essential input for economic rewards (Hanushek et al. 2015; Hanushek and Woessmann 2015). Indeed, Chapter 2 reveals that economic returns vary depending on the combination of credentials and skills that individuals possess. Nevertheless, sociological studies have favoured levels of educational credentials as well as years of schooling in exploring IEO whilst largely overlooking skills levels, with the exception of some research (Bukodi, Erikson, and Goldthorpe 2014; Bukodi and Goldthorpe 2019; Doren and Grodsky 2016; Erikson 2016; Flisi et al. 2017; Gesthuizen et al. 2011; Jencks et al. 1972; Kerckhoff et al. 2001; Van de Werfhorst 2018; Van de Werfhorst and Mijs 2010). In short, educational "opportunity" is not enough; both opportunity *and* skills matter as educational outcomes of individuals.

It is therefore indispensable to pay close attention to the distinction between educational attainment and skills of individuals while distinguishing skills diffusion

from educational expansion at a societal level. Put differently, a new dimension of intergenerational educational inequality is uncovered via answering how origins affect children's educational attainment *and* skills acquisition, and how such association differs depending on the degree of educational expansion *and* skills diffusion.

Thus, this chapter examines the OE association in consideration of skills as well as educational attainment at both individual and societal levels. I first review the relevant literature in the next section, followed by data and method. After examining the analysis results, implications are discussed in the final section.

2. Inequality of Educational Opportunity

Social inequality and mobility have been investigated by a large volume of literature. Sociological research has particularly paid attention to the association between 1) parental education/occupations, 2) children's education, and 3) children's occupations in consideration of its elasticity associated with educational expansion at a societal level (Boudon 1974; Breen 2004; Goldthorpe 2014). Within this broader framework, the relationship between parental education/occupations (origin) and children's education (educational attainment) has been examined with the concept of inequality of educational opportunity (IEO) (Bar Haim and Shavit 2013; Boudon 1974; Breen et al. 2009; Breen and Jonsson 2005; Burger 2016; Erikson 2016; Fujihara and Ishida 2016; Hällsten and Pfeffer 2017; Holm and Breen 2016; Jerrim, Chmielewski, and Parker 2015; Jonsson and Erikson 2007; Mijs 2016; Shavit and Blossfeld 1993; Tieben, de Graaf, and de Graaf 2010; Triventi et al. 2016; Weiss and Roksa 2016).

In addition to detecting the significant impact of origins on educational attainment, researchers have attempted to elucidate whether and to what extent educational expansion contributes to mitigating such inequality. On the one hand, research has argued that inequality persists despite growth in access to educational opportunity within a society (Bar Haim and Shavit 2013; Jonsson and Erikson 2007; Shavit and

Blossfeld 1993; Wakeling and Laurison 2017). On the other, introducing an internationally comparative approach, evidence has suggested that educational expansion functions as an equaliser and accordingly the link between origins and children's education weakens (Breen et al. 2009, 2010). Furthermore, Bernardi, Hertel, and Yastrebov (2018) analysed intergenerational inequality of college attainment, arguing that the relative inequality in the form of odds ratio had declined over time whereas the absolute inequality had been stable.

When it comes to specific measures of educational attainment, the vast literature has employed years of schooling or levels of educational qualifications. In addition, shedding light on the heterogeneity within the same level of educational credentials, say among tertiary graduates, research has also revealed that social backgrounds have significant impacts on prestige of educational institutions and fields of study (Ayalon and Yogev 2005; Boliver 2011; Davies and Guppy 1997; Ford and Thompson 2016; Gerber and Cheung 2008; Hällsten and Thaning 2018; Kraaykamp, Tolsma, and Wolbers 2013; Lucas 2001; Reimer and Pollak 2010; Thomsen 2015; Torche 2011; Triventi 2013a). These findings suggest that, even though IEO seems to be alleviated in response to educational expansion, the association between origins and valuable educational qualifications, which are significant input for socio-economic destinations, has been maintained once the dispersion within the same educational stage is considered.

Although the literature has uncovered various dimensions of intergenerational educational inequality associated with educational expansion, there remain two essential perspectives that have not been adequately investigated. Firstly, individual skills levels, as well as educational attainment, should be taken into account as an important educational outcome. As noted, one of the fundamental concepts that have underpinned conventional IEO research is that educational attainment, including the difference in prestige and fields of study, generally affects socio-economic outcomes.

That is, educational attainment has been examined not only as a destination in itself but also as a valuable tool to better understand the mechanisms of social stratification and mobility. This means that the necessity to explore IEO focused on "opportunity" may diminish should educational attainment have little impact on destinations.

Meanwhile, recent economic research has argued that actual skills, rather than mere educational attainment, play significant roles in obtaining economic rewards (Hanushek et al. 2015; Hanushek and Woessmann 2015). In addition, the preceding chapter indicates the possibility that destinations are significantly affected by skills as well as credentials. More importantly, in association with educational expansion, economic returns to high credentials are assumed to decline whereas high skills retain their rewards despite diminishing scarcity. Nonetheless, unlike educational attainment, the level of skills has been inadequately investigated by sociological studies focused on IEO with some exceptions that have detected the influence of origins on skills acquisition as well as educational attainment (e.g. Bukodi and Goldthorpe 2019). Thus, this chapter sheds light on the association between social backgrounds and both educational credentials and skills that individuals possess, using internationally comparable data as with Chapter 2.

Secondly, the influence of societal-level skills diffusion (i.e. a larger share of highly skilled people) should be examined as a different societal condition from educational expansion (i.e. a larger share of highly educated people). For decades, sociologists have analysed how the structure of IEO changes in response to educational expansion using the share of population with a particular level/type of educational credential or mean years of schooling in a given society (Bar Haim and Shavit 2013; Breen et al. 2009, 2010; Jonsson and Erikson 2007; Kraaykamp et al. 2013; Mare 1981; Reimer and Pollak 2010; Shavit and Blossfeld 1993; Thomsen 2015). However, the degree of skills diffusion is not consistent with that of educational expansion (see Figure II-2), and more critically, they have different impacts on the formation of social

stratification via influencing the allocation of economic rewards based on educational attainment (credentials) and skills (see Chapter 2).

One of the premises in tandem with the lack of appropriate data, which has prevented previous research from distinguishing between these two different societal conditions, is that the diffusion of highly skilled people (skills diffusion) is realised in parallel with the proliferation of educational opportunity (educational expansion). This misconception is not necessarily serious if they both have similar influences on the association between origins and education. However, given that skills diffusion and educational expansion function differently, it is also imperative to analyse their impact respectively in order to better understand the mechanisms of educational inequality. Without paying attention to this discrepancy, we might misunderstand the consequence of skills diffusion as that of educational expansion.

Against such a backdrop, paying close attention to the distinction between educational attainment and skills at both individual and societal levels, this chapter analyses the effect of origins on children's educational outcomes in consideration of the degree of educational expansion and skills diffusion. I would argue that, through this investigation, a new dimension of intergenerational educational inequality is detected.

3. Data and Method

To answer the above-mentioned question, data on educational attainment and skills at both individual and societal levels are required. Although there are several useful datasets that make it possible to analyse individual educational attainment and skills as well as origins, they are basically limited to specific societies and hence international comparability is not necessarily ensured. In particular, while educational attainment is comparable based on the international standard, skills have lacked a common yardstick across countries. Accordingly, the association between social backgrounds and

educational outcomes including skills has been unmeasurable in an internationally comparable way for decades.

However, with the development of an international survey of adult skills (PIAAC) led by the OECD, the degree of societal-level skills diffusion and educational expansion as well as individual-level educational attainment and skills are evaluable across countries. As explained earlier, PIAAC is composed of a standardised assessment of cognitive skills and questionnaires including educational attainment and socio-economic statuses. Using the same dataset as the analysis of skilled occupations in Chapter 2, this chapter also focuses on people aged 30 to 39 in 26 countries (see Table II-1 for specific countries and the sample size).

One potential approach here is to analyse how the OE association has shifted over time in the process of educational expansion and skills diffusion in a given society (and compare its structure across countries). However, while this approach provides detailed implications for each society, the results of country-specific analyses are hardly generalisable. Herein, as discussed earlier, a multilevel regression modelling using the internationally comparable PIAAC data becomes an ideal method to grasp the general tendency of intergenerational educational inequality via properly accounting for country-level variables.

In terms of specific measures, extending the framework demonstrated in Chapter 2, the dependent variable is defined based on the possession of high credentials and/or skills (i.e. four educational specifications). Although continuous measures of educational attainment (e.g. years of schooling) and skills (e.g. row scores of PIAAC) are appropriate to examine the extent to which the outcome is expected to change in response to an increase/decrease in predictors, the said categorical variables are useful to elucidate the structure of distribution of educational assets (both credentials and skills) in a society. Put differently, by investigating the probability that respondents with different social backgrounds possess high levels of credentials and/or skills, it

becomes possible to figure out how origins affect social stratification and intergenerational inequality in the form of educational specifications, rather than how origins linearly contribute to the level of educational attainment and skills. This sociological perspective is important, particularly given that the allocation of economic rewards is significantly influenced by the combination of credentials and skills that individuals possess (see Chapter 2).[37]

As detailed in Chapter 2, credentials and skills are quantified by the International Standard Classification of Education (ISCED) 2011 and the mean score of literacy and numeracy in PIAAC respectively; high credentials are equivalent to ISCED 2011 Level 5 and above, whereas the PIAAC score 326 and above are taken as high skills. Using these criteria, four educational specifications are defined: 1) both high credentials and high skills (HCHS), 2) only high credentials without high skills (HCLS), 3) only high skills without high credentials (LCHS), and 4) neither (LCLS). With LCLS as reference, a multilevel multinomial logistic regression analysis is conducted to examine the probability of falling into other three specifications.

As regards individual-level independent variables, origins of respondents are quantified by parental education. Although skills as well as occupations/incomes of parents are also considered to affect the intergenerational transmission of educational outcomes, recent research has argued that parental education functions as a significant determinant of children's education and destinations as well as parental social and economic class (Erola et al. 2016; Gugushvili et al. 2017; Kariya 2017). This means that, despite the fact that there are no datasets that provide all the individual-level variables concerning parental skills, occupations, and incomes/earnings in conjunction with children's educational attainment and skills in an internationally comparable way, it becomes reasonable to elucidate the OE association by focusing on the impact of

[37] It is also important to note that the analysis using a continuous measure of skills generally demonstrates the consistent result with the one using educational specifications (see Appendix A in Chapter 2).

parental educational attainment as a fundamental measure of origins.[38] This analysis therefore uses ISCED 2011 Level 5 and above, as with children's educational specifications, to quantify parental education. In so doing, given the possibility that the impact of father's education is not necessarily consistent with that of mother's education (Sewell and Shah 1968), a tertiary educated mother dummy and a tertiary educated father dummy are employed respectively. Here one may assume that the influence of father's education and mother's education varies depending on children's gender. Thus, while using the pooled data composed of both men and women in the main manuscript, the results of gender-specific analyses are also described in Appendix. Other individual-level variables include gender (male dummy), cohort (late-thirties dummy), and immigrant background (first generation immigrant dummy).

Meanwhile, country-level independent variables are the degree of educational expansion, skills diffusion, and tracking. As illustrated in the preceding chapter, the extent of educational expansion and skills diffusion refers to the share of population who attained tertiary education (ISCED 2011 Level 5 and above) and the proportion of individuals whose mean score of literacy and numeracy in PIAAC is 326 and above. Although the primary focus of this analysis is on educational expansion and skills diffusion, considering the significant influence of tracking on inequality of academic achievement (Van de Werfhorst 2018), the relevant country-level indicator suggested by Bol and van de Werfhorst (2013) is controlled for. As with the analysis of the ED association, the difference in these variables across countries is taken as the variation of societal conditions.

[38] This also indicates that, in interpreting the analysis results, it is imperative to carefully consider how parental education affects children's educational attainment and skills acquisition (i.e. whether parental education per se has direct effects or it represents other dimensions of origins such as cognitive/non-cognitive skills and social/economic class). This perspective is applicable to the analysis of OD association (Chapter 4) as well (i.e. whether parental education as such directly affects destinations or it operates as a proxy). Although the current dataset does not allow such empirical elaboration, the potential mechanism of these associations is hypothetically discussed in the final chapter.

Using these societal variables as well as individual-level measures, a multilevel multinomial logistic regression analysis (generalised linear mixed model) is conducted in accordance with Heck, Thomas, and Tabata (2012).[39] In Model 1, only individual-level independent variables are employed to examine the effect of parental education on the probability of obtaining high credentials and/or high skills as compared to possessing neither of them. b_4 and b_5 in equation (1) below are focused on.

$$\log\left(\frac{\pi_k}{\pi_{LCLS}}\right) = b_{0j} + b_1 M_{ij} + b_2 A_{ij} + b_3 I_{ij} + b_4 ME_{ij} + b_5 FE_{ij} + \varepsilon_{ij} \cdots (1)$$

where i=level one (individual), j=level two (country), π_{LCLS}=the probability of being LCLS for individual i in country j, π_k=the probability of falling into response categories (HCHS, HCLS, and LCHS respectively) for individual i in country j, b_n=coefficient of individual level independent variables, M_{ij}=men dummy, A_{ij}=late-thirties dummy, I_{ij}=immigrant dummy, ME_{ij}=mother's education (tertiary dummy), FE_{ij}=father's education (tertiary dummy), and ε_{ij}=residual for individual i in country j.

In Model 2, the degree of country-level educational expansion and tracking are added to Model 1. Moreover, cross-level interaction terms between these two societal variables and parental education are employed. In addition to examining the effects of individual-level and country-level variables, the cross-level interaction terms demonstrate how the relationship between parental education (mother's and father's respectively) and children's educational specifications differs depending on the degree of educational expansion and tracking.

$$b_{0j}(\text{in equation (1)}) = \gamma_{00} + \gamma_{01} E_j + \gamma_{02} T_j + u_{0j} \cdots (2)$$

where γ_{00}=average intercept, γ_{0n}=coefficient of country level independent variables,

[39] Descriptive statistics are the same as "Skilled Occupations" in Table II-3.

E_j=the degree of educational expansion, T_j=the index of tracking, and u_{0j}=country (j) dependent deviation. Here I substitute equation (2) into equation (1) and denote b_n by γ_{n0} whilst adding four interaction terms between parental education (*ME* and *FE*) and societal educational conditions (*E* and *T*). Coefficients γ_{41} and γ_{51} in conjunction with γ_{40} and γ_{50} in equation (3) explain the elasticity of the influence of parental education in association with educational expansion.

$$\log\left(\frac{\pi_k}{\pi_{LCLS}}\right) = \gamma_{00} + \gamma_{10}M_{ij} + \gamma_{20}A_{ij} + \gamma_{30}I_{ij} + \gamma_{40}ME_{ij} + \gamma_{50}FE_{ij} + \gamma_{01}E_j + \gamma_{02}T_j + \gamma_{41}ME_{ij}E_j + \gamma_{51}FE_{ij}E_j + \gamma_{42}ME_{ij}T_j + \gamma_{52}FE_{ij}T_j + u_{0j} + \varepsilon_{ij} \cdots (3)$$

Finally, Model 3 further employs the degree of skills diffusion as another country-level variable. Furthermore, two cross-level interaction terms are generated by multiplying parental education and skills diffusion. While country-level variables indicate the effect of educational expansion and skills diffusion on the probability of achieving each individual educational specification (γ_{01} and γ_{03}), the coefficients of interaction terms suggest how the influence of parental education on children's educational attainment and skills acquisition varies in association with societal-level skills diffusion as well as educational expansion. γ_{41}, γ_{51}, γ_{43} and γ_{53} are focused on.[40]

$$\log\left(\frac{\pi_k}{\pi_{LCLS}}\right) = \gamma_{00} + \gamma_{10}M_{ij} + \gamma_{20}A_{ij} + \gamma_{30}I_{ij} + \gamma_{40}ME_{ij} + \gamma_{50}FE_{ij} + \gamma_{01}E_j + \gamma_{02}T_j + \gamma_{03}S_j + \gamma_{41}ME_{ij}E_j + \gamma_{51}FE_{ij}E_j + \gamma_{42}ME_{ij}T_j + \gamma_{52}FE_{ij}T_j + \gamma_{43}ME_{ij}S_j + \gamma_{53}FE_{ij}S_j + u_{0j} + \varepsilon_{ij} \cdots (4)$$

[40] Although the impact of tracking is not the primary focus of this thesis, I summarise the analysis result without cross-level interaction terms between parental education and educational expansion/skills diffusion (i.e. interaction terms only between parental education and tracking are included) in Appendix for reference.

4. Results

Table III-3 shows the analysis result of Model 1. Firstly, in Model 1 where only individual-level independent variables are employed, the coefficients of parental education (mother's and father's) are significantly positive for all the three educational specifications (b_4 and b_5 are 1.135 and 1.500 for HCHS, 0.825 and 1.127 for HCLS, and 0.698 and 0.720 for LCHS respectively). This suggests that origins in terms of parental education affect the probability of children obtaining high credentials and/or high skills, contributing to the formation of intergenerational inequality of educational outcomes. Herein, paying attention to the heterogeneity in magnitude of mother's education and father's education across educational specifications (b_4 and b_5 for HCHS, HCLS, and LCHS), the impact of parental education on the acquisition of HCHS is larger than that on HCLS and LCHS.[41] This means that the relative advantage of having tertiary educated mother or father, in the form of high chance of gaining both high credentials and high skills (HCHS), is more significant as compared to the probability of acquiring merely high credentials (HCLS) or high skills (LCHS).

Furthermore, comparing HCLS and LCHS, the impact of father's education is significantly larger on HCLS than on LCHS, whereas there is no significant difference in the influence of mother's education between these two specifications. This implies that tertiary educated fathers enhance children's chance of obtaining high credentials more significantly as compared with high skills,[42] while the contribution of mother's education to HCLS and that to LCHS are not statistically different. These heterogeneous associations between origins and educational outcomes can be detected only via paying attention to the variance in individual educational specifications whilst

[41] The differences in coefficient of parental education (both mother's education and father's education) between HCHS and other two educational specifications are all statistically significant. As noted in Chapter 2, the significance of differences is tested by simply changing the reference and described referring to the 5% significance level unless otherwise stated.

[42] It is important to note that these differences in impact of parental education across educational specifications are no longer significant in Model 2 and Model 3 where country-level variables and cross-level interaction terms are accounted for.

distinguishing between father's and mother's education.[43]

Table III-1 Multilevel Multinomial Logistic Regression of Educational Specifications (Model 1)

Independent Variable		Model 1								
		HCHS			HCLS			LCHS		
		B		S.E.	B		S.E.	B		S.E.
Intercept		-2.177	***	0.169	-0.541		0.090	-3.394	***	0.201
Level One (Individual)	Men (dummy)	0.050		0.040	-0.507	***	0.027	0.628	***	0.068
	Age (35-39 years old dummy)	0.012		0.040	-0.009	***	0.027	0.013		0.065
	First Generation Immigrant (dummy)	-0.922	***	0.071	0.073		0.040	-0.863	***	0.127
	Tertiary Educated Mother (dummy)	1.135	***	0.052	0.825	***	0.041	0.698	***	0.091
	Tertiary Educated Father (dummy)	1.500	***	0.050	1.127	***	0.038	0.720	***	0.086
Variance	Random Effect Covariance Structure (Intercept)	0.695 **			0.193 **			0.904 **		
Model Fit	-2LL	390838.775								
	AIC	390844.775								

(*** p<0.001, ** p<0.01, * p<0.05) [two tailed] [N: Individual=30,284, Country=26］

Note: Data are unweighted.

Model 2 (Table III-2) adds two country-level variables (the extent of educational expansion and tracking) and four cross-level interaction terms between parental education (father's and mother's respectively) and the degree of educational expansion/tracking to Model 1. The coefficients of parental education at an individual level are persistent only for HCHS and HCLS, whereas its significant impact is not confirmed as far as LCHS is concerned. That is, after accounting for societal-level educational conditions, the probability of obtaining high skills unaccompanied by high credentials, as compared to that of possessing neither high credentials nor high skills, is not necessarily improved even though children have tertiary educated parents. This

[43] Although the primary focus of this paper is on the association between origins and educational specifications, the result also provides interesting findings with regard to the effects of other individual backgrounds. For example, a dummy variable for men significantly improves the probability of LCHS, whereas its effect is negative on HCLS and insignificant on HCHS. Likewise, the impact of immigrant background on HCHS and LCHS is negative. Meanwhile, as compared to the cohort aged between 30 and 34, the late-thirties are less likely to become HCLS. The social mechanism that generates these nuanced associations between social backgrounds and educational specifications qualifies as an important question for future research.

is inconsistent with the idea that the advantaged parents are likely to transmit their prestigious position via providing children with high skills when they fail to attain high educational qualifications (e.g. Bukodi and Goldthorpe 2019).

In addition, the significant difference in impact on HCHS and HCLS between mother's education and father's education is no longer confirmed in Model 2. Although father's education seems to have stronger influences on the acquisition of high credentials (HCHS and HCLS) when merely individual-level variables are taken into account, tertiary educated mothers improve children's chance as much as tertiary educated fathers do once country-level variables and cross-level interactions are controlled for. Indeed, Figure III-1 and Figure III-2 (marginal effects of parental education) indicates that, while the probability of falling into HCHS and HCLS differs in accordance with parental education, there is no significant difference in the magnitude between mother's and father's education.

Meanwhile, among two country-level variables, the extent of educational expansion demonstrates the significant positive effect on the acquisition of high credentials regardless of skills levels (γ_{01} is 0.064 for HCHS and 0.025 for HCLS). One may therefore expect that people are more likely to gain high credentials (both HCHS and HCLS) in countries where access to tertiary education has greatly expanded as compared with other societies.[44] Furthermore, the coefficient of the interaction term between father's education and educational expansion is significantly negative for HCLS, while that of mother's education is negative for both HCHS and HCLS (γ_{41} is -0.021 for HCHS and -0.022 for HCLS, and γ_{51} is -0.014 for HCLS). This result suggests that the impact of parental education on children's educational attainment (i.e. the chance of falling into HCHS or HCLS) weakens in association with the larger share of tertiary education in a given society. Put differently, as argued by previous research

[44] Given that the societal-level variable used here is an aggregate indicator based on the individual-level variable, further examination is essential to conclude that educational expansion, as an independent societal-level factor, affects the acquisition of high credentials at an individual level.

(e.g. Breen et al. 2009, 2010), educational expansion is considered to operate as an equaliser and mitigates the intergenerational transmission of educational attainment.[45] In particular, given that two interaction terms are both negative for HCLS, the advantage of having tertiary educated parents in terms of gaining high credentials without high skills becomes considerably smaller due to the higher degree of educational expansion.

Table III-2 Multilevel Multinomial Logistic Regression of Educational Specifications (Model 2)

Independent Variable		Model 2								
		HCHS			HCLS			LCHS		
		B		S.E.	B		S.E.	B		S.E.
Intercept		-4.189	***	0.548	-1.335	***	0.290	-4.742	***	0.817
Level One (Individual)	Men (dummy)	0.048		0.040	-0.507	***	0.027	0.628	***	0.068
	Age (35-39 years old dummy)	0.013		0.040	-0.007		0.027	0.012		0.065
	First Generation Immigrant (dummy)	-0.931	***	0.071	0.074		0.040	-0.866	***	0.127
	Tertiary Educated Mother (dummy)	1.912	***	0.281	1.653	***	0.210	0.733		0.500
	Tertiary Educated Father (dummy)	1.670	***	0.265	1.624	***	0.189	0.265		0.483
Cross-Level Interactions	Educational Expansion * Tertiary Educated Mother	-0.021	**	0.008	-0.022	***	0.006	-0.001		0.014
	Educational Expansion * Tertiary Educated Father	-0.006		0.007	-0.014	**	0.005	0.013		0.014
	Tracking * Tertiary Educated Mother	0.002		0.075	0.034		0.063	-0.002		0.125
	Tracking * Tertiary Educated Father	-0.090		0.068	-0.038		0.055	0.122		0.112
Level Two (Country)	Educational Expansion	0.064	***	0.017	0.025	**	0.009	0.043		0.025
	Index of Tracking	0.075		0.165	-0.144		0.089	0.253		0.246
Variance	Random Effect Covariance Structure (Intercept)	0.394 **			0.113 **			0.873 **		
Model Fit	-2LL	391171.393								
	AIC	391177.393								

(*** p<0.001, ** p<0.01, * p<0.05) [two tailed] [N: Individual=30,284, Country=26］

Note: Data are unweighted.

In Model 3 (Table III-3), another country-level variable (skills diffusion) and cross-level interaction terms between parental education and skills diffusion are

[45] It is important to note that, while the literature has focuses on specific societies to conduct time-series analyses, this research employs a cross-country approach and hence not necessarily imply the change of the OE association in response to societal educational transformation.

employed. While individual-level variables show the same effects as Model 2, country-level and cross-level variables reveal a more nuanced relationship between origins and educational specifications. Firstly, while the extent of educational expansion maintains its positive impact on the probability of HCLS (γ_{01}=0.033 for HCLS), the positive association with HCHS is no longer significant, and instead educational expansion significantly demonstrates a negative effect on LCHS (γ_{01}=-0.025 for LCHS). This means that the probability of obtaining only high skills unaccompanied by high credentials, as compared to possessing neither of them, is smaller in highly qualified societies.

In the meantime, the coefficient of skills diffusion is significantly positive for HCHS and LCHS (γ_{03} is 0.136 for HCHS and 0.184 for LCHS), suggesting that individuals are more likely to obtain high skills regardless of educational attainment in highly skilled societies. These results also imply that, although Model 2 implies the positive impact of educational expansion on the probability of acquiring both high credentials and high skills (HCHS), this association is in fact generated by skills diffusion. Put differently, whereas educational expansion merely reflects the accumulation of individuals with only high credentials unaccompanied by high skills (HCLS), skills diffusion is significantly associated with the development of human resources who possess not only credentials but also high skills (HCHS) in a given society.[46]

Furthermore, paying attention to the coefficients of interaction terms, the effect of parental education on HCHS and HCLS becomes significantly smaller in association with skills diffusion (γ_{43} is -0.036 for HCHS and -0.032 for HCLS, and γ_{53} is -0.054 for HCHS and -0.021 for HCLS). Meanwhile, the significant negative coefficients of the interaction terms between the degree of educational expansion and father's education

[46] It is important to note, however, the analysis demonstrated here does not necessarily mean causality and hence further empirical examination is required to elucidate how these individual-level and societal-level variables influence each other.

are no longer confirmed regardless of educational specifications. Likewise, the negative association between educational expansion and the advantage of tertiary educated mother is significant only for HCLS (γ_{41}=-0.017). This suggests one possibility that what we have understood as the consequence of educational expansion as an equaliser (i.e. the small/decreasing influence of parental education on children's education) is in reality significantly formed by skills diffusion. I argue that it is therefore critical to distinguish between educational attainment (credentials) and skills at both individual and societal levels in analysing the mechanism of intergenerational educational inequality, which has been obscured for decades under the conventional concept of IEO focused on educational "opportunity."

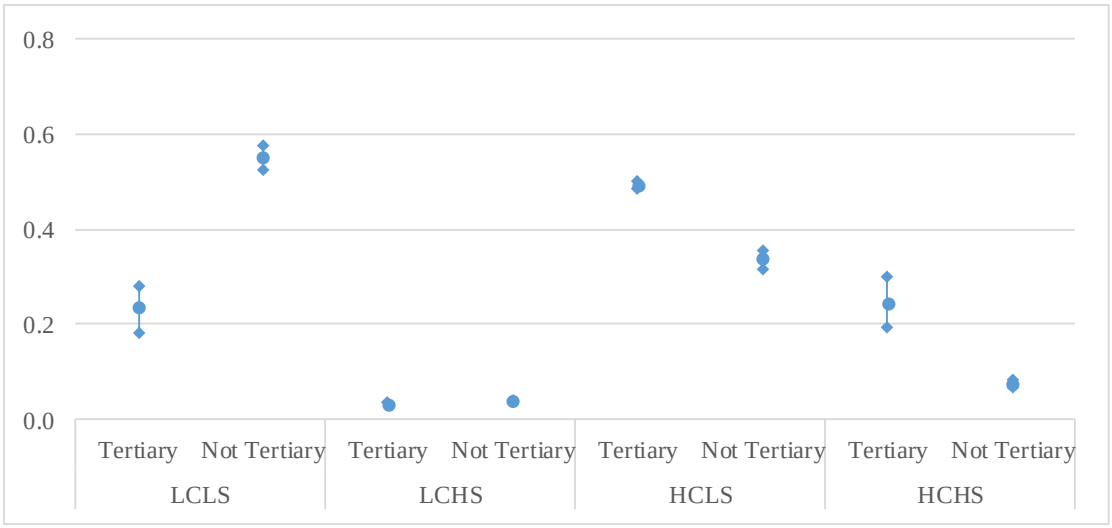
Table III-3 Multilevel Multinomial Logistic Regression of Educational Specifications (Model 3)

Independent Variable		Model 3								
		HCHS			HCLS			LCHS		
		B		S.E.	B		S.E.	B		S.E.
Intercept		-4.205	***	0.312	-1.342	***	0.274	-4.553	***	0.358
Level One (Individual)	Men (dummy)	0.052		0.040	-0.507	***	0.027	0.630	***	0.068
	Age (35-39 years old dummy)	0.009		0.040	-0.008		0.027	0.011		0.065
	First Generation Immigrant (dummy)	-0.940	***	0.071	0.072		0.040	-0.857	***	0.127
	Tertiary Educated Mother (dummy)	2.159	***	0.300	1.872	***	0.221	0.965		0.544
	Tertiary Educated Father (dummy)	1.978	***	0.277	1.683	***	0.194	0.481		0.511
Cross-Level Interactions	Educational Expansion * Tertiary Educated Mother	-0.015		0.008	-0.017	**	0.006	0.003		0.014
	Educational Expansion * Tertiary Educated Father	0.004		0.008	-0.009		0.006	0.021		0.014
	Tracking * Tertiary Educated Mother	0.005		0.075	0.032		0.063	-0.008		0.125
	Tracking * Tertiary Educated Father	-0.062		0.068	-0.019		0.055	0.143		0.112
	Skills Diffusion * Tertiary Educated Mother	-0.036	**	0.014	-0.032	**	0.011	-0.030		0.025
	Skills Diffusion * Tertiary Educated Father	-0.054	***	0.012	-0.021	*	0.010	-0.040		0.023
Level Two (Country)	Educational Expansion	0.018		0.011	0.033	**	0.010	-0.025	*	0.013
	Index of Tracking	-0.038		0.092	-0.125		0.085	0.078		0.104
	Skills Diffusion	0.136	***	0.016	-0.023		0.015	0.184	***	0.019
Variance	Random Effect Covariance Structure (Intercept)	0.105 **			0.099 **			0.116 *		
Model Fit	-2LL	391730.757								
	AIC	391736.757								

(*** p<0.001, ** p<0.01, * p<0.05) [two tailed] [N: Individual=30,284, Country=26］

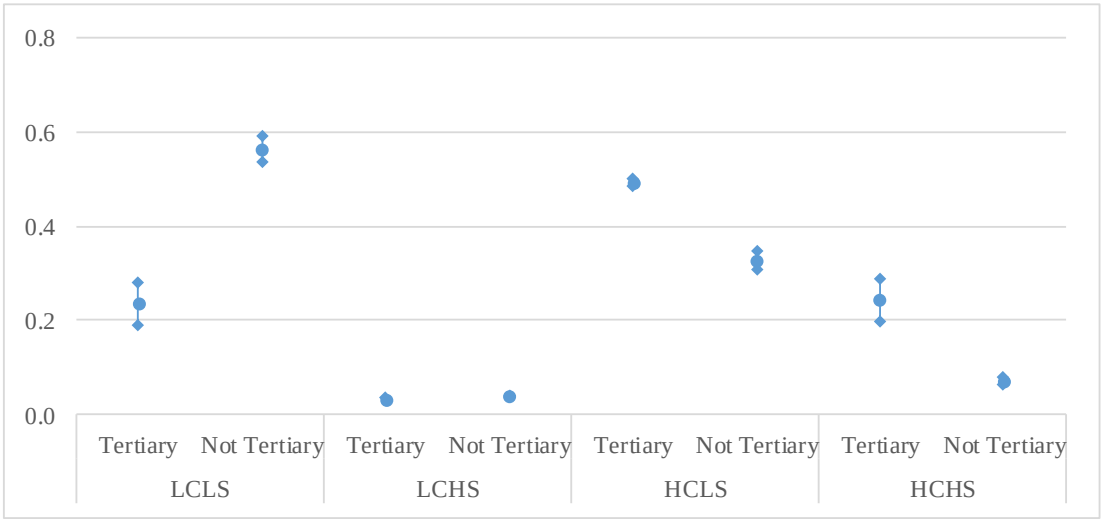
Note: Data are unweighted.

Figure III-1 Probability of Attaining Educational Specifications by Mother's Education



Note: Marginal effects in this figure are calculated based on Model 3. Diamonds indicate the 95% confidence interval. "Tertiary" means those whose mother is tertiary educated, whereas "Not Tertiary" indicates mother's educational attainment is below tertiary.

Figure III-2 Probability of Attaining Educational Specifications by Father's Education



Note: Marginal effects in this figure are calculated based on Model 3. Diamonds indicate the 95% confidence interval. "Tertiary" means those whose father is tertiary educated, whereas "Not Tertiary" indicates father's educational attainment is below tertiary.

5. Discussion and Conclusion

This chapter sheds light on new dimensions of intergenerational educational inequality. While previous research has remarkably progressed our understanding of the OE association in consideration of societal-level educational expansion, this research is the first to pay close attention to 1) individual educational specifications, which are broader concepts of educational outcomes that include skills levels as well as educational attainment, and 2) skills diffusion, which is a different societal condition from educational expansion. Herein, individual educational specifications are defined as follows: possessing both high credentials and high skills (HCHS); only high credentials without high skills (HCLS); only high skills without high credentials (LCHS); neither (LCLS).

A multilevel multinomial logistic regression analysis, using the internationally comparable OECD's PIAAC data for 30,284 people in 26 countries, reveals how social backgrounds affect the probability of falling into three educational specifications (HCHS, HCLS, and LCHS with LCLS as reference) and how this association varies depending on the degree of educational expansion and skills diffusion. The analysis results suggest that, as indicated by the literature, parental education significantly affects children's chance of obtaining high credentials (both HCHS and HCLS) even after controlling for other individual-level and societal-level predictors including gender, immigrant background, the strength of tracking system. Although the positive impact of parental education on LCHS is also implied in Model 1 where only individual-level variables are employed, this association is no longer confirmed once country-level and cross-level variables are accounted for in Model 2 and Model 3. Likewise, while the magnitude of father's education seems to be significantly larger than that of mother's in Model 1, this difference becomes insignificant in other models.

Meanwhile, country-level variables as well as cross-level interaction terms

demonstrate an interesting contrast across educational specifications. In Model 2 where the degree of educational expansion and tracking is employed, the coefficients of educational expansion for HCHS and HCLS are positive. At the same time, interaction terms between educational expansion and mother's education show significant negative coefficients for both HCHS and HCLS, while the contribution of father's education to HCLS also becomes smaller associated with the higher degree of educational expansion. This implies that educational expansion operates as an equaliser in a way to generally improve the chance of obtaining high credentials whilst mitigating the impact of parental education (especially mother's education).

However, once the degree of skills diffusion is taken into account in Model 3, the positive effect of educational expansion on HCHS disappears whereas the societal-level skills diffusion demonstrates a positive association with it. Furthermore, the coefficient of interaction term between educational expansion and mother's education is no longer significant for HCHS, while interactions between skills diffusion and parental education (both mother's and father's) show significant negative coefficients. That is, as far as the chance of HCHS is concerned, skills diffusion, rather than educational expansion, seems to function as an equaliser.

As regards HCLS, the degree of educational expansion maintains its significant positive effect as a country-level predictor, and the coefficient of the interaction term with mother's education is still significantly negative. Yet, the negative coefficient of interaction between educational expansion and father's education is not confirmed in Model 3. Instead, more importantly, the interaction terms between skills diffusion and both mother's and father's education show significant negative coefficients. This suggests that, although educational expansion contributes to improving the probability of attaining high credentials per se (HCLS), skills diffusion operates more significantly in reducing the power of parental education and hence contributes to weakening intergenerational inequality.

Model 3 further indicates an interesting mechanism of the acquisition of high skills as well as high credentials. While the impact of educational expansion on LCHS is insignificant in Model 2, it becomes significantly negative in Model 3 in conjunction with the positive association between skills diffusion and LCHS. Assuming that these two country-level educational variables function as independent societal conditions (rather than mere aggregated data of individual-level educational credentials and skills), one may argue that educational expansion enhances the probability of possessing only high credentials unaccompanied by high skills (HCLS) whilst deteriorating the chance of obtaining high skills without high credentials (LCHS). In contrast, skills diffusion is associated with the high chance of gaining high skills regardless of educational attainment without undermining the acquisition of high credentials. This also implies the possibility that, as discussed in Chapter 2 focused on the allocation of labour market outcomes, the higher degree of skills diffusion is likely to contribute to realising a meritocratic society via mitigating the influence of parental education on children's educational outcomes whilst generally improving the probability of individuals attaining high skills.

This interpretation is still ad hoc supposition and requires further examinations, particularly given that the analytical approach here is a cross-national comparison and that the degree of educational expansion and that of skills diffusion are collective data based on individual educational specifications (i.e. not adequate to claim causality or change). In addition, the reason why skills diffusion contributes to the formation of a meritocratic society needs to be elaborated.[47] Nevertheless, in the sense that the

[47] Along with functionalist explanations (e.g. skills diffusion reflects the accumulation of human resources with adequate cognitive ability to make rational choices in a way to underpin a society where educational assets are allocated based on individuals' merit rather than origins), it is also important to explore other possibilities such as 1) education and socio-economic systems that enable the accumulation of highly skilled people (rather than skills diffusion per se) in each society operate as an equaliser, and 2) skills diffusion merely enhances the importance of other types of family backgrounds including parental skills and social/economic class (instead of parental education) and hence does not necessarily promote a fair system even though the impact of parental education as such diminishes.

nuanced association between societal educational conditions and individuals' educational attainment/skills acquisition is detectable only when educational attainment and skills are distinguished at both individual and societal levels, the analytical framework demonstrated in this chapter qualifies as an important perspective to investigate the OE association.

Although the current analysis therefore extends the frontier of IEO research, there remain important challenges to be addressed in future research. Firstly, the discussion in this section is based on the assumption that independent variables affect the formation of dependent variables. However, as explained earlier, this chapter employs a multilevel regression modelling using cross-country data and hence not elucidating causality or time-series change. In particular, given that country-level educational indicators are aggregated based on individual-level educational variables, more elaborated investigation into causal relationships is essential. In so doing, country-specific longitudinal analyses and their comparison, in conjunction with analyses by different social backgrounds such as cohort and immigrant background, could provide further insights into the OE association.

Secondly, as with the vast literature, this analysis utilises a retrospective approach instead of prospective one. However, as research has suggested (Breen and Ermisch 2017; Lawrence and Breen 2016; Song and Mare 2015), it is meaningful to pay close attention to the parental generation including those who do not have children lest we overrate the degree of intergenerational inequality.

Thirdly, variables would be extended by, for example, classifying high credentials based on their types including fields of study and prestige of institutions. Likewise, other dimensions of skills, such as social and emotional skills as well as occupation-specific skills, are worthy of investigation. In addition, it is important to examine the impact of parental skills, occupations, and incomes/earnings, in conjunction with educational attainment, in order to conclude what aspects of origins do (not) matter and

how their influences change in association with societal-level educational conditions.

Finally, while this research defines children's educational outcomes by adopting educational specifications as static assets of individuals, it is crucial to pay attention to the dynamics of obtaining educational credentials and skills. That is, given the possibility that individuals acquire credentials and skills at different times, two simple questions need to be further investigated: 1) to what extent and how credentials affect skills levels, and vice versa, and 2) how these relationships vary in association with origins as well as educational expansion and skills diffusion at a societal level.

I argue that, despite the said potential for further development, the contribution of this piece is significant as a new empirical approach to the OE association with close attention to both educational attainment and skills at individual and societal levels. In particular, it is worthwhile to recognise the possibility that skills diffusion operates as a different equaliser from educational expansion in a way to weaken the impact of parental education. It is time for sociologists of IEO to shift their focus from mere "opportunity" to broader educational outcomes of individuals and societies.[48]

[48] By replacing "opportunity" with "outcomes," one may call this new line of research "IEO 2.0."

Appendix

E. Multilevel Multinomial Logistic Regression of Educational Specifications (by Gender)

The tables below show the result of a multilevel multinomial logistic regression analysis of educational specifications for women and men. This analysis simply excludes a male dummy from equation (4) in the main manuscript. At the individual level, two results generally demonstrate a similar pattern except for the significant positive coefficient of immigrant background for men, which is not confirmed for women. It is also worthy of note that, as with the analysis of pooled data including both women and men, the contribution of parental education is significant for high credentials (both HCHS and HCLS) whereas there is no significant association between tertiary educated parents and the probability of obtaining only high skills unaccompanied by high credentials (LCHS).

However, there are several differences when it comes to country-level and cross-level variables. For example, in addition to the positive association between educational expansion and HCLS as indicated in the main manuscript, the coefficient of educational expansion is also significantly positive for HCHS only in the analysis of men. Furthermore, while the significant positive relationship between skills diffusion and HCHS/LCHS is confirmed for both women and men in line with the pooled data, men further witness the significant negative association between skills diffusion and HCLS.

Meanwhile, the strength of tracking demonstrates significant negative coefficients for high credentials (both HCHS and HCLS) only in the analysis of women. This suggests that women are less likely to attain tertiary education regardless of skills levels in societies that have developed relatively strong tracking systems. Here it is important to note that, despite the negative association between tracking and HCHS/HCLS, the probability of women obtaining secondary and post-secondary non tertiary education might be intensified by tracking, which is not included in the measure of high

credentials in this analysis.

In the meantime, paying attention to the interaction between societal-level educational conditions and parental education, the significant negative coefficient of the interaction term between educational expansion and tertiary educated mother is confirmed only for men (HCHS and HCLS). By contrast, women are more likely than men to witness the devaluation of mother's education associated with skills diffusion in terms of the probability of obtaining high credentials. While the negative coefficient of the interaction term between skills diffusion and father's education for HCHS exists for both women and men, the interaction between skills diffusion and mother's education demonstrates negative coefficients for HCHS and HCLS only in the analysis of women. These results suggest the possibility that, whereas educational expansion functions as an equaliser merely for men via mitigating the contribution of mother's education, skills diffusion weakens the advantage of having tertiary educated parents primarily for both women and men (especially women).

Although the gender difference is not the primary focus of this paper, the social mechanisms that generate these variances are important sociological puzzles to be further examined.

Independent Variable		Model 3' (Women)								
		HCHS			HCLS			LCHS		
		B		S.E.	B		S.E.	B		S.E.
Intercept		-3.675	***	0.325	-1.091	***	0.274	-4.628	***	0.439
Level One (Individual)	Age (35-39 years old dummy)	-0.100		0.059	-0.047		0.037	0.071		0.111
	First Generation Immigrant (dummy)	-0.923	***	0.102	-0.072		0.054	-0.668	**	0.200
	Tertiary Educated Mother (dummy)	1.804	***	0.453	1.661	***	0.323	1.714		0.954
	Tertiary Educated Father (dummy)	1.912	***	0.407	1.571	***	0.272	0.230		0.883
Cross-Level Interactions	Educational Expansion * Tertiary Educated Mother	0.002		0.012	-0.003		0.009	-0.007		0.026
	Educational Expansion * Tertiary Educated Father	0.001		0.011	-0.008		0.008	0.028		0.025
	Tracking * Tertiary Educated Mother	0.141		0.112	0.142		0.088	-0.028		0.210
	Tracking * Tertiary Educated Father	0.055		0.102	0.028		0.076	0.160		0.191
	Skills Diffusion * Tertiary Educated Mother	-0.049	*	0.020	-0.049	**	0.016	-0.055		0.044
	Skills Diffusion * Tertiary Educated Father	-0.040	*	0.018	-0.019		0.014	-0.037		0.040
Level Two (Country)	Educational Expansion	0.005		0.011	0.022	*	0.010	-0.022		0.015
	Index of Tracking	-0.209	*	0.094	-0.221	**	0.086	0.196		0.119
	Skills Diffusion	0.132	***	0.016	-0.009		0.015	0.177	***	0.023
Variance	Random Effect Covariance Structure (Intercept)	0.083 *			0.094 **			0.087		
Model Fit	-2LL	204844.206								
	AIC	204850.206								

(*** p<0.001, ** p<0.01, * p<0.05) [two tailed] [N: Individual=15,507, Country=26]

Independent Variable		Model 3' (Men)								
		HCHS			HCLS			LCHS		
		B		S.E.	B		S.E.	B		S.E.
Intercept		-4.475	***	0.337	-2.145	***	0.308	-3.809	***	0.369
Level One (Individual)	Age (35-39 years old dummy)	0.100		0.056	0.029		0.040	-0.006		0.081
	First Generation Immigrant (dummy)	-0.951	***	0.100	0.239	***	0.059	-0.931	***	0.164
	Tertiary Educated Mother (dummy)	2.531	***	0.399	2.172	***	0.308	0.720		0.659
	Tertiary Educated Father (dummy)	2.012	***	0.376	1.832	***	0.277	0.615		0.620
Cross-Level Interactions	Educational Expansion * Tertiary Educated Mother	-0.033	**	0.011	-0.035	***	0.009	0.002		0.017
	Educational Expansion * Tertiary Educated Father	0.008		0.011	-0.011		0.008	0.018		0.017
	Tracking * Tertiary Educated Mother	-0.112		0.101	-0.083		0.090	-0.044		0.156
	Tracking * Tertiary Educated Father	-0.162		0.091	-0.076		0.080	0.132		0.139
	Skills Diffusion * Tertiary Educated Mother	-0.024		0.018	-0.012		0.016	-0.013		0.030
	Skills Diffusion * Tertiary Educated Father	-0.064	***	0.017	-0.022		0.014	-0.043		0.029
Level Two (Country)	Educational Expansion	0.028	*	0.012	0.047	***	0.011	-0.025		0.013
	Index of Tracking	0.110		0.098	-0.008		0.097	0.025		0.108
	Skills Diffusion	0.130	***	0.018	-0.042	*	0.017	0.175	***	0.020
Variance	Random Effect Covariance Structure (Intercept)	0.105 *			0.119 **			0.109		
Model Fit	-2LL	185940.977								
	AIC	185946.977								

(*** p<0.001, ** p<0.01, * p<0.05) [two tailed] [N: Individual=14,777, Country=26]

Note: Data are unweighted.

F. Multilevel Multinomial Logistic Regression of Educational Specifications (without interaction terms between parental education and educational expansion/skills diffusion)

The table below summarises the result of a multilevel multinomial logistic regression analysis of educational specifications without interaction terms between parental education and educational expansion/skills diffusion. It is revealed that, while the interaction between parental education and tracking does not demonstrate significant associations with any educational specifications in the main manuscript, the ones between mother's education and tracking show significant positive coefficients for HCHS and HCLS. This means that, without accounting for the heterogeneity in the impact of parental education associated with educational expansion and skills diffusion, the advantage of having tertiary educated mothers is likely to be intensified in societies that have relatively strong tracking systems.

Independent Variable		Model 3''								
		HCHS			HCLS			LCHS		
		B		S.E.	B		S.E.	B		S.E.
Intercept		-4.049	***	0.302	-1.185	***	0.269	-4.664	***	0.346
Level One	Men (dummy)	0.051		0.040	-0.506	***	0.027	0.629	***	0.068
(Individual)	Age (35-39 years old dummy)	0.011		0.040	-0.008		0.027	0.014		0.065
	First Generation Immigrant (dummy)	-0.935	***	0.071	0.067		0.040	-0.849	***	0.127
	Tertiary Educated Mother (dummy)	1.195	***	0.058	0.915	***	0.046	0.714	***	0.095
	Tertiary Educated Father (dummy)	1.471	***	0.052	1.143	***	0.040	0.717	***	0.086
Cross-Level	Tracking * Tertiary Educated Mother	0.153	**	0.054	0.200	***	0.044	0.019		0.087
Interactions	Tracking * Tertiary Educated Father	-0.048		0.048	0.065		0.038	0.050		0.075
Level Two (Country)	Educational Expansion	0.020		0.011	0.029	**	0.010	-0.018		0.012
	Index of Tracking	-0.048		0.091	-0.165	*	0.084	0.113		0.101
	Skills Diffusion	0.117	***	0.016	-0.027		0.015	0.174	***	0.018
Variance	Random Effect Covariance Structure (Intercept)	0.083 *			0.094 **			0.087		
Model Fit	-2LL	390774.647								
	AIC	390780.647								

IV. Origins and Destinations

1. Introduction

Social inequality and mobility are one of the biggest concerns among social scientists and policy makers. The vast evidence has revealed that social origins significantly determine destinations, that is, people with advantaged socio-economic backgrounds are more likely than disadvantaged individuals to attain preferable socio-economic statuses such as better occupations and monetary rewards (e.g. Blau and Duncan 1967; Jencks et al. 1972; Sewell and Hauser 1975). As discussed in Chapter 3, among other things, sociologists have attempted to elucidate the mechanism of this intergenerational inequality through the framework focused on 1) parental education/occupations (origins), 2) children's education (education), and 3) children's occupations (destinations) in consideration of the consequence of educational expansion at a societal level (Bernardi and Ballarino 2016; Boudon 1974; Breen 2004; Bukodi and Goldthorpe 2019; Goldthorpe 2014).

This approach is called "OED triangle," and a variety of nuanced relationships have been empirically uncovered. As with IEO research (see Chapter 3), on the one hand, evidence has suggested that the impact of origins on destinations has been decreasing in response to educational expansion in several societies (Breen 2004, 2010; Breen and Jonsson 2007; Breen and Luijkx 2007; Devine and Li 2013; Gil-Hernández et al. 2017; Marks 2013; Pfeffer and Hertel 2015). On the other hand, in the case of Great Britain, researchers have argued that intergenerational inequality in terms of the link between parental statuses and children's outcomes has not weakened despite the increasing educational opportunity (Bukodi and Goldthorpe 2019; Goldthorpe and Jackson 2007; Goldthorpe and Mills 2008; Sturgis and Buscha 2015).

Although this line of research has greatly progressed our understanding of intergenerational social inequality and mobility, it is important to note that the OE association (Chapter 3) and the ED association (Chapter 2) are both significantly

influenced by not only the degree of educational expansion but also that of skills diffusion. This means that sociologists might have over/underestimated the impact of educational expansion by adopting the conventional OED approach, which has long overlooked the distinction between the accumulation of highly educated people and that of highly skilled people. It is therefore imperative to extend the framework demonstrated in the previous chapters, investigating the influence of societal-level skills diffusion and educational expansion on OD as well as OE and ED associations.

Specifically, in elucidating the OED triangle with the said perspectives, this chapter pays particular attention to the following two elements. Firstly, the direct effect of social origins (DESO) on destinations is carefully examined. Whereas the OD linkage is often illustrated as a compound of OE and ED with the assumption that education significantly mediates the association between origins and destinations, recent research has detected considerable DESO on children's socio-economic outcomes (Bernardi and Ballarino 2016; Breen, Karlson, and Holm 2013; Gil-Hernández et al. 2017; Gugushvili et al. 2017). Further, in addition to the static association between origins and destinations, the trend of DESO over time has been also investigated in various societies (Bernardi and Ballarino 2016; Passaretta et al. 2018). Nevertheless, as with the literature on OE and ED, the effect of skills diffusion on the variation in DESO has been inadequately taken into account. Thus, as detailed in the following sections, I shed light on how DESO differs depending on the degree of skills diffusion as well as educational expansion.

Secondly, the heterogeneity in impact of origins across different educational groups is also carefully investigated. This perspective is important given that evidence has revealed that the influence of parental statuses is relatively small among individuals with higher educational attainment as compared with less educated people (Breen and Jonsson 2007; Gil-Hernández et al. 2017; Hout 1988; Mastekaasa 2011; Pfeffer and Hertel 2015; Torche 2011, 2018). Should this be the case even after accounting for

skills as well as credentials at both individual and societal levels, the overall OD association (at least the one mediated by education) is expected to be smaller due to societal educational expansion and skills diffusion. By contrast, there is also a possibility that the effect of origins is intensified within highly educated individuals or demonstrates a U-shaped pattern across educational levels (Falcon and Bataille 2018; Torche 2011). This may happen, for example, when individuals with post-graduate qualifications and/or high skills are more likely to make use of their parental socio-economic statuses in competing for better labour market outcomes. In such circumstances, while the OE and ED associations might become smaller in societies where the degree of educational expansion and skills diffusion is relatively high, the overall OD association does not necessarily deteriorate as origins still operate especially among highly educated/skilled individuals in a way to retain larger returns to credentials and skills. To test these contradictory perspectives, as detailed in the following sections, it is necessary to investigate the dispersion in impact of parental statuses across different educational specifications via employing three-way interactions between societal-level educational expansion/skills diffusion, origins, and children's education as predictors of destinations.

Against such a backdrop, this chapter sheds light on the OD association with close attention to DESO and the heterogeneity in parental influences on economic rewards across educational groups, in consideration of societal-level educational expansion and skills diffusion as well as individual-level educational specifications.

2. The Association between Origins and Destinations

The so-called OED triangle has been used in the vast literature to conceptualise and empirically analyse the mechanism and trend of social inequality and mobility (Bernardi and Ballarino 2016; Boudon 1974; Breen 2004; Goldthorpe 2014; Ishida et al. 1995). In so doing, social scientists have developed various methodologies including

the Blau and Duncan status attainment model (Blau and Duncan 1967), mediation analysis involving nonlinear models (e.g. Albert 2012; Breen and Karlson 2014; Breen et al. 2013; Imai, Keele, and Tingley 2010; Imai, Keele, and Yamamoto 2010; Karlson and Holm 2011), and more descriptive decomposition approaches (e.g. Bloome, Dyer, and Zhou 2018). Using these frameworks, in addition to delineating the OE association (see Chapter 3) and the ED association (see Chapter 2) respectively based on the assumption that the influence of origins on destinations is mediated by children's education, the direct OD association (DESO) has been also examined in many societies.

Bernardi and Ballarino (2016), for example, conducted a comparative study of DESO in 14 countries to reveal that origins significantly affected destinations even after accounting for the mediation by children's education, indicating the importance of paying attention to DESO as well as the OE and ED associations. From a time-series perspective, they also concluded that DESO had been persistent in most societies with the exception of four countries, two of which witnessed the weakening DESO whereas DESO was intensified in the other two countries. Further, they argued that the impact of origins seemed to be stronger at a later stage in individuals' working history as compared with their early career. Likewise, Gugushvili et al. (2017) focused on the case of Britain, confirming the existence of persistent DESO. Nevertheless, they also pointed out the possibility that continuing education mediated the OD association and hence the relatively strong DESO in later-life, demonstrated by Bernardi and Ballarino (2016), could be an overestimation. Meanwhile, shedding light on the gender difference in Spain, Gil-Hernández et al. (2017) figured out that DESO had been stable among men while women witnessed the decreasing DESO over time.

In the meantime, incorporating the aforementioned approaches, the total effects of origins on destinations and their elasticity associated with educational expansion have been investigated by a large volume of research. As discussed earlier, some research has argued that the overall association between parental statuses and children's socio-

economic outcomes has been stable and/or fluctuating despite the progress of educational expansion that has enhanced educational opportunities across social origins (Bukodi and Goldthorpe 2019; Goldthorpe and Jackson 2007; Goldthorpe and Mills 2008; Sturgis and Buscha 2015). On the other, researchers have reported that the impact of origins on destinations has been diminishing in many societies (Breen 2004, 2010; Breen and Jonsson 2007; Breen and Luijkx 2007; Devine and Li 2013; Gil-Hernández et al. 2017; Marks 2013; Pfeffer and Hertel 2015).

In addition, paying attention not only to the average effect but also to the heterogeneity across different educational groups, evidence has also suggested that the influence of parental statuses is relatively small among individuals with high educational attainment as compared to less educated people (Breen and Jonsson 2007; Gil-Hernández et al. 2017; Hout 1988; Mastekaasa 2011; Pfeffer and Hertel 2015; Torche 2018). These findings imply that, as long as the difference in impact of family backgrounds between highly educated and less educated groups is stable, intergenerational inequality is expected to decrease in response to the expansion of higher-level education in a given society. Nevertheless, if highly educated people are more likely to make use of their parental assets to secure better occupations and monetary rewards (Falcon and Bataille 2018; Torche 2011), the impact of origins becomes larger among individuals with high educational attainment (or at least forms a U-shaped pattern), leading to the persistent OD association overall. Likewise, considering the possibility that the advantaged are more likely than the disadvantaged to complete higher-level education without dropping out after their entry (Bloome et al. 2018; Bowen, Chingos, and McPherson 2009; Ciocca Eller and DiPrete 2018), one may also assume that the total OD association might be maintained due to the relatively high/low completion rate of individuals with advantaged/disadvantaged backgrounds, which cannot be detected by focusing merely on the OE and ED associations respectively.

Here it is important to note that sociologists have traditionally investigated social class (occupations) rather than monetary rewards (earnings and income), which have been primarily scrutinised by economists (Torche 2015). However, as discussed in Chapter 2, recent research has demonstrated the importance of shedding light on monetary outcomes in the context of social inequality and mobility (Blanden, Gregg, and Macmillan 2013; Bloome et al. 2018; Breen, Mood, and Jonsson 2016; Gregg et al. 2017; Hällsten and Thaning 2018; Mood 2017; Rothstein 2019; Sirniö, Martikainen, and Kauppinen 2016; Torche 2015; Witteveen and Attewell 2017; Zimmerman 2019). Bloome et al. (2018), for instance, analysed intergenerational income inequality as well as educational inequality using their newly developed tool to reveal that the association between origins and children's monetary outcome had been stable as a consequence of the interaction between increasing educational inequality, growing returns to education, educational expansion, and the decreasing influence of parental income within educational groups.

Although various dimensions of the OD association, including DESO and the heterogeneous impact of origins across different educational groups, have been elucidated as above, there are two essential aspects to be further investigated. Firstly, skills diffusion should be taken into account as a different societal condition from educational expansion. One of the theoretical backgrounds behind the observed change in DESO is that educational expansion has caused some societal transformations in a way to strengthen/mitigate the importance of capital that have benefited individuals with advantaged backgrounds in securing their preferable destinations (Gil-Hernández et al. 2017; Triventi 2013b). However, given the fact that skills diffusion emerges as a different societal phenomenon from educational expansion and that these two educational conditions concurrently operate in forming the OE and ED associations in a different manner (see Chapter 3 and Chapter 2), it is worthwhile examining the impact of both skills diffusion and educational expansion on the OD association. Furthermore,

another line of research has argued that DESO has decreased because of the structural change in the labour market (i.e. the expansion of the tertiary sector) that has promoted chances of obtaining better occupations regardless of origins (Gil-Hernández et al. 2017). Nevertheless, considering the discussion on skill-biased technological change whereby industrial transformations have occurred in conjunction with the increasing demand for high skills (Autor et al. 2003; Berman et al. 1998; Katz and Murphy 1992), occupational opportunities might not be enhanced along with the advancement of industry as long as it progresses without the accumulation of highly skilled human resources, resulting in the persistent DESO. It is therefore important to investigate the influence of skills diffusion before concluding that the shift in DESO is caused by the structural change of the world of work.

Secondly, individual educational specifications, as defined by the combination of credentials and skills, should be taken into account. While previous research on the OD association has quantified individual education primarily by the level of credentials or years of schooling, it is imperative to pay attention to both credentials and skills, provided that the ED and OE associations significantly vary in accordance with educational specifications (see Chapter 2 and Chapter 3). Indeed, Sullivan et al. (2018b) argued that, once cognitive skills (quartiles of test scores) were accounted for in addition to educational attainment, the influence of origins on occupations seemed to be fully mediated by education (i.e. there was no DESO). Meanwhile, Gugushvili et al. (2017) suggested the possibility that cognitive ability mediated the association between origins and destinations by benefiting advantaged children even though they failed to obtain high educational attainment. Should this be the case, the interaction between parental statuses and what I call LCHS (i.e. the possession of high skills unaccompanied by high credentials) should demonstrate a significant positive effect on economic rewards. However, this supposition has not been empirically tested, and more importantly, the impact of societal educational expansion and skills diffusion on this

relationship (i.e. how the effect of these interactions on destinations would differ depending on societal-level educational conditions) has remained undetected. Moreover, from the perspective of skill-biased technological change as mentioned above, the analysis incorporating actual skills in addition to educational attainment is also indispensable.

By addressing these research gaps, it becomes possible to better understand the social structure and mechanism that affect the association between origins, credentials, skills, and labour market outcomes. Thus, this chapter extends the framework demonstrated in Chapter 2 and Chapter 3 to elucidate the OD association with particular attention to DESO and the heterogeneity across different educational groups, in consideration of individual-level educational specifications as well as societal-level educational expansion and skills diffusion.

3. Data and Method

In line with Chapter 2 and Chapter 3, this chapter also utilises the PIAAC data to conduct multilevel regression analyses (generalised linear mixed models). As regards the dependent variables (i.e. destinations), both skilled occupations (dummy) and earnings (quintiles) are employed. In the meantime, as with Chapter 2, it is worthwhile to examine the OD association using continuous variables as outcomes. I therefore describe the analysis of categorical dependent variables in the main manuscript, while the result with continuous ones are shown in Appendix.

In terms of independent variables concerning origins, one typical approach is to use parental occupations and/or monetary statuses. However, the PIAAC dataset does not include such information as explained in the previous chapters, and hence this chapter also employs parental education (i.e. a tertiary educated mother dummy and a tertiary educated father dummy respectively) as measures of origins. This operationalisation is particularly important given that some evidence has shown the

significant direct effect of parental education on destinations even after controlling for parental social class and other key variables (Gugushvili et al. 2017). [49]

Meanwhile, with regard to children's education, I use educational specifications as defined by the combination of credentials and skills (i.e. whether individuals possess both high credentials and high skills: HCHS, only high credentials without high skills: HCLS, only high skills unaccompanied by high credentials: LCHS, or neither of them: LCLS). Other individual-level predictors include gender, age, immigration, and work experience in line with the analysis of labour market outcomes (see Chapter 2).

Country-level independent variables also follow Chapter 2. Specifically, in addition to the degree of educational expansion and skills diffusion (i.e. the share of tertiary graduates and that of those whose PIAAC mean score of literacy and numeracy is 326 and above in each country), the strength of tracking system, macroeconomic performance (GDP per capita), economic structures (the share of manufacturing and service industry as percent of GDP), and union density are employed. The number of samples in each target country and descriptive statistics are shown in Table II-1 and Table II-3.

With the said variables as well as the focus of this chapter in mind, multilevel logistic regression analyses (binary for skilled occupations and ordered for earnings quintiles) are conducted. Specific models are as follows.

In Model 1, only individual-level independent variables are used. One significant difference from Model 1 in Chapter 2 is that educational specifications are excluded in this analysis (see equations (1a) and (1b) below) to examine the overall OD association including the indirect effect mediated by education.

[49] Nevertheless, as discussed in chapter 3, it is important to carefully interpret the effect of parental education in this analysis given the possibility that mother's education and father's education operate as proxies of other dimensions of social origins such as economic, cultural, and social capital as well as skills that parents possess.

Skilled Occupations

$$\log\left(\frac{p_{ij}}{1-p_{ij}}\right) = b_{0j} + b_1 M_{ij} + b_2 A_{ij} + b_3 I_{ij} + b_4 ME_{ij} + b_5 FE_{ij} + b_6 W_{ij} + \varepsilon_{ij} \cdots (1a)$$

where *i*=level one (individual), *j*=level two (country), p_{ij}=the probability of obtaining skilled occupations for individual i in country j, b_n=coefficient of individual level independent variables, M_{ij}=men dummy, A_{ij}=late-thirties dummy, I_{ij}=immigrant dummy, ME_{ij}=mother's education (tertiary dummy), FE_{ij}=father's education (tertiary dummy), W_{ij}=years of paid work, and ε_{ij}=residual for individual *i* in country *j*. In this model, I simply focus on b_4 and b_5 (and their marginal effects) that imply the total effect of parental education on the probability of obtaining skilled occupations.

Earnings

$$Y_{ij}^* = \beta_{0j} + \beta_1 M_{ij} + \beta_2 A_{ij} + \beta_3 I_{ij} + \beta_4 ME_{ij} + \beta_5 FE_{ij} + \beta_6 W_{ij} + \varepsilon_{ij} \cdots (1b)$$

where β_n=coefficient of individual level independent variables, Y_{ij}^*=latent response for individual *i* in country *j*, and an observed response Y_{ij} (earnings quintiles) can be determined by thresholds (τ_n) as following. Other abbreviations are the same as equation (1a).

$$Y_{ij} = \begin{cases} 1 \text{ if } & Y_{ij}^* \le \tau_1 \\ 2 \text{ if } & \tau_1 < Y_{ij}^* \le \tau_2 \\ 3 \text{ if } & \tau_2 < Y_{ij}^* \le \tau_3 \\ 4 \text{ if } & \tau_3 < Y_{ij}^* \le \tau_4 \\ 5 \text{ if } & \tau_4 < Y_{ij}^* \end{cases}$$

Model 2 adds country-level variables (except for the degree of skills diffusion) and four interaction terms between parental education and the degree of educational

expansion and tracking (tertiary educated mother/father dummies * educational expansion/tracking) to Model 1. This provides some evidence about how the overall OD association varies depending on the difference in societal educational conditions.

Skilled Occupations

$$b_{0j}(\text{in equation (1a)}) = \gamma_{00} + \gamma_{01}E_j + \gamma_{02}T_j + \gamma_{03}G_j + \gamma_{04}Em_j + \gamma_{05}Es_j + \gamma_{06}U_j + u_{0j} \cdots (2a)$$

where γ_{00}=average intercept, γ_{0n}=coefficient of country level independent variables, E_j=the degree of educational expansion, T_j=the index of tracking, G_j=GDP per capita, Em_j=the share of manufacturing, Es_j=the share of service, U_j=union density, and u_{0j}=country (j) dependent deviation. Here I substitute equation (2a) into equation (1a) and denote b_n by γ_{n0} whilst adding four interaction terms between parental education (*ME* and *FE*) and societal educational conditions (*E* and *T*). Coefficients γ_{41} and γ_{51} in tandem with γ_{40} and γ_{50} explain the variation in the overall OD association in accordance with the degree of educational expansion.

$$\begin{aligned}\log\left(\frac{p_{ij}}{1-p_{ij}}\right) = {} & \gamma_{00} + \gamma_{10}M_{ij} + \gamma_{20}A_{ij} + \gamma_{30}I_{ij} + \gamma_{40}ME_{ij} + \gamma_{50}FE_{ij} + \gamma_{60}W_{ij} + \gamma_{01}E_j + \gamma_{02}T_j \\ & + \gamma_{03}G_j + \gamma_{04}Em_j + \gamma_{05}Es_j + \gamma_{06}U_j + \gamma_{41}ME_{ij}E_j + \gamma_{51}FE_{ij}E_j + \gamma_{42}ME_{ij}T_j \\ & + \gamma_{52}FE_{ij}T_j + u_{0j} + \varepsilon_{ij} \cdots (3a)\end{aligned}$$

Earnings

$$\beta_{0j}(\text{in equation (1b)}) = \gamma_{00} + \gamma_{01}E_j + \gamma_{02}T_j + \gamma_{03}G_j + \gamma_{04}Em_j + \gamma_{05}Es_j + \gamma_{06}U_j + u_{0j} \cdots (2b)$$

Taking the same steps as the occupation analysis, Model 2 of the earnings analysis can be described as follows.

$$Y_{ij}^{*} = \gamma_{00} + \gamma_{10}M_{ij} + \gamma_{20}A_{ij} + \gamma_{30}I_{ij} + \gamma_{40}ME_{ij} + \gamma_{50}FE_{ij} + \gamma_{60}W_{ij} + \gamma_{01}E_j + \gamma_{02}T_j + \gamma_{03}G_j + \gamma_{04}Em_j + \gamma_{05}Es_j + \gamma_{06}U_j + \gamma_{41}ME_{ij}E_j + \gamma_{51}FE_{ij}E_j + \gamma_{42}ME_{ij}T_j + \gamma_{52}FE_{ij}T_j + u_{0j} + \varepsilon_{ij} \cdots (3b)$$

Model 3 further adds the degree of skills diffusion (*S*) and two interaction terms between this country-level variable (*S*) and parental education (*ME* and *FE*). In addition to γ_{41} and γ_{51} as well as γ_{40} and γ_{50}, γ_{43} and γ_{53} in equations (4a) and (4b) illustrate the difference in impact of two societal educational conditions (educational expansion and skills diffusion) on the overall OD association.

Skilled Occupations

$$\log\left(\frac{p_{ij}}{1-p_{ij}}\right) = \gamma_{00} + \gamma_{10}M_{ij} + \gamma_{20}A_{ij} + \gamma_{30}I_{ij} + \gamma_{40}ME_{ij} + \gamma_{50}FE_{ij} + \gamma_{60}W_{ij} + \gamma_{01}E_j + \gamma_{02}T_j + \gamma_{03}S_j + \gamma_{04}G_j + \gamma_{05}Em_j + \gamma_{06}Es_j + \gamma_{07}U_j + \gamma_{41}ME_{ij}E_j + \gamma_{51}FE_{ij}E_j + \gamma_{42}ME_{ij}T_j + \gamma_{52}FE_{ij}T_j + \gamma_{43}ME_{ij}S_j + \gamma_{53}FE_{ij}S_j + u_{0j} + \varepsilon_{ij} \cdots (4a)$$

Earnings

$$Y_{ij}^{*} = \gamma_{00} + \gamma_{10}M_{ij} + \gamma_{20}A_{ij} + \gamma_{30}I_{ij} + \gamma_{40}ME_{ij} + \gamma_{50}FE_{ij} + \gamma_{60}W_{ij} + \gamma_{01}E_j + \gamma_{02}T_j + \gamma_{03}S_j + \gamma_{04}G_j + \gamma_{05}Em_j + \gamma_{06}Es_j + \gamma_{07}U_j + \gamma_{41}ME_{ij}E_j + \gamma_{51}FE_{ij}E_j + \gamma_{42}ME_{ij}T_j + \gamma_{52}FE_{ij}T_j + \gamma_{43}ME_{ij}S_j + \gamma_{53}FE_{ij}S_j + u_{0j} + \varepsilon_{ij} \cdots (4b)$$

Based on the understanding of the overall OD association, Model 4 employs individual-level educational variables (i.e. educational specifications) and interactions between educational specifications and societal educational conditions (the degree of educational expansion, tracking, and skills diffusion) as follows.

Skilled Occupations

$$\log\left(\frac{p_{ij}}{1-p_{ij}}\right) = \gamma_{00} + \gamma_{10}M_{ij} + \gamma_{20}A_{ij} + \gamma_{30}I_{ij} + \gamma_{40}ME_{ij} + \gamma_{50}FE_{ij} + \gamma_{60}W_{ij} + \gamma_{70}HCHS_{ij}$$
$$+ \gamma_{80}HCLS_{ij} + \gamma_{90}LCHS_{ij} + \gamma_{01}E_j + \gamma_{02}T_j + \gamma_{03}S_j + \gamma_{04}G_j + \gamma_{05}Em_j + \gamma_{06}Es_j$$
$$+ \gamma_{07}U_j + \gamma_{41}ME_{ij}E_j + \gamma_{51}FE_{ij}E_j + \gamma_{42}ME_{ij}T_j + \gamma_{52}FE_{ij}T_j + \gamma_{43}ME_{ij}S_j$$
$$+ \gamma_{53}FE_{ij}S_j + \gamma_{71}HCHS_{ij}E_j + \gamma_{81}HCLS_{ij}E_j + \gamma_{91}LCHS_{ij}E_j + \gamma_{72}HCHS_{ij}T_j$$
$$+ \gamma_{82}HCLS_{ij}T_j + \gamma_{92}LCHS_{ij}T_j + \gamma_{73}HCHS_{ij}S_j + \gamma_{83}HCLS_{ij}S_j + \gamma_{93}LCHS_{ij}S_j$$
$$+ u_{0j} + \varepsilon_{ij} \cdots (5a)$$

Earnings

$$Y_{ij}^{*} = \gamma_{00} + \gamma_{10}M_{ij} + \gamma_{20}A_{ij} + \gamma_{30}I_{ij} + \gamma_{40}ME_{ij} + \gamma_{50}FE_{ij} + \gamma_{60}W_{ij} + \gamma_{70}HCHS_{ij} + \gamma_{80}HCLS_{ij}$$
$$+ \gamma_{90}LCHS_{ij} + \gamma_{01}E_j + \gamma_{02}T_j + \gamma_{03}S_j + \gamma_{04}G_j + \gamma_{05}Em_j + \gamma_{06}Es_j + \gamma_{07}U_j$$
$$+ \gamma_{41}ME_{ij}E_j + \gamma_{51}FE_{ij}E_j + \gamma_{42}ME_{ij}T_j + \gamma_{52}FE_{ij}T_j + \gamma_{43}ME_{ij}S_j + \gamma_{53}FE_{ij}S_j$$
$$+ \gamma_{71}HCHS_{ij}E_j + \gamma_{81}HCLS_{ij}E_j + \gamma_{91}LCHS_{ij}E_j + \gamma_{72}HCHS_{ij}T_j + \gamma_{82}HCLS_{ij}T_j$$
$$+ \gamma_{92}LCHS_{ij}T_j + \gamma_{73}HCHS_{ij}S_j + \gamma_{83}HCLS_{ij}S_j + \gamma_{93}LCHS_{ij}S_j + u_{0j} + \varepsilon_{ij} \cdots (5b)$$

where $HCHS_{ij}$=HCHS dummy, $HCLS_{ij}$=HCLS dummy, and $LCHS_{ij}$=LCHS dummy. γ_{40} and γ_{50} in equations (5a) and (5b) imply the direct effect of social origins (DESO) after accounting for the impact mediated by educational specifications. Furthermore, γ_{41}, γ_{51}, γ_{43} and γ_{53} suggest how DESO in terms of the influence of parental education on economic rewards differs depending on the degree of societal-level educational expansion and skills diffusion. Here it is important to note that several methods enable an elaborate investigation of DESO as well as the indirect effect mediated by education at an individual level (e.g. Breen et al. 2013; Karlson and Holm 2011). Thus, while this chapter employs an multilevel modelling to examine DESO by simply controlling for educational variables in accordance with recent research (e.g. Gugushvili et al. 2017),

a more elegant decomposition as demonstrated by Breen et al. (2013), for example, is one direction of future research.

In Model 5, paying attention to the heterogeneity in impact of parental education across educational specifications, six interaction terms between parental education (*ME* and *FE)* and educational specifications (*HCHS*, *HCLS*, and *LCHS*) are included in the analysis. Coefficients γ_{470}, γ_{480}, γ_{490}, γ_{570}, γ_{580} and γ_{590} in equations (6a) and (6b) demonstrate how the effects of origins on economic rewards differ depending on credentials and skills that individuals possess.

Skilled Occupations

$$\log\left(\frac{p_{ij}}{1-p_{ij}}\right) = \gamma_{00} + \gamma_{10}M_{ij} + \gamma_{20}A_{ij} + \gamma_{30}I_{ij} + \gamma_{40}ME_{ij} + \gamma_{50}FE_{ij} + \gamma_{60}W_{ij} + \gamma_{70}HCHS_{ij} + \gamma_{80}HCLS_{ij} + \gamma_{90}LCHS_{ij} + \gamma_{470}ME_{ij}HCHS_{ij} + \gamma_{480}ME_{ij}HCLS_{ij} + \gamma_{490}ME_{ij}LCHS_{ij} + \gamma_{570}FE_{ij}HCHS_{ij} + \gamma_{580}FE_{ij}HCLS_{ij} + \gamma_{590}FE_{ij}LCHS_{ij} + \gamma_{01}E_j + \gamma_{02}T_j + \gamma_{03}S_j + \gamma_{04}G_j + \gamma_{05}Em_j + \gamma_{06}Es_j + \gamma_{07}U_j + \gamma_{41}ME_{ij}E_j + \gamma_{51}FE_{ij}E_j + \gamma_{42}ME_{ij}T_j + \gamma_{52}FE_{ij}T_j + \gamma_{43}ME_{ij}S_j + \gamma_{53}FE_{ij}S_j + \gamma_{71}HCHS_{ij}E_j + \gamma_{81}HCLS_{ij}E_j + \gamma_{91}LCHS_{ij}E_j + \gamma_{72}HCHS_{ij}T_j + \gamma_{82}HCLS_{ij}T_j + \gamma_{92}LCHS_{ij}T_j + \gamma_{73}HCHS_{ij}S_j + \gamma_{83}HCLS_{ij}S_j + \gamma_{93}LCHS_{ij}S_j + u_{0j} + \varepsilon_{ij} \cdots (6a)$$

Earnings

$$Y_{ij}^{*} = \gamma_{00} + \gamma_{10}M_{ij} + \gamma_{20}A_{ij} + \gamma_{30}I_{ij} + \gamma_{40}ME_{ij} + \gamma_{50}FE_{ij} + \gamma_{60}W_{ij} + \gamma_{70}HCHS_{ij} + \gamma_{80}HCLS_{ij} + \gamma_{90}LCHS_{ij} + \gamma_{470}ME_{ij}HCHS_{ij} + \gamma_{480}ME_{ij}HCLS_{ij} + \gamma_{490}ME_{ij}LCHS_{ij} + \gamma_{570}FE_{ij}HCHS_{ij} + \gamma_{580}FE_{ij}HCLS_{ij} + \gamma_{590}FE_{ij}LCHS_{ij} + \gamma_{01}E_j + \gamma_{02}T_j + \gamma_{03}S_j + \gamma_{04}G_j + \gamma_{05}Em_j + \gamma_{06}Es_j + \gamma_{07}U_j + \gamma_{41}ME_{ij}E_j + \gamma_{51}FE_{ij}E_j + \gamma_{42}ME_{ij}T_j + \gamma_{52}FE_{ij}T_j + \gamma_{43}ME_{ij}S_j + \gamma_{53}FE_{ij}S_j + \gamma_{71}HCHS_{ij}E_j + \gamma_{81}HCLS_{ij}E_j + \gamma_{91}LCHS_{ij}E_j + \gamma_{72}HCHS_{ij}T_j + \gamma_{82}HCLS_{ij}T_j + \gamma_{92}LCHS_{ij}T_j + \gamma_{73}HCHS_{ij}S_j + \gamma_{83}HCLS_{ij}S_j + \gamma_{93}LCHS_{ij}S_j + u_{0j} + \varepsilon_{ij} \cdots (6b)$$

Finally, Model 6 employs three-way interaction terms between societal educational conditions (*E*, *T*, and *S*), parental education (*ME* and *FE*), and educational specifications (*HCHS*, *HCLS*, and *LCHS*). Coefficients from γ_{471} to γ_{593} in equations (7a) and (7b) as well as other individual-level and cross-level interaction terms make it possible to reveal how the effects of interaction between origins and educational specifications vary in association with societal educational conditions, whilst examining DESO on destinations net of other key predictors at both individual and societal levels. In addition, only for the earnings analysis (as Model 7), individual-level occupational variables ($\gamma_{100}So_{ij}, \gamma_{110}Sw_{ij},$ and $\gamma_{120}Sb_{ij}$) are further employed to examine the (in)consistency with the result of Model 6.

Skilled Occupations

$$\begin{aligned}\log\left(\frac{p_{ij}}{1-p_{ij}}\right) = {} & \gamma_{00} + \gamma_{10}M_{ij} + \gamma_{20}A_{ij} + \gamma_{30}I_{ij} + \gamma_{40}ME_{ij} + \gamma_{50}FE_{ij} + \gamma_{60}W_{ij} + \gamma_{70}HCHS_{ij} \\ & + \gamma_{80}HCLS_{ij} + \gamma_{90}LCHS_{ij} + \gamma_{470}ME_{ij}HCHS_{ij} + \gamma_{480}ME_{ij}HCLS_{ij} \\ & + \gamma_{490}ME_{ij}LCHS_{ij} + \gamma_{570}FE_{ij}HCHS_{ij} + \gamma_{580}FE_{ij}HCLS_{ij} + \gamma_{590}FE_{ij}LCHS_{ij} \\ & + \gamma_{01}E_j + \gamma_{02}T_j + \gamma_{03}S_j + \gamma_{04}G_j + \gamma_{05}Em_j + \gamma_{06}Es_j + \gamma_{07}U_j + \gamma_{41}ME_{ij}E_j \\ & + \gamma_{51}FE_{ij}E_j + \gamma_{42}ME_{ij}T_j + \gamma_{52}FE_{ij}T_j + \gamma_{43}ME_{ij}S_j + \gamma_{53}FE_{ij}S_j + \gamma_{71}HCHS_{ij}E_j \\ & + \gamma_{81}HCLS_{ij}E_j + \gamma_{91}LCHS_{ij}E_j + \gamma_{72}HCHS_{ij}T_j + \gamma_{82}HCLS_{ij}T_j + \gamma_{92}LCHS_{ij}T_j \\ & + \gamma_{73}HCHS_{ij}S_j + \gamma_{83}HCLS_{ij}S_j + \gamma_{93}LCHS_{ij}S_j + \gamma_{471}ME_{ij}HCHS_{ij}E_j \\ & + \gamma_{481}ME_{ij}HCLS_{ij}E_j + \gamma_{491}ME_{ij}LCHS_{ij}E_j + \gamma_{571}FE_{ij}HCHS_{ij}E_j \\ & + \gamma_{581}FE_{ij}HCLS_{ij}E_j + \gamma_{591}FE_{ij}LCHS_{ij}E_j + \gamma_{472}ME_{ij}HCHS_{ij}T_j \\ & + \gamma_{482}ME_{ij}HCLS_{ij}T_j + \gamma_{492}ME_{ij}LCHS_{ij}T_j + \gamma_{572}FE_{ij}HCHS_{ij}T_j \\ & + \gamma_{582}FE_{ij}HCLS_{ij}T_j + \gamma_{592}FE_{ij}LCHS_{ij}T_j + \gamma_{473}ME_{ij}HCHS_{ij}S_j \\ & + \gamma_{483}ME_{ij}HCLS_{ij}S_j + \gamma_{493}ME_{ij}LCHS_{ij}S_j + \gamma_{573}FE_{ij}HCHS_{ij}S_j \\ & + \gamma_{583}FE_{ij}HCLS_{ij}S_j + \gamma_{593}FE_{ij}LCHS_{ij}S_j + u_{0j} + \varepsilon_{ij} \cdots (7a)\end{aligned}$$

Earnings

$$
\begin{aligned}
Y_{ij}^{*} = {} & \gamma_{00} + \gamma_{10}M_{ij} + \gamma_{20}A_{ij} + \gamma_{30}I_{ij} + \gamma_{40}ME_{ij} + \gamma_{50}FE_{ij} + \gamma_{60}W_{ij} + \gamma_{70}HCHS_{ij} + \gamma_{80}HCLS_{ij} \\
& + \gamma_{90}LCHS_{ij} + \gamma_{470}ME_{ij}HCHS_{ij} + \gamma_{480}ME_{ij}HCLS_{ij} + \gamma_{490}ME_{ij}LCHS_{ij} \\
& + \gamma_{570}FE_{ij}HCHS_{ij} + \gamma_{580}FE_{ij}HCLS_{ij} + \gamma_{590}FE_{ij}LCHS_{ij} + \gamma_{01}E_j + \gamma_{02}T_j + \gamma_{03}S_j \\
& + \gamma_{04}G_j + \gamma_{05}Em_j + \gamma_{06}Es_j + \gamma_{07}U_j + \gamma_{41}ME_{ij}E_j + \gamma_{51}FE_{ij}E_j + \gamma_{42}ME_{ij}T_j \\
& + \gamma_{52}FE_{ij}T_j + \gamma_{43}ME_{ij}S_j + \gamma_{53}FE_{ij}S_j + \gamma_{71}HCHS_{ij}E_j + \gamma_{81}HCLS_{ij}E_j \\
& + \gamma_{91}LCHS_{ij}E_j + \gamma_{72}HCHS_{ij}T_j + \gamma_{82}HCLS_{ij}T_j + \gamma_{92}LCHS_{ij}T_j + \gamma_{73}HCHS_{ij}S_j \\
& + \gamma_{83}HCLS_{ij}S_j + \gamma_{93}LCHS_{ij}S_j + \gamma_{471}ME_{ij}HCHS_{ij}E_j + \gamma_{481}ME_{ij}HCLS_{ij}E_j \\
& + \gamma_{491}ME_{ij}LCHS_{ij}E_j + \gamma_{571}FE_{ij}HCHS_{ij}E_j + \gamma_{581}FE_{ij}HCLS_{ij}E_j \\
& + \gamma_{591}FE_{ij}LCHS_{ij}E_j + \gamma_{472}ME_{ij}HCHS_{ij}T_j + \gamma_{482}ME_{ij}HCLS_{ij}T_j \\
& + \gamma_{492}ME_{ij}LCHS_{ij}T_j + \gamma_{572}FE_{ij}HCHS_{ij}T_j + \gamma_{582}FE_{ij}HCLS_{ij}T_j \\
& + \gamma_{592}FE_{ij}LCHS_{ij}T_j + \gamma_{473}ME_{ij}HCHS_{ij}S_j + \gamma_{483}ME_{ij}HCLS_{ij}S_j \\
& + \gamma_{493}ME_{ij}LCHS_{ij}S_j + \gamma_{573}FE_{ij}HCHS_{ij}S_j + \gamma_{583}FE_{ij}HCLS_{ij}S_j \\
& + \gamma_{593}FE_{ij}LCHS_{ij}S_j + u_{0j} + \varepsilon_{ij} \cdots (7\text{b})
\end{aligned}
$$

4. Results

Table IV-1 summarises the results of Model 1 to Model 3 of occupation analysis. In these models, educational specifications are excluded from independent variables to examine the overall association between origins (parental education) and children's occupations. Model 1 employs only individual-level predictors, revealing that both mother's education and father's education (tertiary educated dummies) show significant positive effects on the probability of obtaining skilled occupations at 0.1% level. In particular, the impact of father's education is much larger than that of mother's education and this difference is statistically significant.[50] Nonetheless, it is important to note that this heterogeneity in impact between mother's education and father's education is no longer significant in other models where country-level variables as well

[50] As with Chapter 2 and Chapter 3, the significance of differences in coefficients (marginal effects) is tested by changing the reference with the 5% significance level unless otherwise stated.

as interaction terms are taken into account, while the significance of main effects of parental education is confirmed regardless of analytical models as explained below. Indeed, Figure IV-1 illustrates the same structure between the marginal effect of tertiary educated mother and that of tertiary educated father.

In Model 2, some country-level variables and interaction terms between parental education and two societal-level educational indicators (the degree of educational expansion and tracking) are added to Model 1. Whereas two individual-level variables concerning parental education demonstrate significant positive effects (γ_{40}=1.236 and γ_{50}=1.373), two interaction terms between maternal/paternal education and educational expansion significantly show negative coefficients (γ_{41}=-0.016 and γ_{51}=-0.013). This means that the overall OD association in the form of the influence of tertiary educated parents on the probability of obtaining skilled occupations is likely to be small in societies where the share of highly educated people is relatively large.

However, once the degree of skills diffusion is considered (Model 3), the coefficient of the interaction between father's education and educational expansion becomes insignificant. Meanwhile, the interaction between father's education and skills diffusion shows a significant negative coefficient (γ_{53}=-0.033). These results suggest that, even though the impact of parental education on occupational attainment seems to be undermined due to the larger proportion of highly educated people, this is true merely for tertiary educated mothers. The devaluation of father's education in terms of its contribution to obtaining skilled occupations is, in fact, associated with the larger share of highly skilled people, rather than the degree of educational expansion. It is therefore essential to pay close attention to the distinction between educational expansion and skills diffusion in better understanding the OD association as well as the OE and ED associations. Implications derived from these heterogeneous relationships are further discussed below.

In the meantime, Model 4 to Model 6 (Table IV-2) include variables concerning

educational specifications to investigate the direct effect of social origins (DESO) after accounting for the mediation by children's education. Firstly, Model 4 indicates that parental education maintains significant positive direct effects (γ_{40}=0.512 and γ_{50}=0.738). This suggests that, as discussed by previous research, there is significant DESO on occupational attainment. Secondly, while the interaction between skills diffusion and father's education significantly demonstrates a negative coefficient as with Model 3 (γ_{53}=-0.029), the one between educational expansion and tertiary educated mothers is no longer significant. Thirdly, interaction terms between educational expansion and high credentials, including both HCHS and HCLS, show significant negative effects as confirmed in Chapter 2 (γ_{71}=-0.034 and γ_{81}=-0.038). These results indicate that the devaluation of mother's education associated with educational expansion is mediated by educational specifications, whereas the direct association between father's education and children's occupational attainment is likely to be smaller in accordance with the larger share of highly skilled human resources even after controlling for the function of educational specifications.

Model 5 further adds six interaction terms between parental education and educational specifications to analyse the heterogeneity in impact of origins across different educational specifications. While all the significant effects in Model 4 are confirmed in Model 5 as well,[51] three interaction terms between parental education and educational specifications (tertiary educated mother * HCHS, tertiary educated father * HCLS, and tertiary educated father * LCHS) also demonstrate significant negative coefficients (γ_{470}=-0.276, γ_{580}=-0.311, and γ_{590}=-0.485). This suggests that the impact of mother's education is smaller among HCHS as compared with those who possess

[51] In addition to variables that demonstrate significant coefficients in Model 4, the interaction between tracking and HCHS also shows a significant negative effect. This suggests that, after taking account of various variables including interactions between parental education and educational specifications, the contribution of HCHS to occupational attainment is expected to be smaller in societies where tracking system is well-developed as compared with countries whose education system is less-tracked. However, this significant negative association is not confirmed in Model 6.

neither high credentials nor high skills, whereas the advantage of having a tertiary educated father in terms of occupational attainment is relatively small for those who possess merely high credentials or high skills. In other words, individuals who possess high credentials and high skills (HCHS) can retain the benefit of having a tertiary educated father, whereas such advantages are limited amongst people with only either of them. Although the mechanism behind this variation between mother's education and father's education as well as across educational specifications should be investigated further, these findings are consistent with earlier studies that have revealed the relatively small impact of origins among highly educated people.

Finally, Model 6 includes three-way interaction terms between societal educational conditions, parental education, and educational specifications. Whereas two cross-level interaction terms between educational expansion and high credentials (HCHS and HCLS) maintain their significant negative coefficients (γ_{71}=-0.028 and γ_{81}=-0.041), other two-way interaction terms no longer demonstrate significant effects. In the meantime, only one three-way interaction term (skills diffusion * tertiary educated father * LCHS) shows a significant negative coefficient (γ_{593}=-0.103). This implies that, although the impact of parental education on occupational attainment seems to be smaller in association with individual-level high credentials/skills and/or societal-level skills diffusion according to Model 5, it is not necessarily true once three-way interactions are further taken into account. Rather, only among highly skilled people who do not possess high credentials, the contribution of father's education is likely to be small in societies where the share of highly skilled people is relatively large. Implications from these findings are discussed in the following section after examining the result of earnings analysis.[52]

[52] Although the primary focus of this chapter is on the impact of origins, it is also worthwhile to note that interaction terms between societal educational conditions and individual educational specifications demonstrate the same result as the analysis of ED association (see Table II-4 in Chapter 2). This is also the case for the earnings analysis.

Table IV-1 Multilevel Binary Logistic Regression of Skilled Occupations (Model 1-3)

Independent Variable		Model 1			Model 2			Model 3		
		B		S.E.	B		S.E.	B		S.E.
Intercept		-0.204	**	0.073	-0.375		0.710	-0.300		0.696
Level One (Individual)	Men (dummy)	-0.128	***	0.025	-0.130	***	0.025	-0.127	***	0.025
	Age (35-39 years old dummy)	0.133	***	0.027	0.132	***	0.027	0.132	***	0.027
	First Generation Immigrant (dummy)	-0.593	***	0.038	-0.586	***	0.038	-0.592	***	0.038
	Tertiary Educated Mother (dummy)	0.606	***	0.036	1.236	***	0.186	1.330	***	0.195
	Tertiary Educated Father (dummy)	0.927	***	0.034	1.373	***	0.170	1.496	***	0.174
	Years of Paid Work	-0.014	***	0.003	-0.014	***	0.003	-0.014	***	0.003
Cross-Level Interactions	Educational Expansion * Tertiary Educated Mother				-0.016	**	0.005	-0.014	*	0.005
	Educational Expansion * Tertiary Educated Father				-0.013	**	0.005	-0.005		0.005
	Tracking * Tertiary Educated Mother				0.062		0.055	0.058		0.055
	Tracking * Tertiary Educated Father				-0.030		0.047	-0.011		0.047
	Skills Diffusion * Tertiary Educated Mother							-0.014		0.009
	Skills Diffusion * Tertiary Educated Father							-0.033	***	0.008
Level Two (Country)	Educational Expansion				0.015		0.009	0.010		0.009
	Index of Tracking				0.107		0.086	0.090		0.084
	Skills Diffusion							0.023		0.014
	GDP per capita (USD, PPP)/10,000				0.178	*	0.076	0.143		0.082
	Economic Structure (Share of Manufacturing)				-0.022		0.015	-0.023		0.014
	Economic Structure (Share of Service)				-0.010		0.010	-0.010		0.010
	Union Density				0.001		0.003	0.000		0.003
Variance	Random Effect Covariance Structure (Intercept)	0.109 **			0.078 **			0.073 **		
Model Fit	-2LL	131255.708			131390.254			131447.003		
	AIC	131257.708			131392.254			131449.003		

(*** p<0.001, ** p<0.01, * p<0.05) [two tailed] [N: Individual=30,284, Country=26］

Note: Data are unweighted.

Table IV-2 Multilevel Binary Logistic Regression of Skilled Occupations
(Model 4-6)

Independent Variable		Model 4			Model 5			Model 6		
		B		S.E.	B		S.E.	B		S.E.
Intercept		-1.585		0.926	-1.589		0.927	-1.606		0.928
Level One	Men (dummy)	-0.026		0.028	-0.025		0.028	-0.025		0.028
(Individual)	Age (35-39 years old dummy)	0.007		0.030	0.010		0.030	0.010		0.030
	First Generation Immigrant (dummy)	-0.489	***	0.043	-0.486	***	0.043	-0.487	***	0.043
	Tertiary Educated Mother (dummy)	0.512	*	0.225	0.522	*	0.230	1.048	**	0.395
	Tertiary Educated Father (dummy)	0.738	***	0.203	0.918	***	0.205	0.746	*	0.339
	Years of Paid Work	0.023	***	0.003	0.023	***	0.003	0.023	***	0.003
	Educational Specifications (Reference = Neither High Credential nor High Skills: LCLS)									
	High Credential & High Skills (HCHS)	3.748	***	0.285	3.774	***	0.285	3.729	***	0.349
	Only High Credential without High Skills (HCLS)	3.432	***	0.143	3.435	***	0.143	3.487	***	0.158
	Only High Skills without High Credential (LCHS)	1.675	***	0.344	1.649	***	0.344	1.675	***	0.385
	Tertiary Educated Mother * HCHS				-0.276	*	0.133	-0.375		0.760
	Tertiary Educated Mother * HCLS				0.018		0.090	-0.822		0.499
	Tertiary Educated Mother * LCHS				0.271		0.188	-1.130		1.094
	Tertiary Educated Father * HCHS				-0.201		0.127	-0.167		0.711
	Tertiary Educated Father * HCLS				-0.311	***	0.084	-0.031		0.440
	Tertiary Educated Father * LCHS				-0.485	**	0.176	0.526		1.108
Cross-Level	Educational Expansion * HCHS	-0.034	***	0.008	-0.032	***	0.008	-0.028	**	0.011
Interactions	Educational Expansion * HCLS	-0.038	***	0.005	-0.037	***	0.005	-0.041	***	0.005
(Two-way)	Educational Expansion * LCHS	-0.014		0.011	-0.013		0.011	-0.016		0.013
	Tracking * HCHS	-0.147		0.075	-0.153	*	0.076	-0.179		0.094
	Tracking * HCLS	-0.092		0.048	-0.086		0.048	-0.082		0.056
	Tracking * LCHS	-0.009		0.088	0.014		0.088	0.015		0.103
	Skills Diffusion * HCHS	0.013		0.012	0.014		0.013	0.008		0.015
	Skills Diffusion * HCLS	-0.002		0.008	0.000		0.008	0.005		0.009
	Skills Diffusion * LCHS	-0.018		0.018	-0.016		0.018	-0.009		0.021
	Educational Expansion * Tertiary Educated Mother	-0.005		0.006	-0.005		0.006	-0.016		0.010
	Educational Expansion * Tertiary Educated Father	0.003		0.006	0.004		0.006	0.004		0.010
	Tracking * Tertiary Educated Mother	0.076		0.062	0.075		0.062	-0.006		0.101
	Tracking * Tertiary Educated Father	0.029		0.054	0.015		0.054	0.047		0.085
	Skills Diffusion * Tertiary Educated Mother	-0.001		0.010	0.001		0.011	-0.011		0.020
	Skills Diffusion * Tertiary Educated Father	-0.029	**	0.009	-0.030	**	0.009	-0.014		0.017

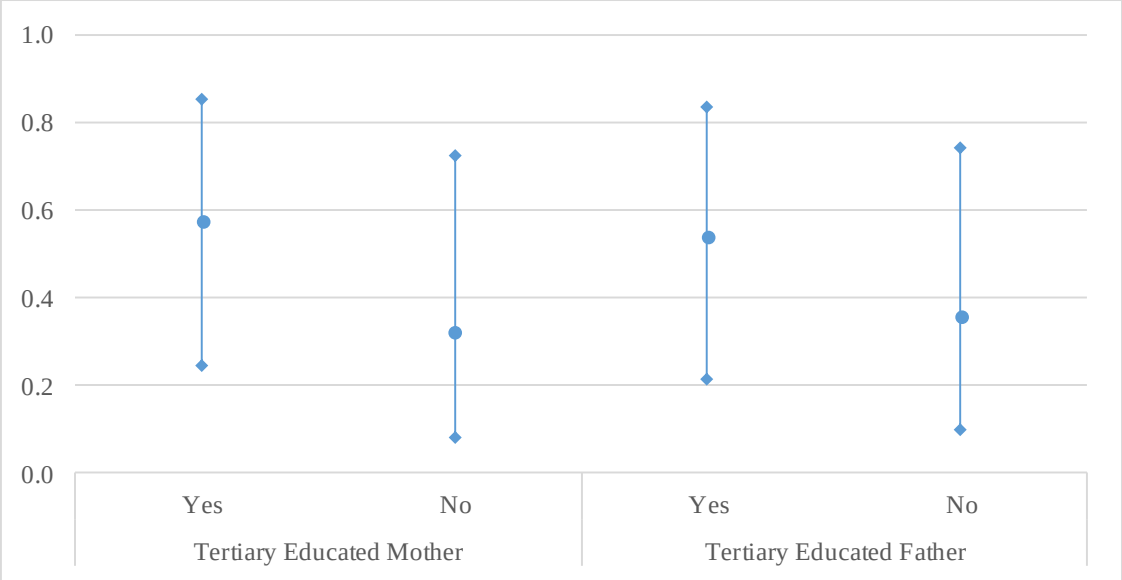
* continues on the next page

Independent Variable (Cont.)		Model 4			Model 5			Model 6		
		B		S.E.	B		S.E.	B		S.E.
Cross-Level Interactions (Three-way)	Educational Expansion * Tertiary Educated Mother * HCHS							0.012		0.021
	Educational Expansion * Tertiary Educated Mother * HCLS							0.017		0.014
	Educational Expansion * Tertiary Educated Mother * LCHS							0.012		0.029
	Educational Expansion * Tertiary Educated Father * HCHS							-0.012		0.020
	Educational Expansion * Tertiary Educated Father * HCLS							0.002		0.013
	Educational Expansion * Tertiary Educated Father * LCHS							0.010		0.029
	Tracking * Tertiary Educated Mother * HCHS							0.235		0.194
	Tracking * Tertiary Educated Mother * HCLS							0.065		0.137
	Tracking * Tertiary Educated Mother * LCHS							0.271		0.264
	Tracking * Tertiary Educated Father * HCHS							-0.090		0.177
	Tracking * Tertiary Educated Father * HCLS							-0.038		0.120
	Tracking * Tertiary Educated Father * LCHS							-0.184		0.230
	Skills Diffusion * Tertiary Educated Mother * HCHS							-0.017		0.033
	Skills Diffusion * Tertiary Educated Mother * HCLS							0.017		0.024
	Skills Diffusion * Tertiary Educated Mother * LCHS							0.076		0.050
	Skills Diffusion * Tertiary Educated Father * HCHS							0.029		0.031
	Skills Diffusion * Tertiary Educated Father * HCLS							-0.030		0.022
	Skills Diffusion * Tertiary Educated Father * LCHS							-0.103	*	0.050
Level Two (Country)	Educational Expansion	0.008		0.013	0.008		0.013	0.009		0.013
	Index of Tracking	0.233	*	0.113	0.234	*	0.113	0.237	*	0.114
	Skills Diffusion	0.015		0.020	0.014		0.020	0.012		0.020
	GDP per capita (USD, PPP)/10,000	0.189		0.108	0.189		0.108	0.189		0.108
	Economic Structure (Share of Manufacturing)	-0.036		0.019	-0.036		0.019	-0.036		0.019
	Economic Structure (Share of Service)	-0.009		0.013	-0.009		0.013	-0.009		0.013
	Union Density	-0.001		0.004	-0.001		0.004	-0.001		0.004
Variance	Random Effect Covariance Structure (Intercept)	0.131 **			0.131 **			0.131 **		
Model Fit	-2LL	140108.650			140085.088			140182.058		
	AIC	140110.650			140087.088			140184.058		

(*** p<0.001, ** p<0.01, * p<0.05) [two tailed] [N: Individual=30,284, Country=26］

Note: Data are unweighted.

Figure IV-1 Probability of Obtaining Skilled Occupations by Parental Education



Note: Marginal effects in this figure are calculated based on Model 6. Diamonds indicate the 95% confidence interval.

Table IV-3 summarises the results of Model 1 to Model 3 of earnings analysis. As with the occupation analysis, these models examine the total effect of parental education by excluding children's educational specifications from independent variables. In Model 1, which merely includes individual-level variables, both a tertiary educated mother and a tertiary educated father demonstrate significant positive coefficients. Among them, the impact of father's education is significantly larger than that of mother's education, and this significant difference is persistent in other models that account for country-level predictors and interaction terms as well as individual educational specifications. More importantly, as explained below, the direct effect of mother's education is no longer significant once educational specifications are controlled for. Indeed, Figure IV-2 (marginal effects of parental education) reveals that mother's education does not affect the earnings distribution, whereas individuals whose father is tertiary educated are likely than others to enjoy a higher probability of attaining

better earnings.

Model 2 adds country-level variables (except for the degree of skills diffusion) and interaction terms between parental education and societal educational conditions (the degree of educational expansion and tracking). While both mother's education and father's education show significant positive main effects (γ_{40}=0.591 and γ_{50}=1.294), the coefficients of two cross-level interaction terms concerning father's education are significantly negative (γ_{51}=-0.020 and γ_{52}=-0.107). This suggests that the overall contribution of tertiary educated fathers to better earnings is smaller in societies where the degree of educational expansion and/or tracking is relatively high. Meanwhile, the impact of tertiary educated mothers is not necessarily influenced by such societal educational conditions.[53]

The main effects of parental education and the devaluation of father's education are stable even after accounting for skills diffusion. Model 3 reveals that, in addition to the significant positive effects of individual-level parental education, the significant negative coefficients of two interaction terms between father's education and societal-level educational expansion/tracking are confirmed (γ_{51}=-0.015 and γ_{52}=-0.097). At the same time, the interaction between father's education and the degree of skills diffusion also shows a significant negative coefficient (γ_{53}=-0.028), suggesting that the impact of father's education is likely to be smaller in association with the larger share of highly skilled human resources in a society. It is also important to note that, as with the relationship with educational expansion and tracking, the overall influence of mother's education on earnings is not necessarily affected by skills diffusion either (i.e. γ_{43} is not significant).

Herein, once educational specifications are included in Model 4 and Model 5 (Table IV-4) to examine DESO, the main effect of mother's education vanishes (i.e. γ_{40}

[53] In addition, the share of service sector in each country significantly shows a negative coefficient, and this association is confirmed in other models except for the final one in which individual-level occupations are controlled for.

is no longer significant). That is, accounting for the effects mediated by educational specifications, the direct impact of having a tertiary educated mother on better earnings cannot be confirmed, whereas that of a tertiary educated father is robust (i.e. γ_{50} is significantly positive in all models). In the meantime, as with the analysis result of ED association in Chapter 2, four interaction terms between high credentials (both HCHS and HCLS) and societal educational conditions (both educational expansion and skills diffusion) demonstrate significant negative coefficients (γ_{71}=-0.018, γ_{81}=-0.018, γ_{72}=-0.046, and γ_{82}=-0.038 in Model 4 and γ_{71}=-0.017, γ_{81}=-0.019, γ_{72}=-0.047, and γ_{82}=-0.039 in Model 5).

Furthermore, in both Model 4 and Model 5, the devaluation of father's education associated with societal educational conditions is confirmed only for the interaction with educational expansion (γ_{51}=-0.011 in Mode 4 and Model 5). Put differently, the direct effect of having a tertiary educated father on better earnings is likely to be small due to the larger share of highly educated people in a society, whereas the degree of skills diffusion and tracking do not affect the direct contribution of father's education. It is also important to note that, unlike the occupation analysis, the interaction terms between parental education and educational specifications do not show statistically significant coefficients (Model 5). This means that the impact of parental education on earnings does not necessarily vary across different educational groups.

Model 6 further employs 18 three-way interaction terms between societal educational conditions, parental education, and educational specifications (Table IV-5). While the negative coefficient of the interaction term between educational expansion and father's education is no longer significant, one three-way interaction (educational expansion * tertiary educated mother * HCLS) shows a significant positive coefficient (γ_{481}=0.026). Here it is crucial to pay attention to this three-way interaction term in conjunction with the fact that the coefficient of the two-way interaction between educational expansion and HCLS is significantly negative (γ_{81}=-0.024) and that the

other two interactions do not demonstrate significant coefficients (γ_{480} and γ_{41}). One may assume that, based on these results, individuals who merely possess high credentials without high skills can avoid (or at least mitigate the risk of) being penalised by educational expansion as long as their mother is tertiary educated. In other words, although mother's high educational attainment does not directly affect better earnings (i.e. γ_{40} is not significant), it benefits children via reducing/offsetting the devaluation of HCLS that occurs due to the larger share of highly educated people in a given society.

At the same time, another three-way interaction between skills diffusion, tertiary educated mother, and HCLS demonstrates a negative coefficient (γ_{483}=-0.043). One important difference from γ_{481} is that the coefficient of the two-way interaction term between skills diffusion and tertiary educated mother is significantly positive (γ_{43}=0.036), while the interaction between skills diffusion and HCLS shows a negative effect (γ_{83}=-0.029). That is, although the advantage of having a tertiary educated mother is generally intensified in societies where the share of highly skilled people is large, this bonus due to skills diffusion is significantly undermined among those who possess only high credentials without high skills. This also means that, relative monetary returns to HCLS are expected to be smaller in association with skills diffusion particularly when their mother is tertiary educated, not only because of the significant negative two-way interaction between HCLS and skills diffusion but also due to the smaller contribution of tertiary educated mother in highly skilled societies. Put differently, HCLS can maintain its monetary rewards even in highly qualified societies (i.e. the higher degree of educational expansion) by making use of his/her advantage as a child of tertiary educated mother, such tactics does not work in societies where the share of highly skilled people is relatively large.

Model 7 adds three individual occupational dummy variables in order to examine the effect of predictors in comparison to Model 6. On the one hand, the aforementioned two three-way interactions between educational expansion/skills diffusion, tertiary

educated mother, and HCLS are no longer significant. On the other hand, interestingly, two interaction terms between father's education and societal educational conditions (the degree of educational expansion and tracking) show significant negative coefficients again (γ_{51}=-0.021 and γ_{52}=-0.164). That is, the diminishing direct effect of father's education on earnings, which is detected in Model 4 and Model 5, seems to disappear once three-way interactions are accounted for in Model 6. Yet, the depreciation of tertiary educated fathers still exists as far as much narrower direct effects are concerned (i.e. after controlling for the association mediated by occupations). The hypothetical explanation and implications are further discussed in the following section.

Table IV-3 Multilevel Ordered Logistic Regression of Earnings Quintiles
(Model 1-3)

Independent Variable		Model 1			Model 2			Model 3		
		B		S.E.	B		S.E.	B		S.E.
Threshold	Cut point 1	-0.815	***	0.044	-1.226	***	0.331	-1.135	***	0.304
	Cut point 2	0.364	***	0.043	-0.045		0.331	0.045		0.304
	Cut point 3	1.356	***	0.044	0.948	**	0.331	1.039	**	0.304
	Cut point 4	2.563	***	0.046	2.157	***	0.331	2.249	***	0.304
Level One (Individual)	Men (dummy)	1.023	***	0.024	1.022	***	0.024	1.024	***	0.024
	Age (35-39 years old dummy)	-0.005		0.026	-0.009		0.026	-0.009		0.026
	First Generation Immigrant (dummy)	-0.604	***	0.036	-0.590	***	0.036	-0.596	***	0.036
	Tertiary Educated Mother (dummy)	0.365	***	0.033	0.591	**	0.176	0.641	**	0.185
	Tertiary Educated Father (dummy)	0.581	***	0.031	1.294	***	0.163	1.431	***	0.168
	Years of Paid Work	0.038	***	0.003	0.039	***	0.003	0.039	***	0.003
Cross-Level Interactions	Educational Expansion * Tertiary Educated Mother				-0.005		0.005	-0.005		0.005
	Educational Expansion * Tertiary Educated Father				-0.020	***	0.005	-0.015	**	0.005
	Tracking * Tertiary Educated Mother				0.031		0.050	0.030		0.050
	Tracking * Tertiary Educated Father				-0.107	*	0.044	-0.097	*	0.044
	Skills Diffusion * Tertiary Educated Mother							-0.007		0.009
	Skills Diffusion * Tertiary Educated Father							-0.028	***	0.008
Level Two (Country)	Educational Expansion				0.005		0.004	0.006		0.004
	Index of Tracking				0.001		0.041	0.001		0.038
	Skills Diffusion							-0.007		0.006
	GDP per capita (USD, PPP)/10,000				0.022		0.035	0.056		0.036
	Economic Structure (Share of Manufacturing)				0.003		0.007	0.005		0.006
	Economic Structure (Share of Service)				-0.011	*	0.005	-0.011	*	0.004
	Union Density				-0.001		0.001	-0.001		0.001
Variance	Random Effect Covariance Structure (Intercept)	0.015 **			0.014 *			0.010 *		
Model Fit	-2LL	285845.973			286314.470			286504.985		
	AIC	285847.973			286316.470			286506.985		

(*** p<0.001, ** p<0.01, * p<0.05) [two tailed] [N: Individual=23,840, Country=26］

Note: Data are unweighted.

Table IV-4 Multilevel Ordered Logistic Regression of Earnings Quintiles
(Model 4-5)

Independent Variable		Model 4			Model 5		
		B		S.E.	B		S.E.
Threshold	Cut point 1	-0.403		0.288	-0.400		0.287
	Cut point 2	0.877	**	0.288	0.879	**	0.287
	Cut point 3	1.980	***	0.288	1.983	***	0.287
	Cut point 4	3.316	***	0.289	3.319	***	0.288
Level One (Individual)	Men (dummy)	1.175	***	0.025	1.175	***	0.025
	Age (35-39 years old dummy)	-0.147	***	0.026	-0.146	***	0.026
	First Generation Immigrant (dummy)	-0.429	***	0.037	-0.428	***	0.037
	Tertiary Educated Mother (dummy)	-0.172		0.190	-0.239		0.199
	Tertiary Educated Father (dummy)	0.780	***	0.175	0.812	***	0.181
	Years of Paid Work	0.074	***	0.003	0.074	***	0.003
	Educational Specifications (Reference = Neither High Credential nor High Skills: LCLS)						
	High Credential & High Skills (HCHS)	3.180	***	0.220	3.205	***	0.221
	Only High Credential without High Skills (HCLS)	2.392	***	0.126	2.396	***	0.126
	Only High Skills without High Credential (LCHS)	1.460	***	0.334	1.459	***	0.334
	Tertiary Educated Mother * HCHS				-0.058		0.102
	Tertiary Educated Mother * HCLS				0.120		0.081
	Tertiary Educated Mother * LCHS				0.123		0.179
	Tertiary Educated Father * HCHS				-0.008		0.098
	Tertiary Educated Father * HCLS				-0.062		0.077
	Tertiary Educated Father * LCHS				-0.181		0.170
Cross-Level Interactions (Two-way)	Educational Expansion * HCHS	-0.018	**	0.006	-0.017	**	0.006
	Educational Expansion * HCLS	-0.018	***	0.004	-0.019	***	0.004
	Educational Expansion * LCHS	-0.014		0.010	-0.014		0.010
	Tracking * HCHS	-0.061		0.055	-0.064		0.056
	Tracking * HCLS	-0.047		0.041	-0.045		0.041
	Tracking * LCHS	-0.034		0.084	-0.026		0.084
	Skills Diffusion * HCHS	-0.046	***	0.010	-0.047	***	0.010
	Skills Diffusion * HCLS	-0.038	***	0.007	-0.039	***	0.007
	Skills Diffusion * LCHS	-0.023		0.017	-0.023		0.017
	Educational Expansion * Tertiary Educated Mother	0.006		0.005	0.005		0.005
	Educational Expansion * Tertiary Educated Father	-0.011	*	0.005	-0.011	*	0.005
	Tracking * Tertiary Educated Mother	0.050		0.051	0.051		0.051
	Tracking * Tertiary Educated Father	-0.084		0.046	-0.083		0.046
	Skills Diffusion * Tertiary Educated Mother	0.008		0.009	0.011		0.009
	Skills Diffusion * Tertiary Educated Father	-0.012		0.008	-0.012		0.008
Level Two (Country)	Educational Expansion	0.002		0.004	0.002		0.004
	Index of Tracking	0.058		0.039	0.057		0.038
	Skills Diffusion	-0.002		0.007	-0.002		0.007
	GDP per capita (USD, PPP)/10,000	0.044		0.033	0.045		0.033
	Economic Structure (Share of Manufacturing)	0.001		0.006	0.001		0.006
	Economic Structure (Share of Service)	-0.011	**	0.004	-0.011	**	0.004
	Union Density	-0.002		0.001	-0.002		0.001
Variance	Random Effect Covariance Structure (Intercept)	0.008 *			0.008 *		
Model Fit	-2LL	307324.005			307368.131		
	AIC	307326.005			307370.131		

(*** p<0.001, ** p<0.01, * p<0.05) [two tailed] [N: Individual=23,840, Country=26］

Note: Data are unweighted.

Table IV-5 Multilevel Ordered Logistic Regression of Earnings Quintiles (Model 6-7)

Independent Variable		Model 6			Model 7		
		B		S.E.	B		S.E.
Threshold	Cut point 1	-0.355		0.287	0.528		0.339
	Cut point 2	0.925	**	0.287	1.889	***	0.339
	Cut point 3	2.029	***	0.288	3.070	***	0.340
	Cut point 4	3.366	***	0.288	4.474	***	0.340
Level One	Men (dummy)	1.177	***	0.025	1.207	***	0.026
(Individual)	Age (35-39 years old dummy)	-0.146	***	0.026	-0.138	***	0.027
	First Generation Immigrant (dummy)	-0.430	***	0.037	-0.303	***	0.038
	Tertiary Educated Mother (dummy)	0.021		0.381	-0.201		0.384
	Tertiary Educated Father (dummy)	0.915	**	0.328	0.807	*	0.330
	Years of Paid Work	0.074	***	0.003	0.070	***	0.003
	Educational Specifications (Reference = Neither High Credential nor High Skills: LCLS)						
	High Credential & High Skills (HCHS)	3.330	***	0.276	2.553	***	0.278
	Only High Credential without High Skills (HCLS)	2.473	***	0.139	1.680	***	0.141
	Only High Skills without High Credential (LCHS)	1.494	***	0.373	1.099	**	0.377
	Occupations (Reference = Elementary Occupations)						
	Skilled Occupation				1.900	***	0.058
	Semi-skilled White Collar				0.701	***	0.057
	Semi-skilled Blue Collar				0.916	***	0.059
	Tertiary Educated Mother * HCHS	0.101		0.599	0.165		0.602
	Tertiary Educated Mother * HCLS	-0.408		0.459	-0.180		0.462
	Tertiary Educated Mother * LCHS	-0.007		1.076	0.310		1.084
	Tertiary Educated Father * HCHS	-0.737		0.557	-0.663		0.560
	Tertiary Educated Father * HCLS	-0.028		0.406	-0.045		0.409
	Tertiary Educated Father * LCHS	-0.419		1.077	-0.621		1.087
Cross-Level	Educational Expansion * HCHS	-0.021	**	0.008	-0.017	*	0.008
Interactions	Educational Expansion * HCLS	-0.024	***	0.005	-0.015	**	0.005
(Two-way)	Educational Expansion * LCHS	-0.016		0.012	-0.010		0.012
	Tracking * HCHS	-0.051		0.071	-0.001		0.072
	Tracking * HCLS	-0.058		0.047	-0.027		0.047
	Tracking * LCHS	-0.042		0.098	-0.048		0.099
	Skills Diffusion * HCHS	-0.046	***	0.012	-0.046	***	0.012
	Skills Diffusion * HCLS	-0.029	***	0.008	-0.033	***	0.008
	Skills Diffusion * LCHS	-0.019		0.020	-0.019		0.020
	Educational Expansion * Tertiary Educated Mother	-0.009		0.010	-0.005		0.010
	Educational Expansion * Tertiary Educated Father	-0.018		0.010	-0.021	*	0.010
	Tracking * Tertiary Educated Mother	0.111		0.095	0.124		0.096
	Tracking * Tertiary Educated Father	-0.149		0.080	-0.164	*	0.081
	Skills Diffusion * Tertiary Educated Mother	0.036	*	0.018	0.035	*	0.018
	Skills Diffusion * Tertiary Educated Father	-0.001		0.016	0.005		0.016

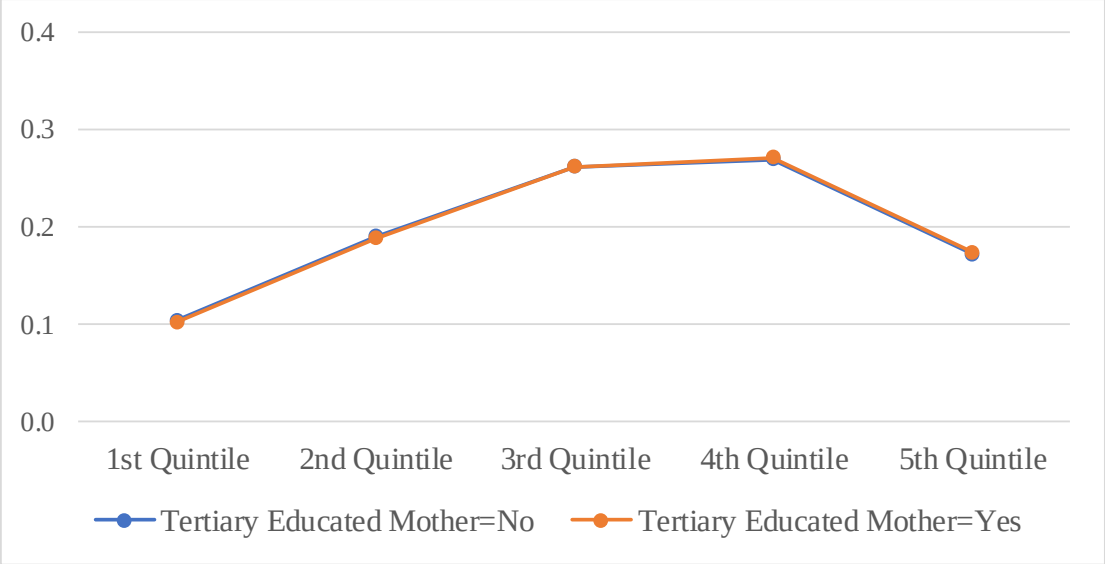
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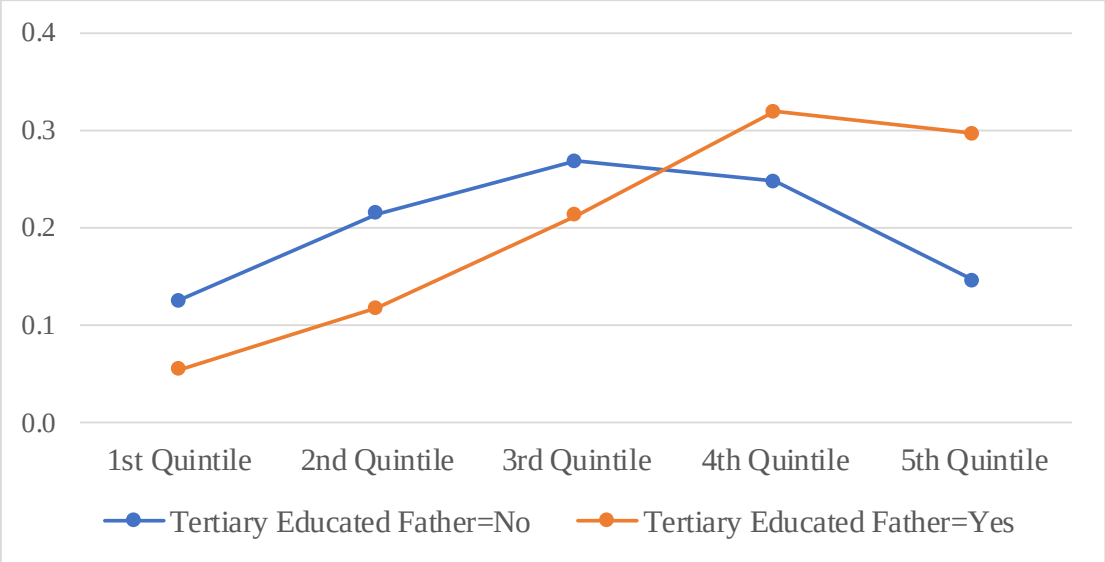
Independent Variable (Cont.)		Model 6			Model 7	
		B		S.E.	B	S.E.
Cross-Level Interactions (Three-way)	Educational Expansion * Tertiary Educated Mother * HCHS	0.006		0.016	0.004	0.016
	Educational Expansion * Tertiary Educated Mother * HCLS	0.026	*	0.012	0.019	0.012
	Educational Expansion * Tertiary Educated Mother * LCHS	-0.010		0.028	-0.025	0.028
	Educational Expansion * Tertiary Educated Father * HCHS	0.018		0.015	0.022	0.015
	Educational Expansion * Tertiary Educated Father * HCLS	0.006		0.012	0.007	0.012
	Educational Expansion * Tertiary Educated Father * LCHS	0.032		0.028	0.037	0.028
	Tracking * Tertiary Educated Mother * HCHS	-0.094		0.144	-0.137	0.145
	Tracking * Tertiary Educated Mother * HCLS	-0.113		0.122	-0.134	0.123
	Tracking * Tertiary Educated Mother * LCHS	-0.014		0.250	-0.184	0.252
	Tracking * Tertiary Educated Father * HCHS	0.054		0.131	0.067	0.132
	Tracking * Tertiary Educated Father * HCLS	0.124		0.107	0.139	0.108
	Tracking * Tertiary Educated Father * LCHS	0.095		0.221	0.200	0.223
	Skills Diffusion * Tertiary Educated Mother * HCHS	-0.035		0.026	-0.028	0.027
	Skills Diffusion * Tertiary Educated Mother * HCLS	-0.043	*	0.022	-0.040	0.022
	Skills Diffusion * Tertiary Educated Mother * LCHS	0.032		0.048	0.039	0.048
	Skills Diffusion * Tertiary Educated Father * HCHS	0.005		0.025	-0.005	0.025
	Skills Diffusion * Tertiary Educated Father * HCLS	-0.016		0.020	-0.011	0.020
	Skills Diffusion * Tertiary Educated Father * LCHS	-0.065		0.047	-0.054	0.048
Level Two (Country)	Educational Expansion	0.004		0.004	0.003	0.005
	Index of Tracking	0.062		0.039	0.014	0.045
	Skills Diffusion	-0.006		0.007	-0.011	0.008
	GDP per capita (USD, PPP)/10,000	0.045		0.033	0.011	0.039
	Economic Structure (Share of Manufacturing)	0.002		0.006	0.010	0.007
	Economic Structure (Share of Service)	-0.010	*	0.004	-0.008	0.005
	Union Density	-0.002		0.001	-0.001	0.001
Variance	Random Effect Covariance Structure (Intercept)	0.008 *			0.013 *	
Model Fit	-2LL	307610.797			321011.872	
	AIC	307612.797			321013.872	

(*** p<0.001, ** p<0.01, * p<0.05) [two tailed] [N: Individual=23,840, Country=26］

Note: Data are unweighted.

Figure IV-2 Probability of Attaining Earnings Quintiles by Parental Education





Note: Marginal effects in this figure are calculated based on Model 6.

5. Discussion and Conclusion

The so-called "OED triangle" has been the gold standard for analysing the association between origins and destinations in consideration of the function of education. Based on this framework as well as findings on the ED association (Chapter 2) and the OE association (Chapter 3), this chapter sheds light on the OD association. In so doing, particular attention is paid to 1) the direct effect of social origins (DESO) after accounting for indirect effects mediated by education (i.e. how parental education directly affects children's economic rewards), 2) the variation in impact of origins across different educational groups (i.e. how the effect of parental education on labour market outcomes differs depending on educational specifications), and 3) how these associations vary in accordance with the degree of educational expansion and skills diffusion at a societal level. While previous research has progressed a better understanding of these aspects, this paper is the first to take account of the distinction between educational credentials and skills at both individual and societal levels.

The results of multilevel logistic regression analyses, using the PIAAC data for approximately 30,000 individuals in 26 countries, reveal that there are statistically significant direct effects of mother's education and father's education on the probability of obtaining skilled occupations (see Figure IV-1). In contrast, whereas the overall OD association between parental education and earnings is confirmed, DESO on monetary rewards is significant only for father's education (see Figure IV-2). This means that, even though the advantage of having a tertiary educated mother exists in a way to promote occupational outcomes as well as educational attainment/skills acquisition and consequently enhance the probability of better earnings, maternal education does not necessarily affect children's earnings directly once educational specifications are accounted for. The mechanism behind this difference in impact between father's education and mother's education is not empirically testable in the current analysis. However, assuming that economic resources are more likely than

other types of capital including social class to be transmitted to children's monetary rewards (Blanden et al. 2013; Torche 2015), one may argue that paternal education functions not only as educational and cultural assets but also as economic capital, which is not necessarily delivered by maternal education.[54]

In terms of the heterogeneity in DESO on occupational attainment across different educational specifications, the impact of mother's education is smaller among those with both high credentials and high skills, whereas the contribution of father's education is limited for children who possess only high credentials or high skills. These findings are consistent with previous research that has revealed the relatively small influence of origins among higher-level educational groups (Breen and Jonsson 2007; Gil-Hernández et al. 2017; Hout 1988; Mastekaasa 2011; Pfeffer and Hertel 2015; Torche 2011, 2018).[55] By contrast, in the earnings analysis, the significant dispersion in DESO is not confirmed (i.e. the coefficients of interaction terms between parental education and educational specifications are all insignificant as shown in Table IV-4 and Table IV-5). This implies that the power of educational attainment and skills to mitigate the influence of origins on destinations emerges at the stage of job allocation more significantly as compared with that of earnings distribution.

Furthermore, paying close attention to the interaction with societal educational conditions, more nuanced relationships are detected in both occupations and earnings

[54] Given that parental occupations and earnings are not included in this analysis, the impact of father's education is considered to significantly reflect the indirect effect mediated by father's earnings (i.e. paternal education affects father's earnings, which then contribute to children's monetary rewards). This means that, paternal education might operate merely as a proxy of father's economic resources, and hence its effect on children's earnings might become insignificant once parental earnings are controlled for. It is also important to note that, when it comes to the mechanisms that seem to directly link parental education with labour market outcomes in this analysis (without mediation by children's education), there is a possibility that educated parents contribute to developing other dimensions of children's ability such as non-cognitive and occupation specific skills, which are not reflected in educational specifications here but considered to be favoured in the world of work. To test these hypotheses, as discussed below, further research with elaborate variables is required.

[55] Meanwhile, one may also argue that the impact of maternal education is maintained among HCLS and LCHS, whereas HCHS retains the advantage of having a tertiary educated father.

analyses. As regards occupational attainment, the contribution of a tertiary educated father becomes smaller in societies where the share of highly skilled people is relatively large (Model 5 in Table IV-2). However, taking account of three-way interactions between societal educational conditions, parental education, and educational specifications (Model 6 in Table IV-2), the devaluation of father's education in association with skills diffusion is observed only for LCHS. That is, as far as individuals who possess high skills without high credentials are concerned, the impact of paternal education on their probability of obtaining skilled occupations is likely to be small in highly skilled societies, whereas those with high credentials (both HCHS and HCLS) do not necessarily lose the advantage of having a tertiary educated father regardless of the extent of skills diffusion. Here, considering the analysis result of the OE association (Chapter 3), one may conclude that skills diffusion operates as an equaliser in a way to mitigate the impact of origins on acquiring high credentials (both HCHS and HCLS) whilst undermining DESO on occupational attainment among LCHS (although skills diffusion does not necessarily mitigate the impact of origins on the probability of obtaining high skills without high credentials (LCHS) nor undermine DESO among HCHS/HCLS). This supports the aforementioned hypothetical idea that skills diffusion, rather than educational expansion, is associated with the formation of a meritocratic society where the influence of origins is expected to be small.

With regard to earnings, one three-way interaction term between educational expansion, mother's education, and high credentials unaccompanied by high skills (HCLS) shows a significant positive coefficient (Model 6 in Table IV-5). In the meantime, the coefficient of the two-way interaction between educational expansion and HCLS is significantly negative, whereas other interactions (i.e. educational expansion * mother's education, and mother's education * HCLS) do not demonstrate significant effects. This suggests that, while individuals who merely possess high credentials without high skills are generally penalised due to educational expansion,

such devaluation may be offset to a certain extent by having a tertiary educated mother who underpins returns to high credentials (or utilises other channels leading to better earnings).

At the same time, in the same analysis model, another three-way interaction term between skills diffusion, tertiary educated mother, and HCLS demonstrates a significant negative coefficient. Here, the two-way interaction between skills diffusion and HCLS also shows a negative effect, whereas the one between skills diffusion and tertiary educated mother is significantly positive. These results imply that, although the advantage of having a tertiary educated mother is generally intensified in highly skilled societies, individuals who possess only high credentials without high skills cannot fully enjoy such advantages. Consequently, in societies where the share of highly skilled people is large, HCLS is penalised not only by the effect of the two-way interaction with skills diffusion but also by the relatively small contribution of maternal education when their mother is tertiary educated.[56]

Nonetheless, once individual occupations are further controlled for (Model 7 in Table IV-5), the said coefficients of three-way interaction terms are no longer significant. Instead, the negative coefficients are observed for two-way interaction terms between father's education and societal educational conditions (the degree of educational expansion and tracking). This means that, while DESO (father's education) on earnings including the flow mediated by occupations is not necessarily undermined by societal educational conditions, the narrowly defined direct effect (i.e. after controlling for occupations) is devalued due to educational expansion and tracking. Herein one may assume that, considering the positive impact of occupations on earnings, the two interaction terms between father's education and educational

[56] This also indicates the possibility that, as discussed, highly skilled societies would promote meritocracy in a way to mitigate the power of origins via relatively benefitting HCLS whose mother is not a tertiary graduate, as compared to their counterparts whose mother is tertiary educated. Notwithstanding, given the significant positive coefficient of the two-way interaction between skills diffusion and maternal education, further investigations are required.

expansion/tracking are positively associated with occupational attainment, and hence their coefficients are insignificant in Model 6 as a total effect (i.e. a composite of positive indirect effects mediated by occupations and negative direct effects on earnings). However, this speculation is not statistically supported by Model 6 of the occupation analysis (Table IV-2) where the two interaction terms (educational expansion/tracking * tertiary educated father) do not show significant impacts on the probability of obtaining skilled occupations (albeit positive coefficients). One potential explanation is that these interactions have effects on other types of occupations such as semi-skilled white/blue collar jobs, which also demonstrate significant positive influences on earnings in Model 7 of the earnings analysis. To test this hypothesis, further research is required.

Thus, this chapter illuminates the OD association via paying close attention to DESO and its heterogeneity across different educational specifications, in consideration of skills diffusion as well as educational expansion. As a result, in addition to the diminishing impact of parental education due to societal educational conditions, several significant three-way interactions are detected in association with occupational attainment and monetary rewards. I argue that, as with the ED and OE associations, the aforementioned nuanced structure is observable only via distinguishing skills from credentials at both individual and societal levels.

Nevertheless, there are ample challenges to be addressed by future research. Firstly, as discussed in Chapter 3, it is crucial to employ a prospective approach, rather than a retrospective one, in order to accurately examine the impact of origins on destinations with attention to highly educated individuals who do not have children (Breen and Ermisch 2017; Lawrence and Breen 2016; Song and Mare 2015). Secondly, country-specific longitudinal analyses could provide more insights into the OD association in each society. In so doing, the heterogeneity across individuals with different backgrounds such as gender, cohort, immigrant background, and work experience need

to be carefully taken into account. In particular, given that the OE association yields nuanced pictures between men and women (see Appendix E), further analyses focused on gender differences are essential. Likewise, the influence of country-level education and labour systems, including tracking that demonstrates several significant effects in this chapter, is worthy of further investigation. Thirdly, key variables concerning credentials and skills can be elaborated via adopting more detailed categories of educational qualifications and other types of skills. Finally, while the current analysis empirically elucidates complicated relationships between origins and destinations as well as societal conditions, more in-depth investigations and theoretical considerations with regard to social mechanisms that generate these OED associations are essential.

By addressing these challenges, it becomes possible to better understand the structure and mechanism of OED triangle and the characteristics of our society as a whole. With this in mind, the next chapter discusses implications and potential for future research, after summarising findings of empirical analyses.

Appendix

G. Multilevel Linear Regression of Occupations (ISEI)

This table illustrates the result of a multilevel linear regression analysis of occupations, using a continuous measure for the dependent variable (International Socio-Economic Index of Occupational Status: ISEI) as with Appendix B in Chapter 2. Combining the analysis model in Appendix B and Model 6 for occupational attainment in Chapter 4 (see Table IV-2), several two-way and three-way interaction terms are employed as independent variables in addition to gender, cohort, immigrant background, parental education, work experience, educational specifications, societal educational conditions (the degree of educational expansion, skills diffusion, and tracking), economic conditions (GDP and its share in manufacturing and service sectors), and union density. Equation is as follows.

$$
\begin{aligned}
Y_{ij} = {} & \gamma_{00} + \gamma_{10}M_{ij} + \gamma_{20}A_{ij} + \gamma_{30}I_{ij} + \gamma_{40}ME_{ij} + \gamma_{50}FE_{ij} + \gamma_{60}W_{ij} + \gamma_{70}HCHS_{ij} + \gamma_{80}HCLS_{ij} \\
& + \gamma_{90}LCHS_{ij} + \gamma_{470}ME_{ij}HCHS_{ij} + \gamma_{480}ME_{ij}HCLS_{ij} + \gamma_{490}ME_{ij}LCHS_{ij} \\
& + \gamma_{570}FE_{ij}HCHS_{ij} + \gamma_{580}FE_{ij}HCLS_{ij} + \gamma_{590}FE_{ij}LCHS_{ij} + \gamma_{01}E_j + \gamma_{02}T_j + \gamma_{03}S_j \\
& + \gamma_{04}G_j + \gamma_{05}Em_j + \gamma_{06}Es_j + \gamma_{07}U_j + \gamma_{41}ME_{ij}E_j + \gamma_{51}FE_{ij}E_j + \gamma_{42}ME_{ij}T_j \\
& + \gamma_{52}FE_{ij}T_j + \gamma_{43}ME_{ij}S_j + \gamma_{53}FE_{ij}S_j + \gamma_{71}HCHS_{ij}E_j + \gamma_{81}HCLS_{ij}E_j \\
& + \gamma_{91}LCHS_{ij}E_j + \gamma_{72}HCHS_{ij}T_j + \gamma_{82}HCLS_{ij}T_j + \gamma_{92}LCHS_{ij}T_j + \gamma_{73}HCHS_{ij}S_j \\
& + \gamma_{83}HCLS_{ij}S_j + \gamma_{93}LCHS_{ij}S_j + \gamma_{471}ME_{ij}HCHS_{ij}E_j + \gamma_{481}ME_{ij}HCLS_{ij}E_j \\
& + \gamma_{491}ME_{ij}LCHS_{ij}E_j + \gamma_{571}FE_{ij}HCHS_{ij}E_j + \gamma_{581}FE_{ij}HCLS_{ij}E_j \\
& + \gamma_{591}FE_{ij}LCHS_{ij}E_j + \gamma_{472}ME_{ij}HCHS_{ij}T_j + \gamma_{482}ME_{ij}HCLS_{ij}T_j \\
& + \gamma_{492}ME_{ij}LCHS_{ij}T_j + \gamma_{572}FE_{ij}HCHS_{ij}T_j + \gamma_{582}FE_{ij}HCLS_{ij}T_j \\
& + \gamma_{592}FE_{ij}LCHS_{ij}T_j + \gamma_{473}ME_{ij}HCHS_{ij}S_j + \gamma_{483}ME_{ij}HCLS_{ij}S_j \\
& + \gamma_{493}ME_{ij}LCHS_{ij}S_j + \gamma_{573}FE_{ij}HCHS_{ij}S_j + \gamma_{583}FE_{ij}HCLS_{ij}S_j + \gamma_{593}FE_{ij}LCHS_{ij}S_j \\
& + u_{0j} + \varepsilon_{ij}
\end{aligned}
$$

where Y_{ij}=ISEI score for individual i in country j, and other parameters are the same as equation (7a) in the main manuscript.

The result below reveals that, as with the multilevel binary logistic regression (Model 6 in Table IV-2), both mother's education and father's education at an individual level demonstrate significant positive effects on ISEI (γ_{40}=7.059 and γ_{50}=4.601). Meanwhile, in addition to the significant negative coefficients of interaction terms between educational expansion and high credentials (both HCHS and HCLS), the interaction between tracking and HCHS also shows a significant coefficient as confirmed in Appendix B.

One inconsistency between the analysis of skilled occupations in the main manuscript and this linear model is that the coefficient of the two-way interaction between educational expansion and mother's education becomes significantly negative (γ_{41}=-0.141), which is not observed in Model 6 in Table IV-2. This suggests that the advantage of having a tertiary educated mother (DESO) for occupational attainment measured by continuous ISEI is likely to be smaller in association with the larger share of tertiary graduates in a given society. Put differently, while educational expansion does not necessarily contribute to social equality in terms of the link between maternal education and the specific job category (i.e. skilled occupations), it may operate as an equaliser in a way to mitigate the influence of tertiary educated mothers as long as occupational attainment is taken as a continuous ladder of socio-economic status.

Another difference between the multilevel binary logistic regression and this analysis is that the three-way interaction term between skills diffusion, father's education, and LCHS does not demonstrate a significant coefficient in the linear model. That is, contrary to the impact of educational expansion, skills diffusion is not significantly associated with the diminishing influence of paternal education when it comes to the continuous measure of occupations regardless of individuals' educational specifications. One hypothetical explanation here is that, according to the concepts like skill-biased technological change, occupational opportunities that require high skills (i.e. skilled occupations) are expected to increase along with skills diffusion in a society

and are likely to be allocated based on individuals' skills. Should this be the case, LCHS is considered to be relatively rewarded in terms of skilled occupations because of high skills, resulting in the diminishing relative impact of parental education in highly skilled societies. Meanwhile, this devaluation of origins hardly occurs when it comes to ISEI, primarily because this continuous measure incorporates a wide range of occupations and hence the influence of parental education on the acquisition of semi-skilled jobs, for example, is also calculated as its contribution as compared with elementary occupations. Although this interpretation is on an ad hoc basis and not fully consistent with the empirical result in the main manuscript (Model 6 in Table IV-2) where the coefficient of the country-level degree of skills diffusion is insignificant, the said discussion could be a first step towards further elaboration.

Multilevel Linear Regression of ISEI

Independent Variable		Model 6'		
		B		S.E.
Intercept		33.203	***	4.849
Level One (Individual)	Men (dummy)	-0.485	**	0.147
	Age (35-39 years old dummy)	-0.154		0.159
	First Generation Immigrant (dummy)	-3.217	***	0.225
	Tertiary Educated Mother (dummy)	7.059	**	2.190
	Tertiary Educated Father (dummy)	4.601	*	1.907
	Years of Paid Work	0.159	***	0.016
	Educational Specifications (Reference = Neither High Credential nor High Skills: LCLS)			
	High Credential & High Skills (HCHS)	25.933	***	1.661
	Only High Credential without High Skills (HCLS)	23.664	***	0.825
	Only High Skills without High Credential (LCHS)	8.913	***	2.304
	Tertiary Educated Mother * HCHS	-3.923		3.567
	Tertiary Educated Mother * HCLS	-4.275		2.696
	Tertiary Educated Mother * LCHS	-4.519		6.472
	Tertiary Educated Father * HCHS	-3.247		3.318
	Tertiary Educated Father * HCLS	-0.935		2.398
	Tertiary Educated Father * LCHS	3.239		6.491
Cross-Level Interactions (Two-way)	Educational Expansion * HCHS	-0.160	**	0.050
	Educational Expansion * HCLS	-0.244	***	0.029
	Educational Expansion * LCHS	-0.029		0.076
	Tracking * HCHS	-0.982	*	0.443
	Tracking * HCLS	-0.519		0.292
	Tracking * LCHS	0.491		0.621
	Skills Diffusion * HCHS	-0.056		0.075
	Skills Diffusion * HCLS	-0.013		0.047
	Skills Diffusion * LCHS	-0.080		0.126
	Educational Expansion * Tertiary Educated Mother	-0.141	*	0.059
	Educational Expansion * Tertiary Educated Father	0.014		0.058
	Tracking * Tertiary Educated Mother	0.243		0.575
	Tracking * Tertiary Educated Father	-0.032		0.491
	Skills Diffusion * Tertiary Educated Mother	0.022		0.107
	Skills Diffusion * Tertiary Educated Father	-0.071		0.095

* continues on the next page

Independent Variable (Cont.)		Model 6'		
		B		S.E.
Cross-Level Interactions (Three-way)	Educational Expansion * Tertiary Educated Mother * HCHS	0.119		0.096
	Educational Expansion * Tertiary Educated Mother * HCLS	0.141		0.075
	Educational Expansion * Tertiary Educated Mother * LCHS	-0.009		0.174
	Educational Expansion * Tertiary Educated Father * HCHS	-0.024		0.094
	Educational Expansion * Tertiary Educated Father * HCLS	0.024		0.072
	Educational Expansion * Tertiary Educated Father * LCHS	-0.014		0.173
	Tracking * Tertiary Educated Mother * HCHS	0.734		0.892
	Tracking * Tertiary Educated Mother * HCLS	-0.252		0.749
	Tracking * Tertiary Educated Mother * LCHS	0.990		1.542
	Tracking * Tertiary Educated Father * HCHS	-0.265		0.816
	Tracking * Tertiary Educated Father * HCLS	-0.112		0.662
	Tracking * Tertiary Educated Father * LCHS	-0.478		1.370
	Skills Diffusion * Tertiary Educated Mother * HCHS	-0.117		0.163
	Skills Diffusion * Tertiary Educated Mother * HCLS	-0.081		0.133
	Skills Diffusion * Tertiary Educated Mother * LCHS	0.519		0.292
	Skills Diffusion * Tertiary Educated Father * HCHS	0.131		0.151
	Skills Diffusion * Tertiary Educated Father * HCLS	-0.133		0.120
	Skills Diffusion * Tertiary Educated Father * LCHS	-0.429		0.286
Level Two (Country)	Educational Expansion	0.076		0.067
	Index of Tracking	1.475	*	0.594
	Skills Diffusion	0.059		0.102
	GDP per capita (USD, PPP)/10,000	0.800		0.567
	Economic Structure (Share of Manufacturing)	-0.153		0.099
	Economic Structure (Share of Service)	-0.030		0.070
	Union Density	0.000		0.022
Variance	Random Effect Covariance Structure (Intercept)	3.603 **		
Model Fit	-2LL	238918.969		
	AIC	238922.969		

(*** p<0.001, ** p<0.01, * p<0.05) [two tailed] [N: Individual=30,284, Country=26］

Note: Data are unweighted.

H. Multilevel Linear Regression of Earnings (Logarithm of Earnings)

This table illustrates the result of a multilevel linear regression analysis of earnings, using a continuous measure for the dependent variable (logarithm of the absolute amount of monthly earnings) as with Appendix C in Chapter 2. The number of samples is therefore limited to approximately 16,000 in 20 countries. Independent variables are the same as Model 6 and Model 7 of the multilevel ordered logistic regression analysis of earnings quintiles (see Table IV-5). Equation is as follows.

$$
\begin{aligned}
Y_{ij} = {} & \gamma_{00} + \gamma_{10}M_{ij} + \gamma_{20}A_{ij} + \gamma_{30}I_{ij} + \gamma_{40}ME_{ij} + \gamma_{50}FE_{ij} + \gamma_{60}W_{ij} + \gamma_{70}HCHS_{ij} + \gamma_{80}HCLS_{ij} \\
& + \gamma_{90}LCHS_{ij} + \gamma_{470}ME_{ij}HCHS_{ij} + \gamma_{480}ME_{ij}HCLS_{ij} + \gamma_{490}ME_{ij}LCHS_{ij} \\
& + \gamma_{570}FE_{ij}HCHS_{ij} + \gamma_{580}FE_{ij}HCLS_{ij} + \gamma_{590}FE_{ij}LCHS_{ij} + \gamma_{01}E_j + \gamma_{02}T_j + \gamma_{03}S_j \\
& + \gamma_{04}G_j + \gamma_{05}Em_j + \gamma_{06}Es_j + \gamma_{07}U_j + \gamma_{41}ME_{ij}E_j + \gamma_{51}FE_{ij}E_j + \gamma_{42}ME_{ij}T_j \\
& + \gamma_{52}FE_{ij}T_j + \gamma_{43}ME_{ij}S_j + \gamma_{53}FE_{ij}S_j + \gamma_{71}HCHS_{ij}E_j + \gamma_{81}HCLS_{ij}E_j \\
& + \gamma_{91}LCHS_{ij}E_j + \gamma_{72}HCHS_{ij}T_j + \gamma_{82}HCLS_{ij}T_j + \gamma_{92}LCHS_{ij}T_j + \gamma_{73}HCHS_{ij}S_j \\
& + \gamma_{83}HCLS_{ij}S_j + \gamma_{93}LCHS_{ij}S_j + \gamma_{471}ME_{ij}HCHS_{ij}E_j + \gamma_{481}ME_{ij}HCLS_{ij}E_j \\
& + \gamma_{491}ME_{ij}LCHS_{ij}E_j + \gamma_{571}FE_{ij}HCHS_{ij}E_j + \gamma_{581}FE_{ij}HCLS_{ij}E_j \\
& + \gamma_{591}FE_{ij}LCHS_{ij}E_j + \gamma_{472}ME_{ij}HCHS_{ij}T_j + \gamma_{482}ME_{ij}HCLS_{ij}T_j \\
& + \gamma_{492}ME_{ij}LCHS_{ij}T_j + \gamma_{572}FE_{ij}HCHS_{ij}T_j + \gamma_{582}FE_{ij}HCLS_{ij}T_j \\
& + \gamma_{592}FE_{ij}LCHS_{ij}T_j + \gamma_{473}ME_{ij}HCHS_{ij}S_j + \gamma_{483}ME_{ij}HCLS_{ij}S_j \\
& + \gamma_{493}ME_{ij}LCHS_{ij}S_j + \gamma_{573}FE_{ij}HCHS_{ij}S_j + \gamma_{583}FE_{ij}HCLS_{ij}S_j + \gamma_{593}FE_{ij}LCHS_{ij}S_j \\
& + u_{0j} + \varepsilon_{ij}
\end{aligned}
$$

where Y_{ij}=the logarithm of earnings for individual i in country j, and other parameters are the same as equation (7b) in the main manuscript. Also, in line with Model 7, three dummy variables concerning occupations ($\gamma_{100}So_{ij}, \gamma_{110}Sw_{ij}$, and $\gamma_{120}Sb_{ij}$) are added to the above model.

The result of multilevel linear regression of continuous earnings reveals that, as with Model 6 and Model 7 in the main manuscript, a tertiary educated father dummy demonstrates a significant positive effect in the linear model (γ_{50}=0.402 for Model 6' and 0.357 for Model 7') whereas the coefficient of mother's education is insignificant. In addition, while the significant negative coefficients of interaction terms between skills diffusion and high credentials (both HCHS and HCLS) are also confirmed in this analysis, interactions between parental education and educational specifications do not show any significant effects.

In the meantime, three-way interaction terms yield different pictures between the analysis of earnings quintiles and that of the logarithm of earnings. In Model 6', instead of interactions between educational expansion/skills diffusion, tertiary educated mother, and HCLS whose coefficients are significantly positive/negative respectively in Model 6 in the main manuscript (see Table IV-5), one three-way interaction between tracking, mother's education, and LCHS shows a significant positive coefficient. Furthermore, the coefficient of the three-way interaction between educational expansion, tertiary educated father, and HCLS in Model 7' is also significantly positive, which is not confirmed in Model 7. Nevertheless, both in Model 6' and Model 7', all the two-way interactions among variables that consist of the said three-way interactions do not demonstrate any significant effects.

Further investigations with more elaborate data are needed to elucidate concrete mechanisms that generate these nuanced relationships. However, incorporating the discussion in Appendix C, one may assume that societal educational conditions including the degree of educational expansion and tracking might intensify the advantage of educated parents among specific educational groups without hindering monetary returns to high credentials and high skills as far as absolute terms (i.e. logarithms of earnings) are concerned. Although the positive influences of educational expansion and skills diffusion on the impact of origins are also implied by the analysis

of relative earnings (i.e. γ_{43} and γ_{481} are significantly positive in Model 6 in Table IV-5), it is important to note that these associations are put forward with some adverse effects (i.e. γ_{483} and γ_{81} are significantly negative), which are not confirmed in the analysis of absolute earnings. Given the limited number of countries/samples in this analysis, however, further comparisons focused on both categorical and continuous measures are essential to conclude that there is the said difference in the OED structure between relative and absolute monetary rewards.

Multilevel Linear Regression of the Logarithm of Earnings

Independent Variable		Model 6'			Model 7'		
		B		S.E.	B		S.E.
Intercept		5.401	***	0.370	5.144	***	0.387
Level One (Individual)	Men (dummy)	0.378	***	0.012	0.358	***	0.013
	Age (35-39 years old dummy)	-0.078	***	0.013	-0.074	***	0.013
	First Generation Immigrant (dummy)	-0.077	***	0.020	-0.032		0.020
	Tertiary Educated Mother (dummy)	-0.025		0.194	-0.137		0.190
	Tertiary Educated Father (dummy)	0.402	*	0.170	0.357	*	0.166
	Years of Paid Work	0.029	***	0.001	0.026	***	0.001
	Educational Specifications (Reference = Neither High Credential nor High Skills: LCLS)						
	High Credential & High Skills (HCHS)	0.664	***	0.128	0.426	**	0.126
	Only High Credential without High Skills (HCLS)	0.719	***	0.071	0.446	***	0.070
	Only High Skills without High Credential (LCHS)	0.458	**	0.177	0.364	*	0.174
	Occupations (Reference = Elementary Occupations)						
	Skilled Occupation				0.539	***	0.027
	Semi-skilled White Collar				0.211	***	0.027
	Semi-skilled Blue Collar				0.274	***	0.028
	Tertiary Educated Mother * HCHS	0.268		0.293	0.342		0.288
	Tertiary Educated Mother * HCLS	-0.045		0.233	0.067		0.229
	Tertiary Educated Mother * LCHS	-0.312		0.539	-0.191		0.528
	Tertiary Educated Father * HCHS	-0.306		0.273	-0.301		0.268
	Tertiary Educated Father * HCLS	-0.334		0.208	-0.331		0.204
	Tertiary Educated Father * LCHS	-0.032		0.513	-0.200		0.503
Cross-Level Interactions (Two-way)	Educational Expansion * HCHS	0.007		0.004	0.008		0.004
	Educational Expansion * HCLS	-0.006	*	0.002	-0.003		0.002
	Educational Expansion * LCHS	-0.010		0.007	-0.010		0.007
	Tracking * HCHS	-0.008		0.036	0.005		0.035
	Tracking * HCLS	-0.003		0.024	0.002		0.024
	Tracking * LCHS	-0.095		0.056	-0.099		0.055
	Skills Diffusion * HCHS	-0.025	***	0.006	-0.024	***	0.005
	Skills Diffusion * HCLS	-0.009	*	0.003	-0.009	**	0.003
	Skills Diffusion * LCHS	0.006		0.010	0.007		0.010
	Educational Expansion * Tertiary Educated Mother	0.000		0.006	0.003		0.006
	Educational Expansion * Tertiary Educated Father	-0.008		0.006	-0.009		0.006
	Tracking * Tertiary Educated Mother	-0.055		0.055	-0.051		0.054
	Tracking * Tertiary Educated Father	-0.052		0.048	-0.056		0.047
	Skills Diffusion * Tertiary Educated Mother	0.000		0.009	-0.001		0.009
	Skills Diffusion * Tertiary Educated Father	-0.004		0.008	-0.002		0.008

* continues on the next page

Independent Variable (Cont.)		Model 6'			Model 7'		
		B		S.E.	B		S.E.
Cross-Level	Educational Expansion * Tertiary Educated Mother * HCHS	-0.009		0.009	-0.011		0.009
Interactions	Educational Expansion * Tertiary Educated Mother * HCLS	0.002		0.007	-0.001		0.007
(Three-way)	Educational Expansion * Tertiary Educated Mother * LCHS	0.012		0.019	0.005		0.019
	Educational Expansion * Tertiary Educated Father * HCHS	0.008		0.009	0.010		0.009
	Educational Expansion * Tertiary Educated Father * HCLS	0.013		0.007	0.013	*	0.007
	Educational Expansion * Tertiary Educated Father * LCHS	0.009		0.017	0.016		0.017
	Tracking * Tertiary Educated Mother * HCHS	0.035		0.079	0.030		0.077
	Tracking * Tertiary Educated Mother * HCLS	0.004		0.069	-0.001		0.067
	Tracking * Tertiary Educated Mother * LCHS	0.351	*	0.150	0.276		0.148
	Tracking * Tertiary Educated Father * HCHS	0.038		0.072	0.039		0.071
	Tracking * Tertiary Educated Father * HCLS	0.064		0.061	0.071		0.060
	Tracking * Tertiary Educated Father * LCHS	-0.059		0.130	-0.017		0.128
	Skills Diffusion * Tertiary Educated Mother * HCHS	0.001		0.013	0.003		0.013
	Skills Diffusion * Tertiary Educated Mother * HCLS	0.001		0.010	0.003		0.010
	Skills Diffusion * Tertiary Educated Mother * LCHS	0.012		0.026	0.017		0.026
	Skills Diffusion * Tertiary Educated Father * HCHS	0.010		0.012	0.006		0.011
	Skills Diffusion * Tertiary Educated Father * HCLS	-0.009		0.009	-0.008		0.009
	Skills Diffusion * Tertiary Educated Father * LCHS	-0.031		0.025	-0.033		0.024
Level Two (Country)	Educational Expansion	0.006		0.005	0.006		0.005
	Index of Tracking	-0.004		0.053	-0.023		0.055
	Skills Diffusion	0.001		0.007	-0.001		0.008
	GDP per capita (USD, PPP)/10,000	0.280	***	0.042	0.271	***	0.044
	Economic Structure (Share of Manufacturing)	0.011		0.007	0.013		0.007
	Economic Structure (Share of Service)	0.002		0.005	0.003		0.005
	Union Density	0.003	*	0.002	0.003		0.002
Variance	Random Effect Covariance Structure (Intercept)	0.015 *			0.017 *		
Model Fit	-2LL	37113.355			36499.803		
	AIC	37117.355			36503.803		

(*** p<0.001, ** p<0.01, * p<0.05) [two tailed] [N: Individual=16,208, Country=20］

Note: Data are unweighted.

I. Logistic Regression of Occupations and Earnings by Country

As demonstrated in Appendix D in Chapter 2, the ED association varies across countries. It is therefore meaningful to conduct country-specific analyses focused on the OD association as well, using individual-level variables. Specific predictors include gender, cohort, immigrant background, parental education, work experience, and educational specifications. It is important to note that this model is the same as Appendix D with different focus (i.e. the impact of parental education instead of educational specifications). Equations are as follows.

Skilled Occupations

$$\log\left(\frac{p_i}{1-p_i}\right) = b_0 + b_1 M_i + b_2 A_i + b_3 I_i + b_4 ME_i + b_5 FE_i + b_6 W_i + b_7 HCHS_i + b_8 HCLS_i + b_9 LCHS_i + \varepsilon_i$$

where p_j=the probability of obtaining skilled occupations for individual i.

Earnings

$$Y_i^* = \beta_0 + \beta_1 M_i + \beta_2 A_i + \beta_3 I_i + \beta_4 ME_i + \beta_5 FE_i + \beta_6 W_i + b_7 HCHS_i + b_8 HCLS_i + b_9 LCHS_i + \varepsilon_i$$

where Y_i^* =latent response for individual i, and an observed response Y_i (earnings quintiles) can be determined by thresholds (τ_n) as following.

$$Y_i = \begin{cases} 1 \text{ if } & Y_i^* \le \tau_1 \\ 2 \text{ if } & \tau_1 < Y_i^* \le \tau_2 \\ 3 \text{ if } & \tau_2 < Y_i^* \le \tau_3 \\ 4 \text{ if } & \tau_3 < Y_i^* \le \tau_4 \\ 5 \text{ if } & \tau_4 < Y_i^* \end{cases}$$

In addition to this model, only for the earnings analysis, three dummy variables related to occupations ($\beta_{10} So_i, \beta_{11} Sw_i,$ and $\beta_{12} Sb_i$) are further added for comparison.

The figures below illustrate the average marginal effects of tertiary educated mother and father respectively on occupational attainment and earnings (i.e. the probability of obtaining skilled occupations and earnings quintiles by parental education) in each country. As with the ED association, there are several patterns concerning the OD association.[57]

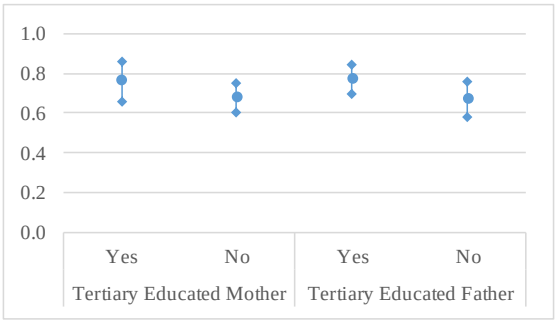
In most countries including Austria, Czech Republic, Germany, Greece, Ireland, Korea, the United Kingdom, and the United States, the impact of father's education on the probability of acquiring skilled occupations is significant, whereas mother's education does not demonstrate a significant effect. In contrast, only maternal education is significantly associated with children's chance of skilled occupations in several countries, such as France, the Netherlands, and Spain. Meanwhile, the significant coefficient is confirmed for both tertiary educated mothers and fathers in Belgium, Canada, Denmark, Israel, and Slovenia, whereas the significant association between occupational attainment and parental education is not observed in Finland, Italy, New Zealand, and Sweden.

With regard to monetary rewards, the significant relationship between parental education and earnings quintiles is not confirmed in most countries. However, in several countries such as Chile, Denmark, Finland, Norway, Slovenia, Turkey, the United Kingdom, and the United States, only father's education demonstrates a significant positive effect on the probability of attaining better earnings. By contrast, in Austria, the coefficient of tertiary educated mother is significantly positive, whereas the significant impact of tertiary educated father is not observed. In the meantime, once occupations are controlled for, merely five countries, namely, Chile, Norway, Turkey, the United Kingdom, and the United States, witness a significant positive impact of father's education on earnings quintiles.

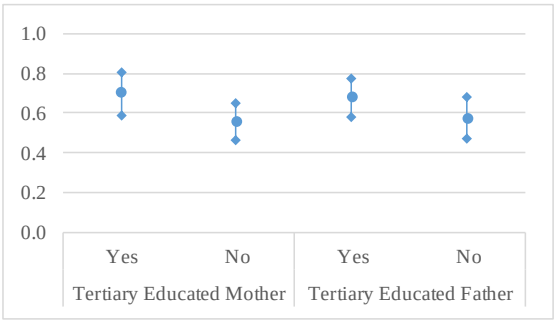
[57] Abbreviations are the same as Figure II-2. Some countries are omitted because of the data limitation.

Skilled Occupations

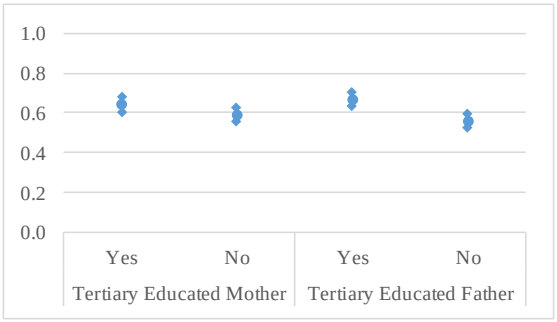
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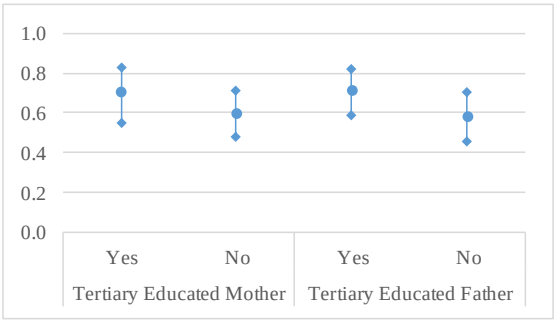
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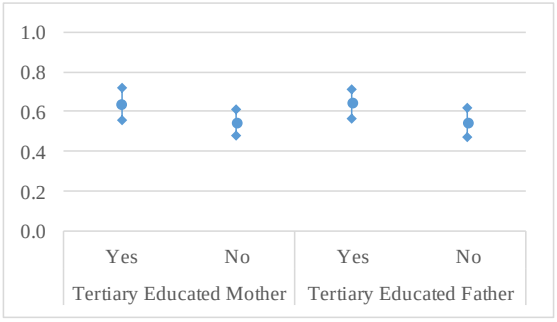
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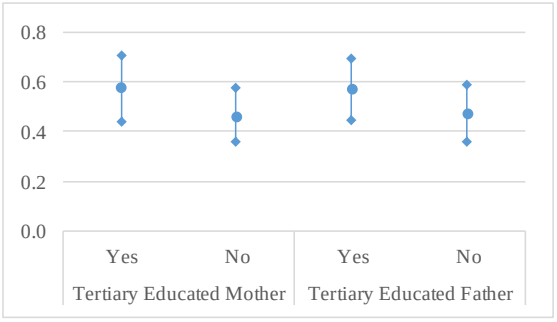
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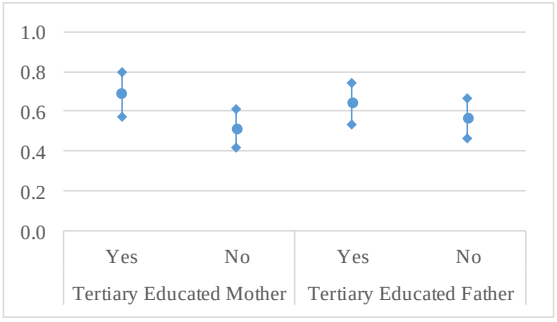
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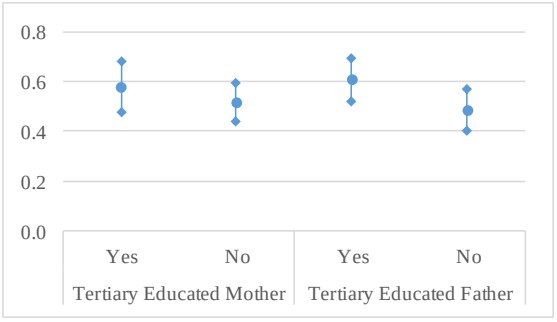
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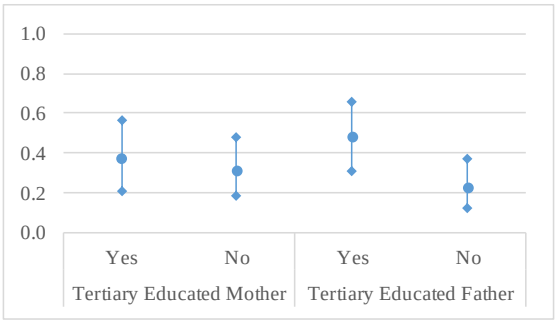
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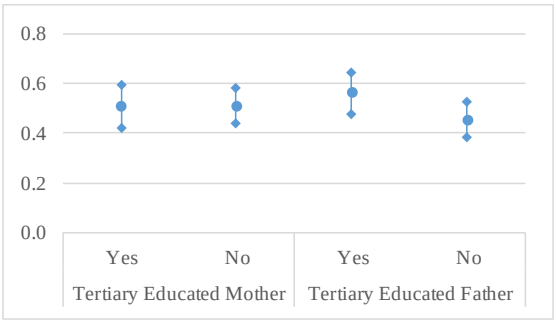
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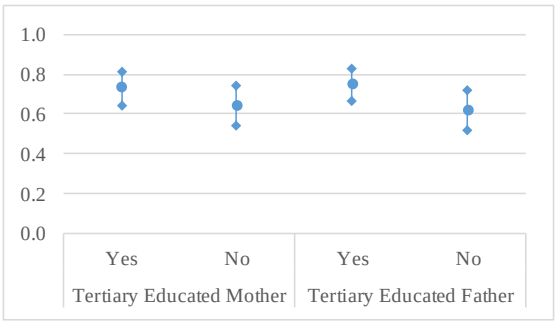
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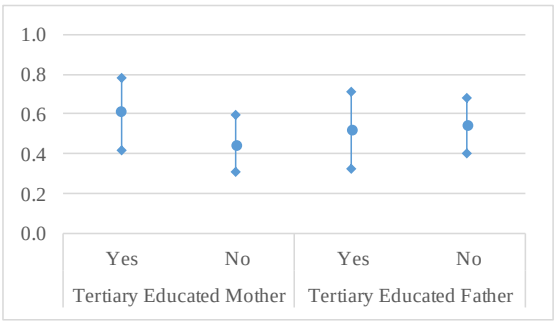
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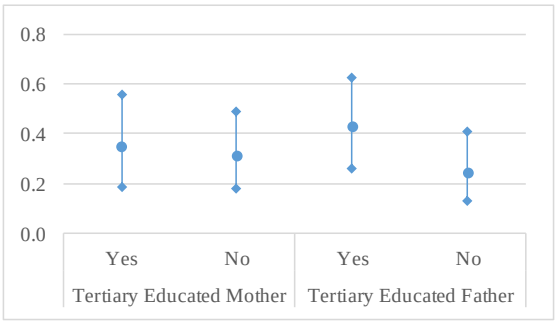
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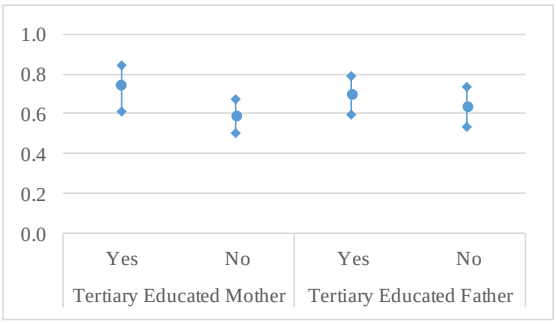
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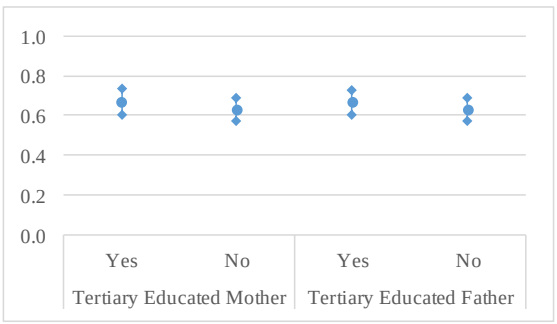
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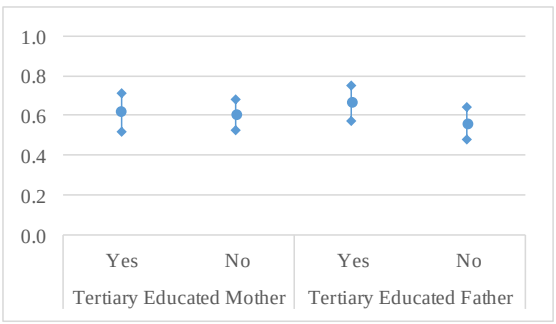
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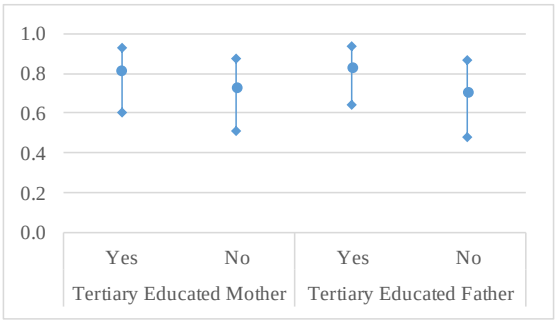
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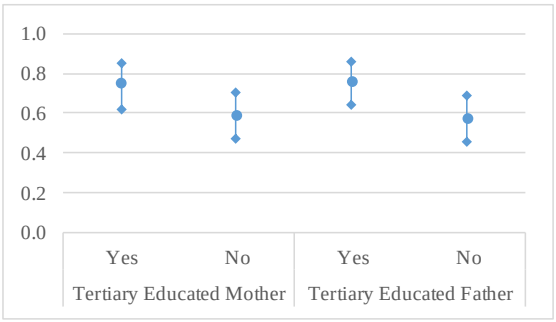
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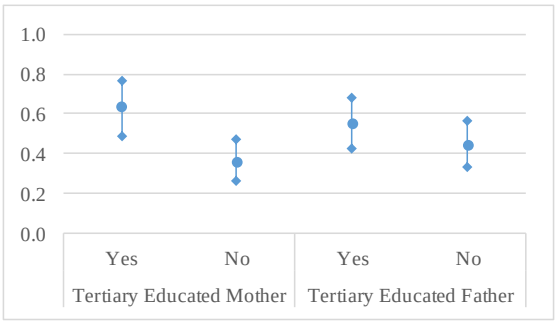
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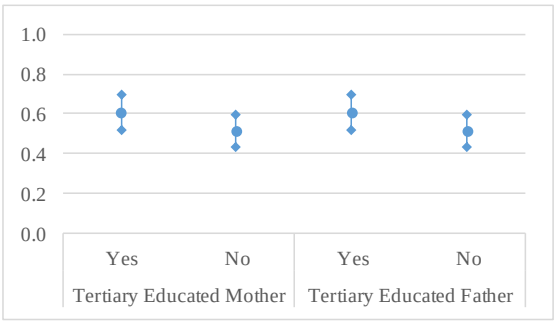
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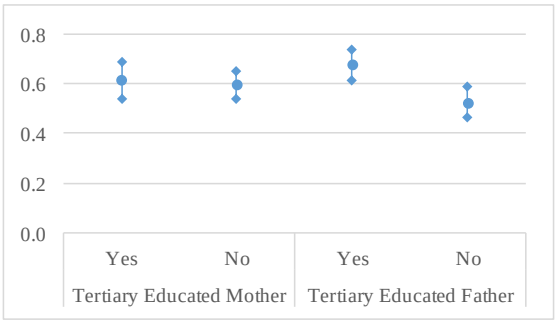
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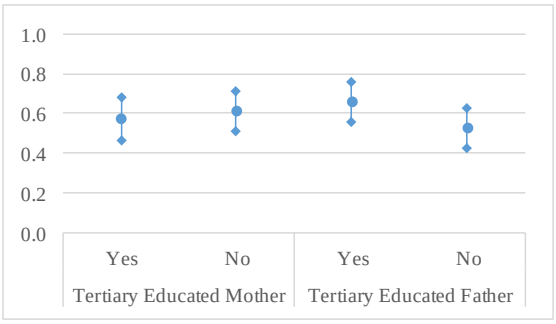
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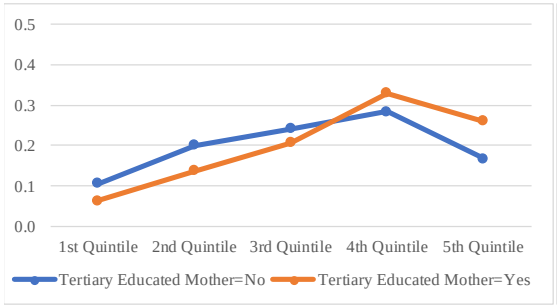


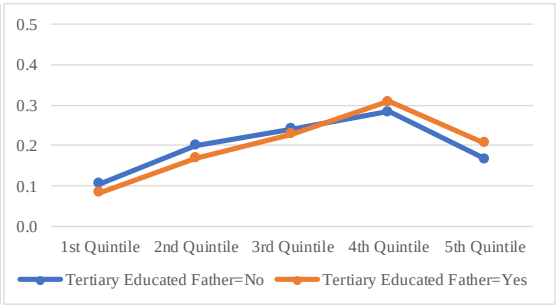
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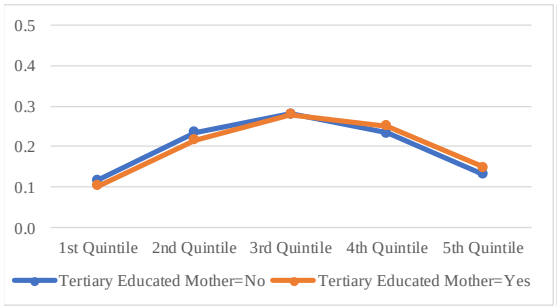
Earnings Quintiles (without occupations as control variables)

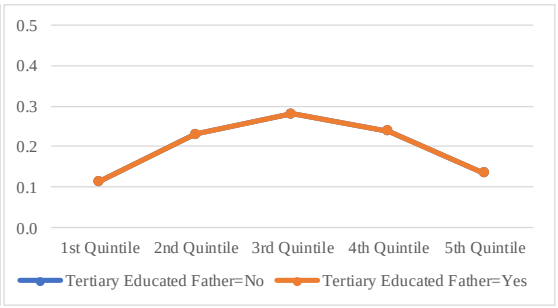
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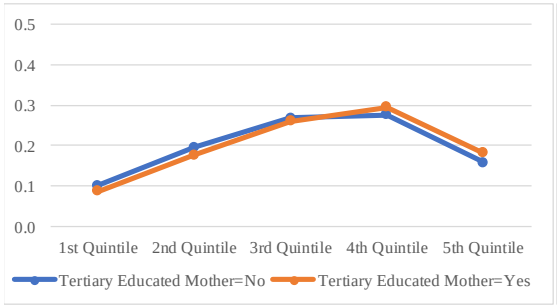


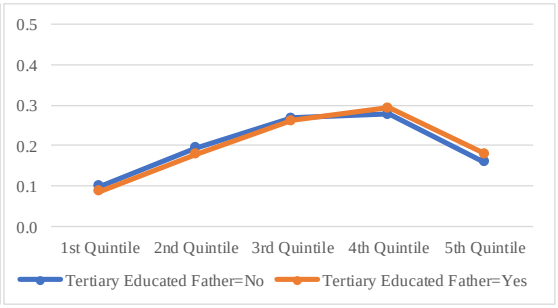
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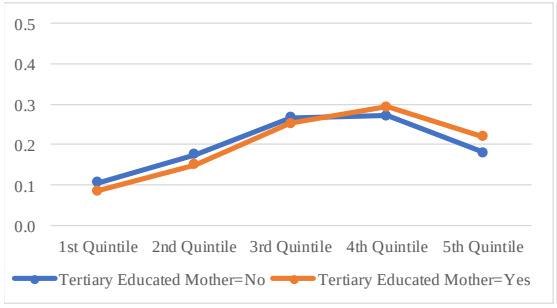


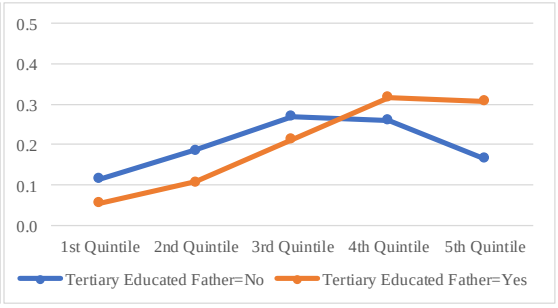
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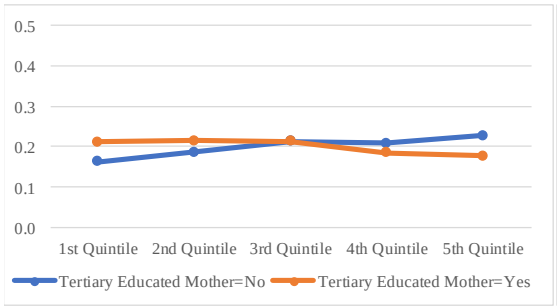


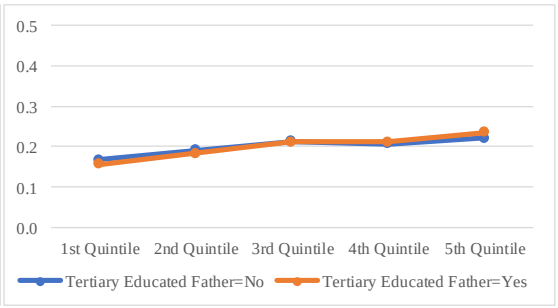
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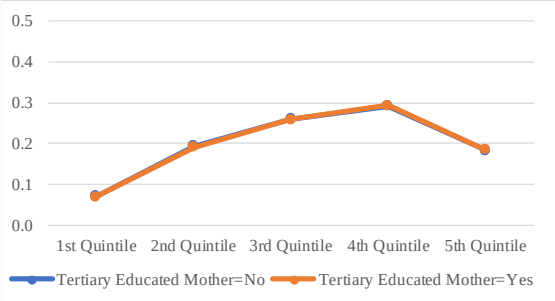


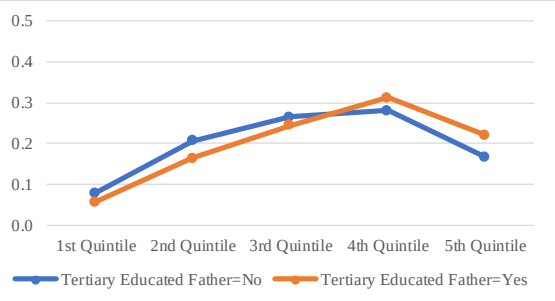
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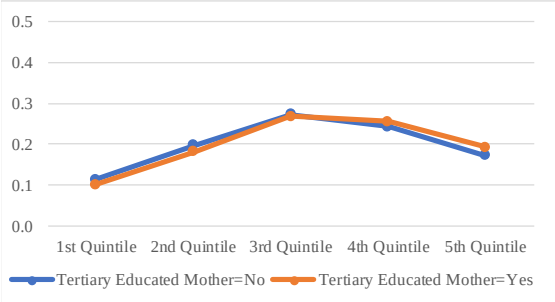


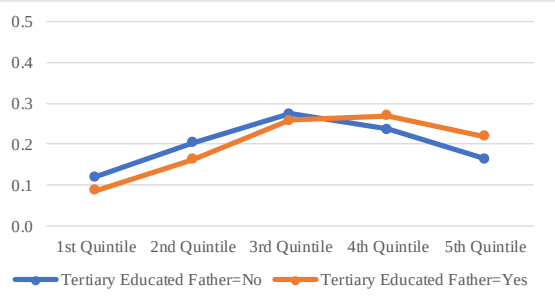
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1st Quintile 2nd Quintile 3rd Quintile 4th Quintile 5th Quintile
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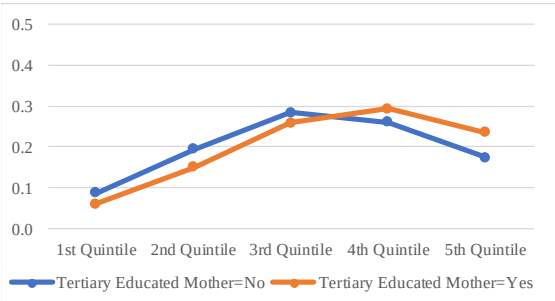

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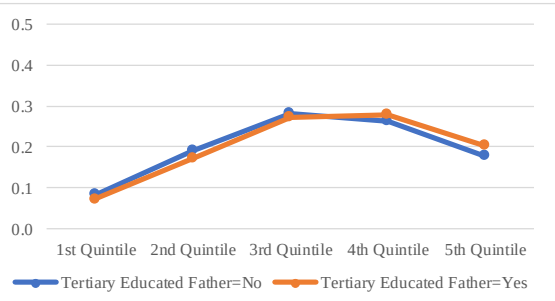
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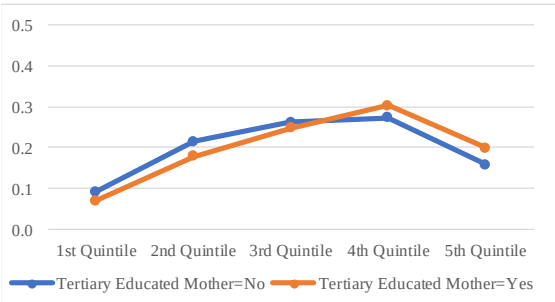

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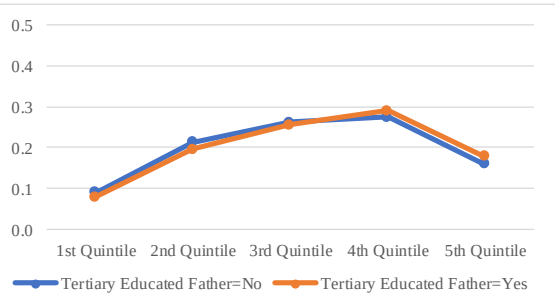
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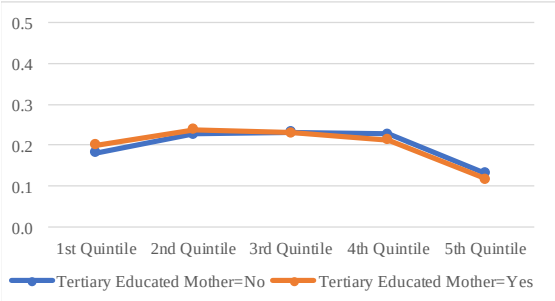

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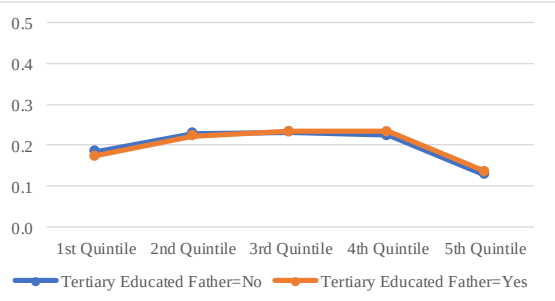
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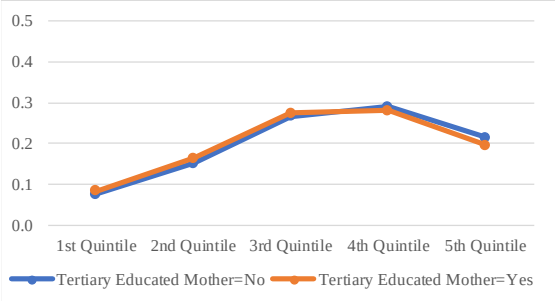

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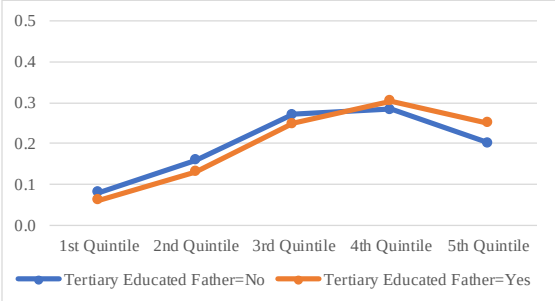
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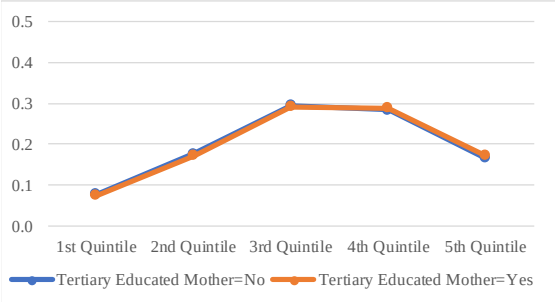

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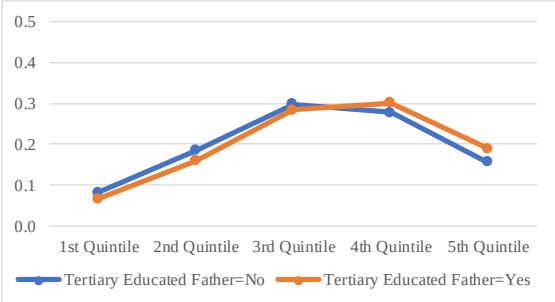
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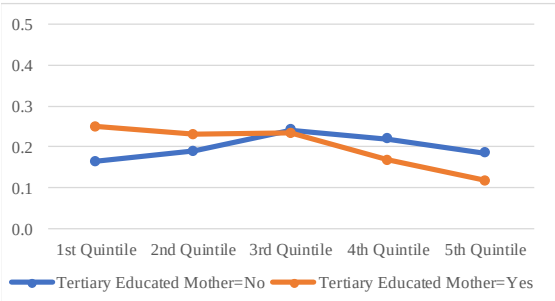

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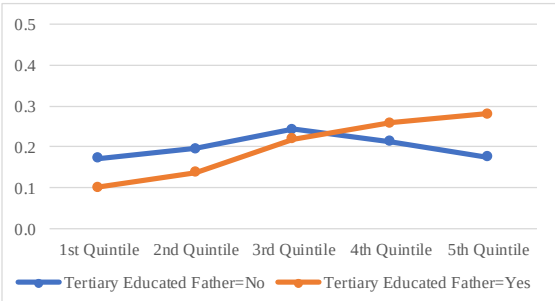
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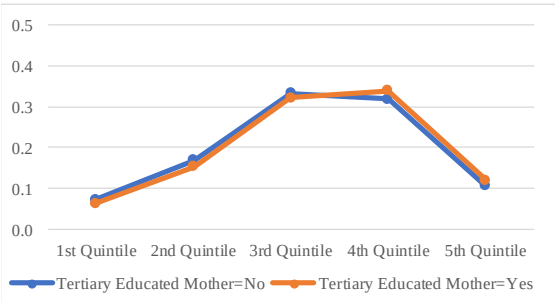

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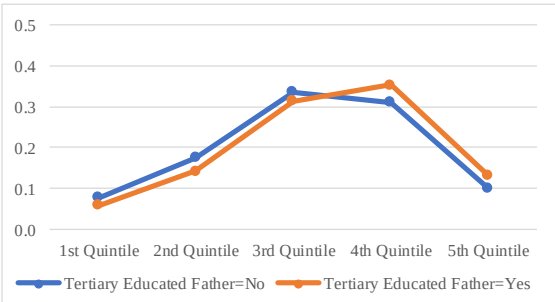
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Tertiary Educated Mother=Yes

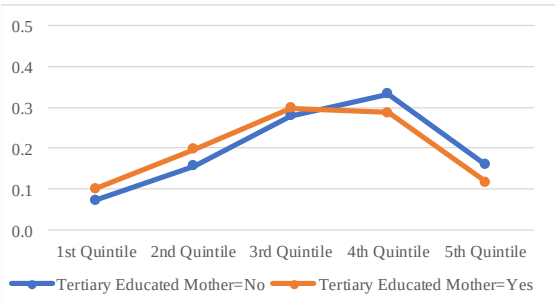

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0.4
0.3
0.2
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1st Quintile 2nd Quintile 3rd Quintile 4th Quintile 5th Quintile
Tertiary Educated Father=No
Tertiary Educated Father=Yes

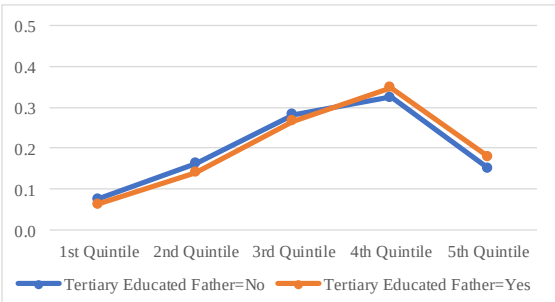
JP


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1st Quintile 2nd Quintile 3rd Quintile 4th Quintile 5th Quintile
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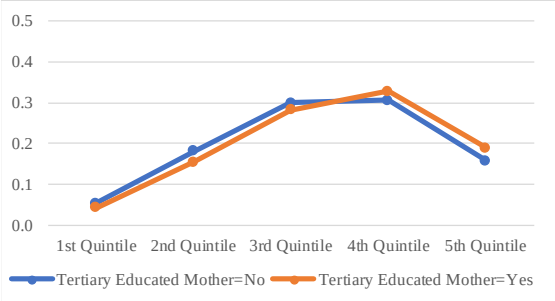

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1st Quintile 2nd Quintile 3rd Quintile 4th Quintile 5th Quintile
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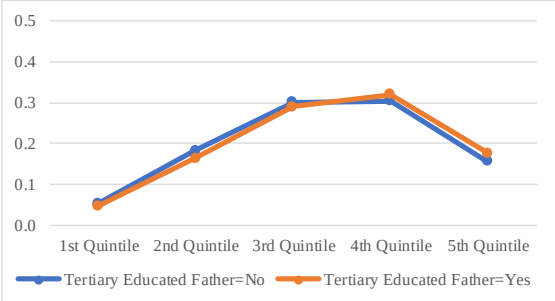
KR


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1st Quintile 2nd Quintile 3rd Quintile 4th Quintile 5th Quintile
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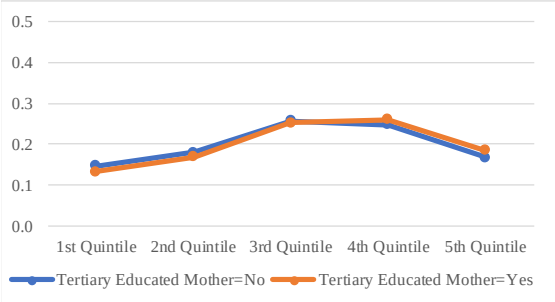

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0.4
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1st Quintile 2nd Quintile 3rd Quintile 4th Quintile 5th Quintile
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Tertiary Educated Father=Yes

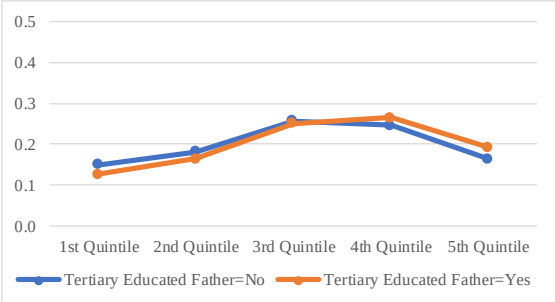
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2nd Quintile
3rd Quintile
4th Quintile
5th Quintile
Tertiary Educated Mother=No
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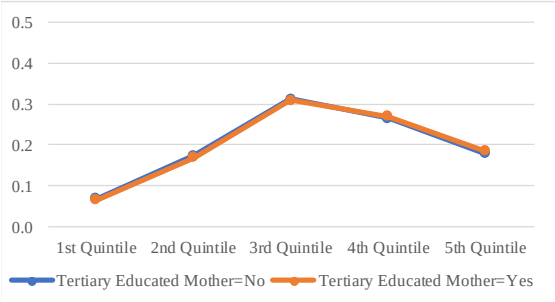

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0.4
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3rd Quintile
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5th Quintile
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Tertiary Educated Father=Yes

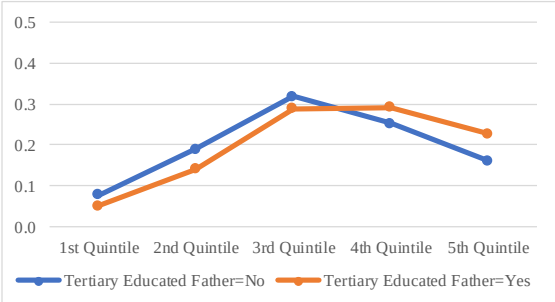
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4th Quintile
5th Quintile
Tertiary Educated Mother=No
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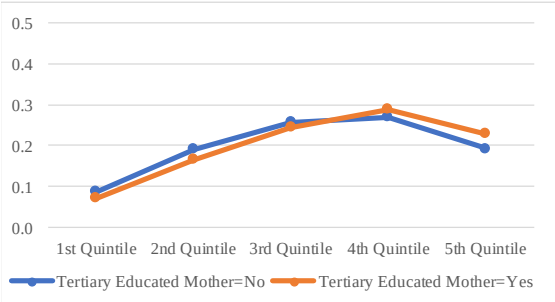

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1st Quintile
2nd Quintile
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5th Quintile
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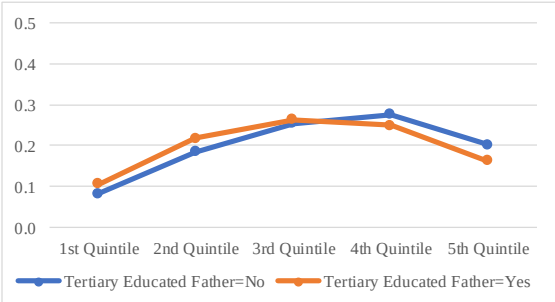
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1st Quintile
2nd Quintile
3rd Quintile
4th Quintile
5th Quintile
Tertiary Educated Mother=No
Tertiary Educated Mother=Yes

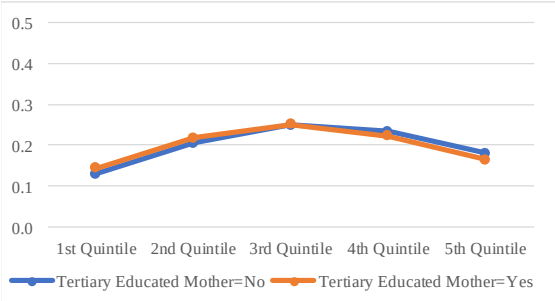

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1st Quintile
2nd Quintile
3rd Quintile
4th Quintile
5th Quintile
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Tertiary Educated Father=Yes

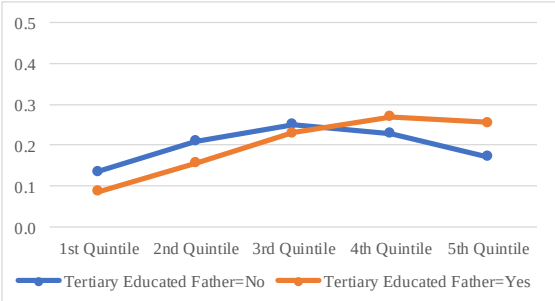
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4th Quintile
5th Quintile
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Tertiary Educated Mother=Yes

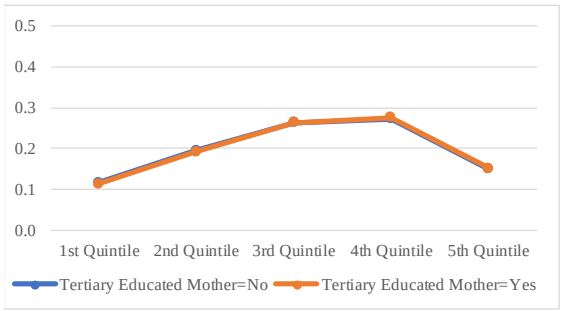

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2nd Quintile
3rd Quintile
4th Quintile
5th Quintile
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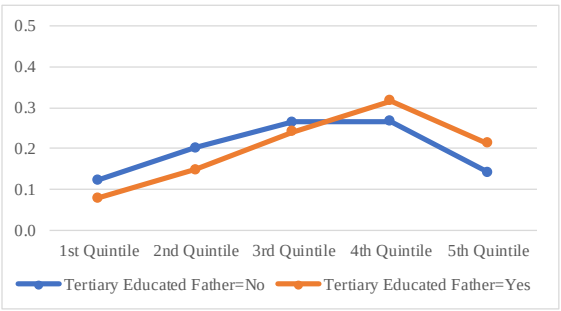
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5th Quintile
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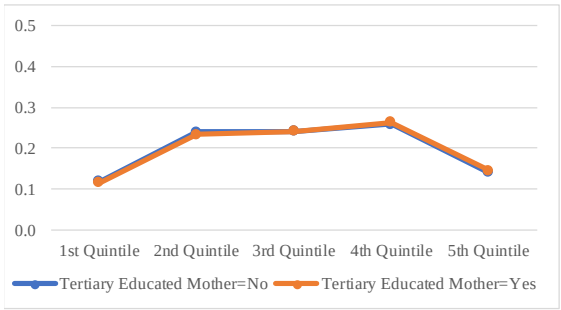

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2nd Quintile
3rd Quintile
4th Quintile
5th Quintile
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Tertiary Educated Father=Yes

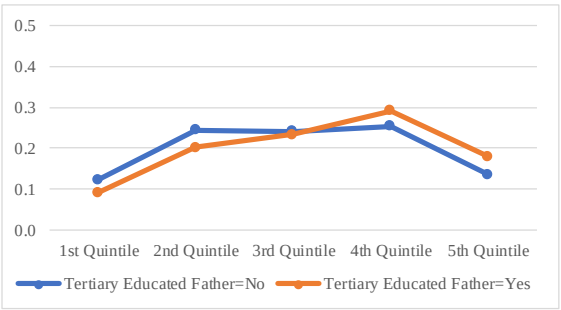
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1st Quintile 2nd Quintile 3rd Quintile 4th Quintile 5th Quintile
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Tertiary Educated Mother=Yes

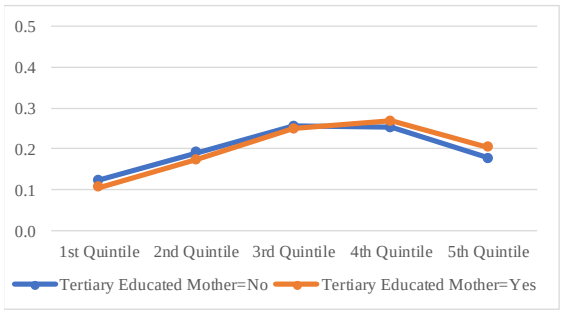

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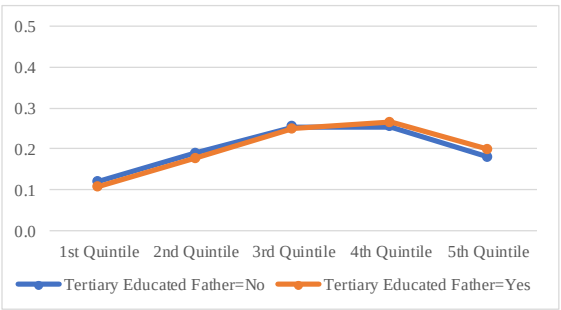
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Tertiary Educated Mother=Yes

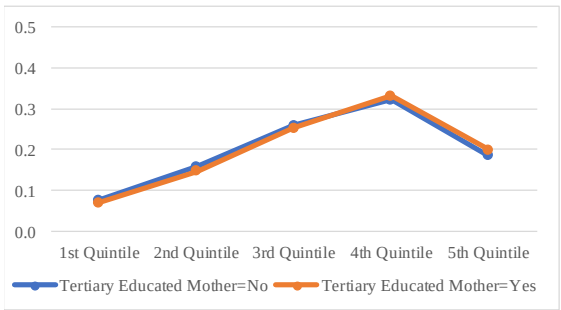

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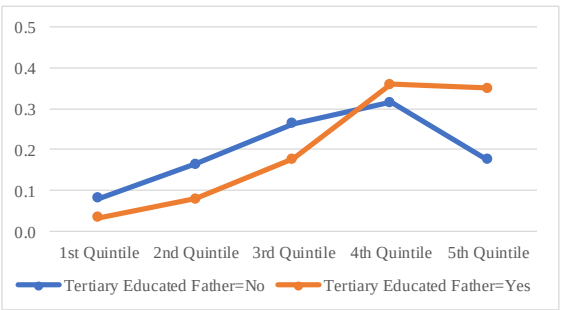
SE


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1st Quintile 2nd Quintile 3rd Quintile 4th Quintile 5th Quintile
Tertiary Educated Mother=No
Tertiary Educated Mother=Yes

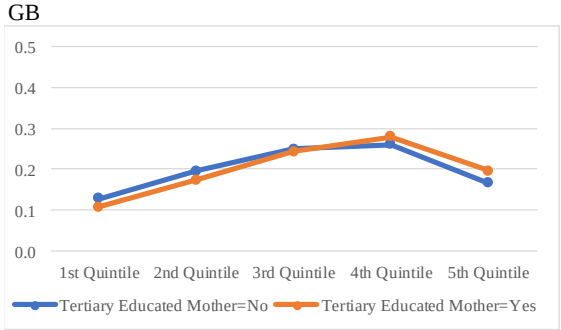

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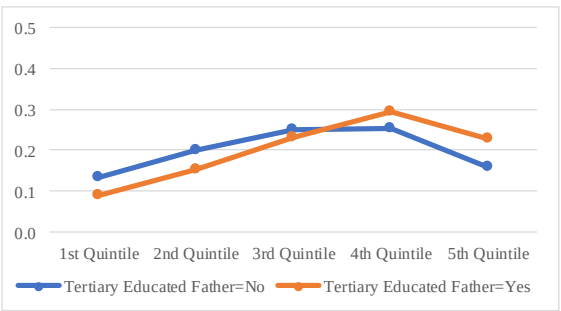
TR


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1st Quintile 2nd Quintile 3rd Quintile 4th Quintile 5th Quintile
Tertiary Educated Mother=No
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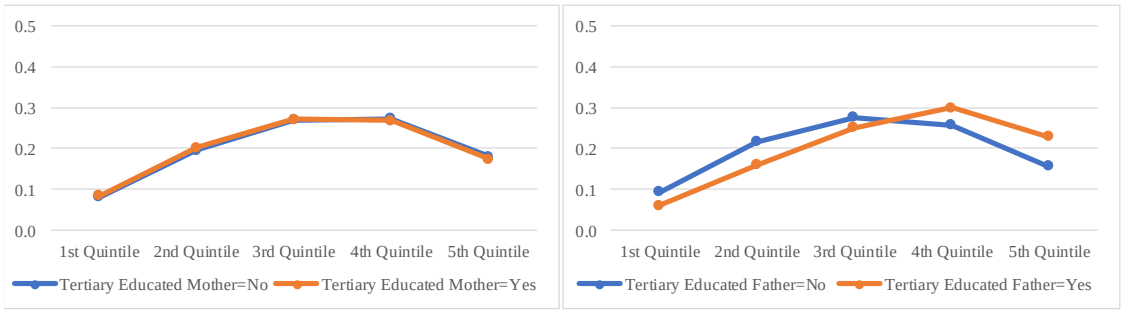

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0.0
1st Quintile 2nd Quintile 3rd Quintile 4th Quintile 5th Quintile
Tertiary Educated Father=No
Tertiary Educated Father=Yes

GB


0.5
0.4
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0.2
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0.0
1st Quintile 2nd Quintile 3rd Quintile 4th Quintile 5th Quintile
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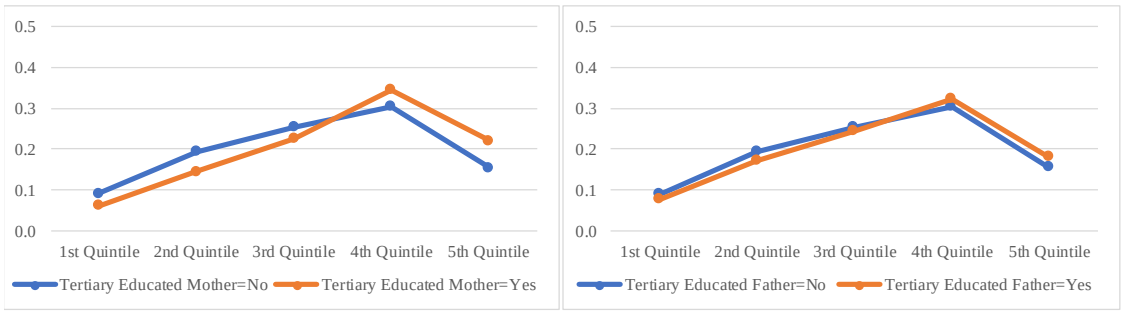

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0.4
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Tertiary Educated Father=No
Tertiary Educated Father=Yes

US

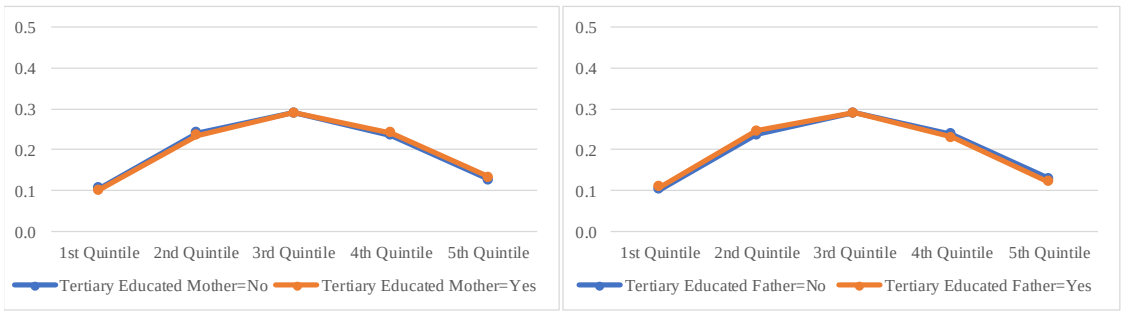


Earnings Quintiles (with occupations as control variables)

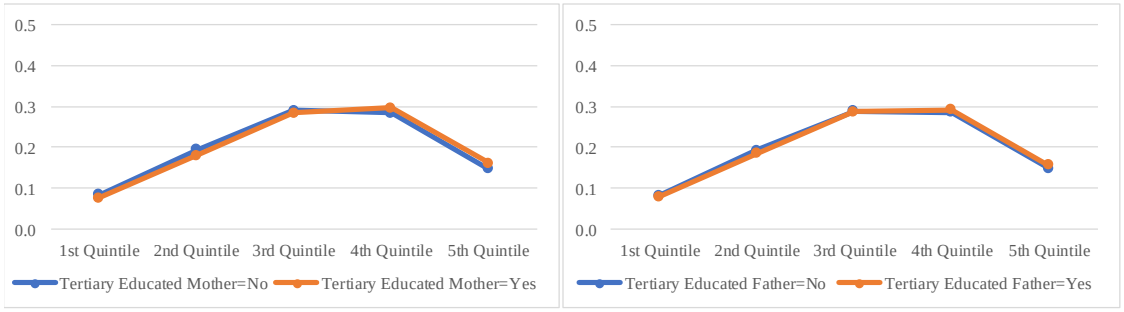
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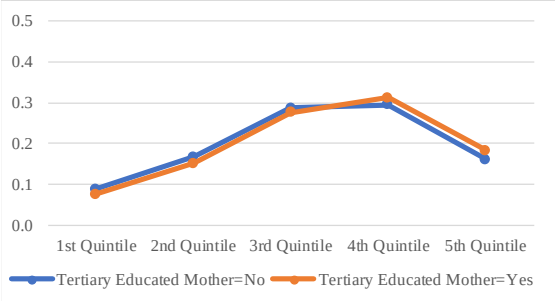
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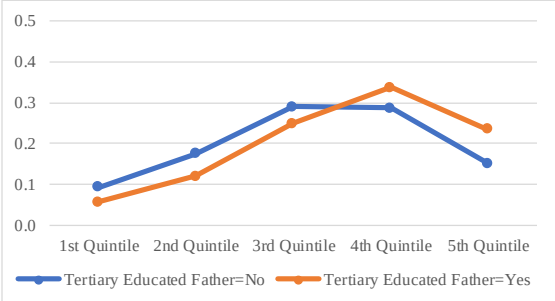


CA

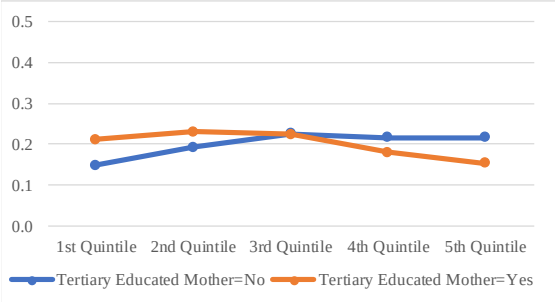


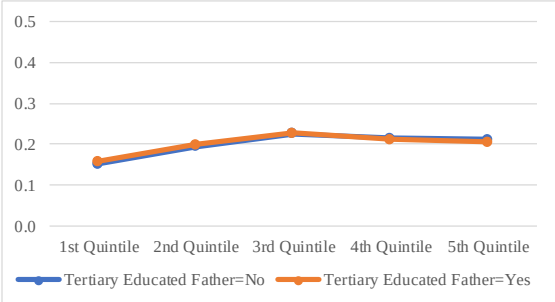
CL


0.5
0.4
0.3
0.2
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0.0
1st Quintile 2nd Quintile 3rd Quintile 4th Quintile 5th Quintile
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Tertiary Educated Mother=Yes

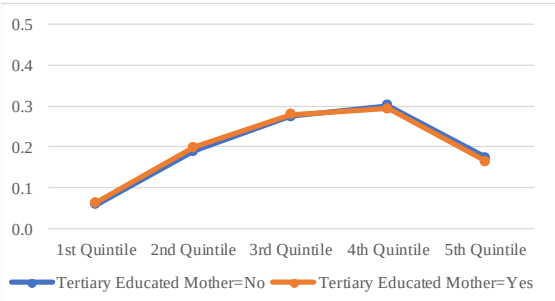

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0.4
0.3
0.2
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0.0
1st Quintile 2nd Quintile 3rd Quintile 4th Quintile 5th Quintile
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Tertiary Educated Father=Yes

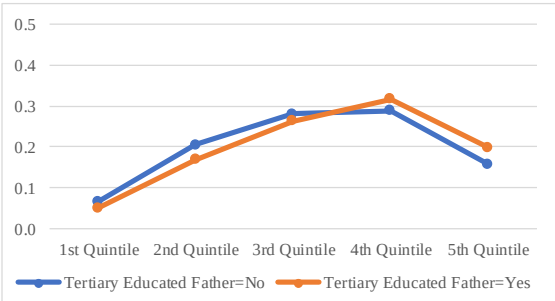
CZ


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0.0
1st Quintile 2nd Quintile 3rd Quintile 4th Quintile 5th Quintile
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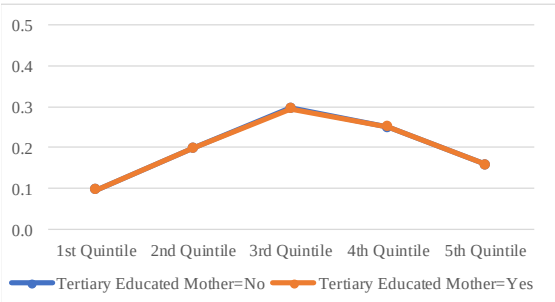

0.5
0.4
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0.0
1st Quintile 2nd Quintile 3rd Quintile 4th Quintile 5th Quintile
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Tertiary Educated Father=Yes

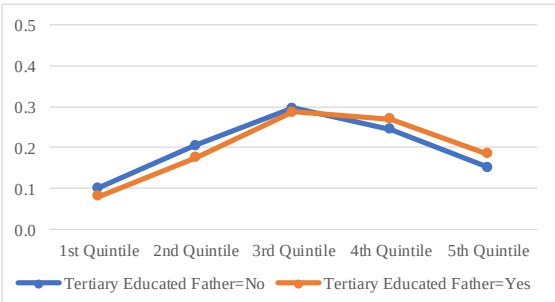
DK


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1st Quintile 2nd Quintile 3rd Quintile 4th Quintile 5th Quintile
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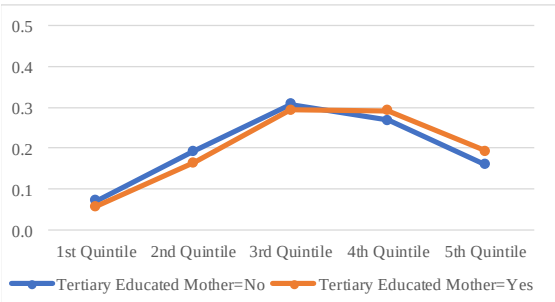

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0.0
1st Quintile 2nd Quintile 3rd Quintile 4th Quintile 5th Quintile
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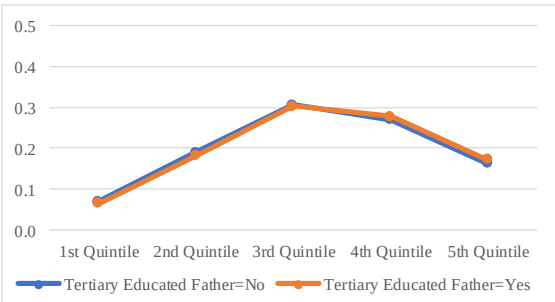
FI


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0.0
1st Quintile 2nd Quintile 3rd Quintile 4th Quintile 5th Quintile
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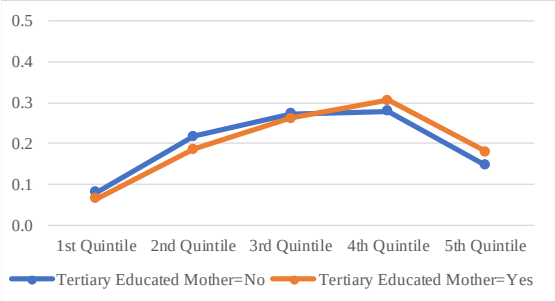

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0.0
1st Quintile 2nd Quintile 3rd Quintile 4th Quintile 5th Quintile
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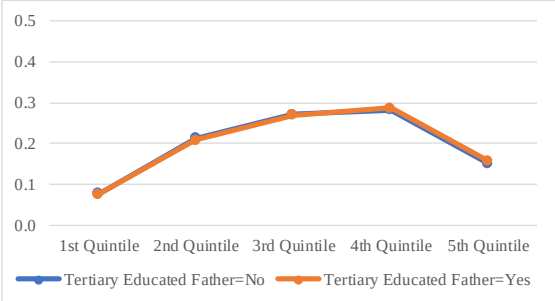
FR


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1st Quintile 2nd Quintile 3rd Quintile 4th Quintile 5th Quintile
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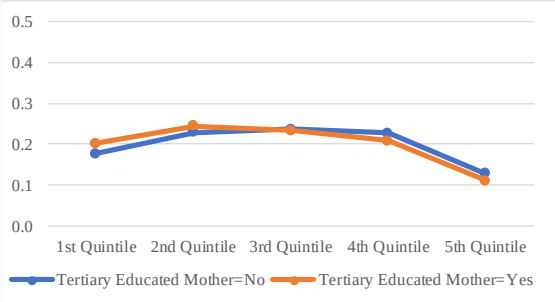

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0.0
1st Quintile 2nd Quintile 3rd Quintile 4th Quintile 5th Quintile
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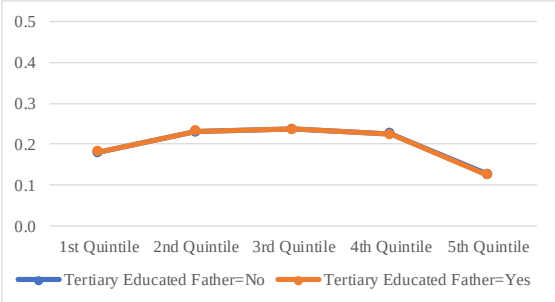
DE


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1st Quintile 2nd Quintile 3rd Quintile 4th Quintile 5th Quintile
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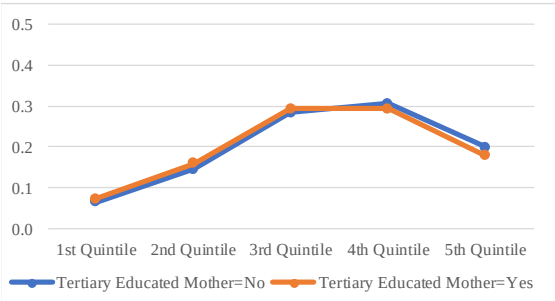

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0.4
0.3
0.2
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0.0
1st Quintile 2nd Quintile 3rd Quintile 4th Quintile 5th Quintile
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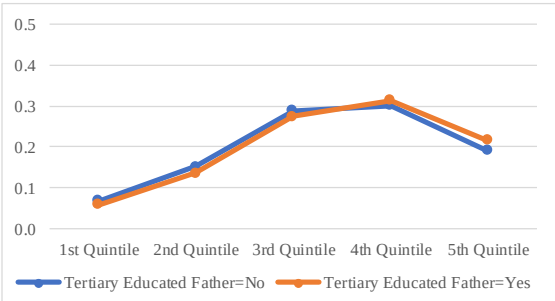
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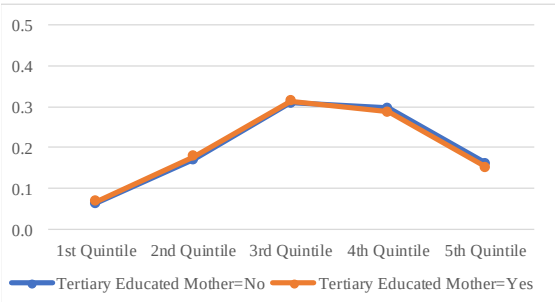

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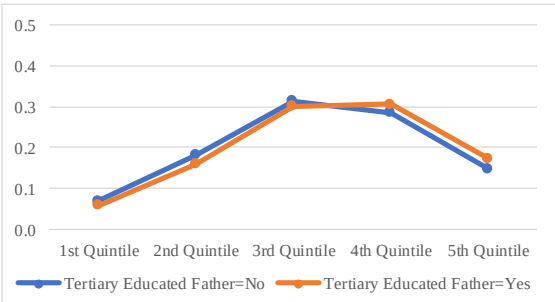
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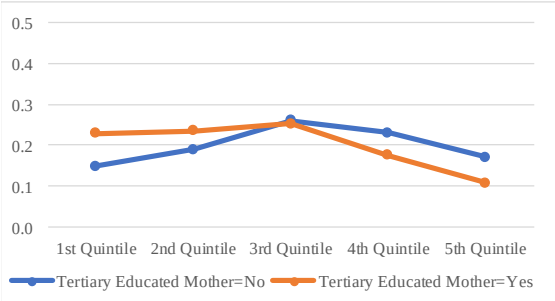

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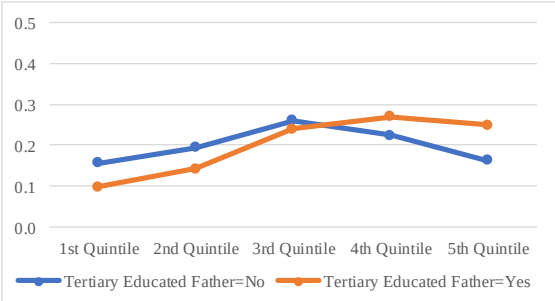
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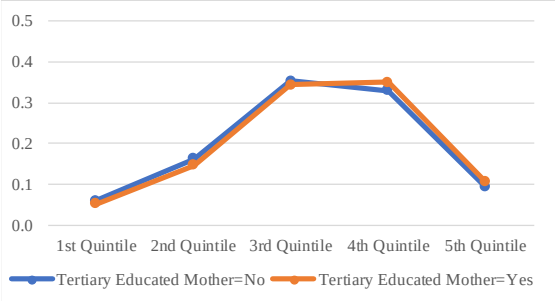

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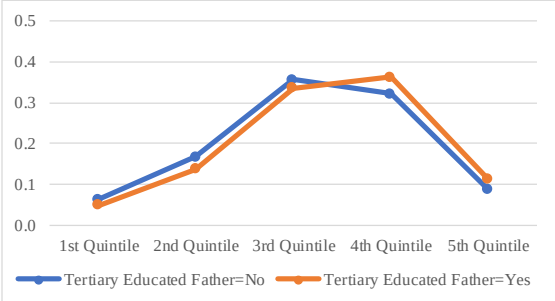
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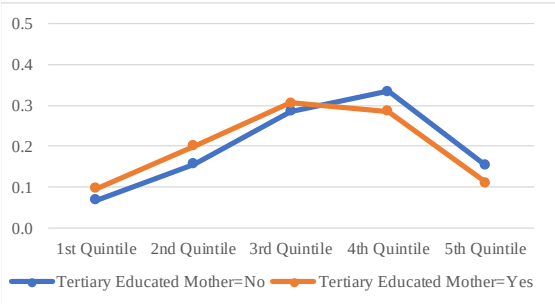

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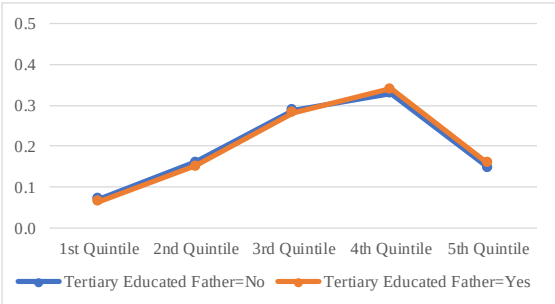
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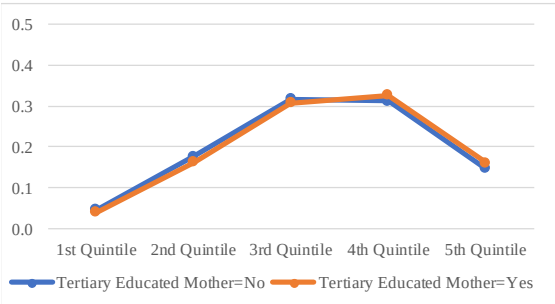

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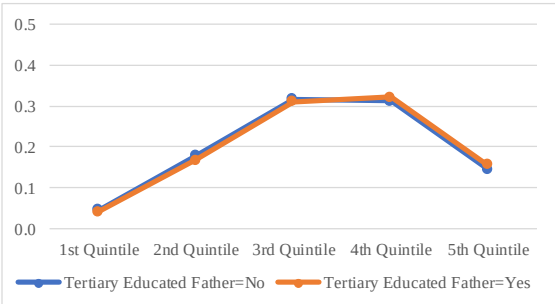
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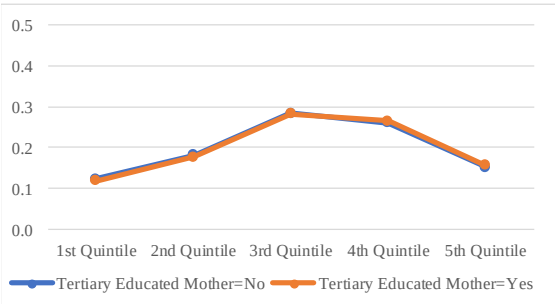

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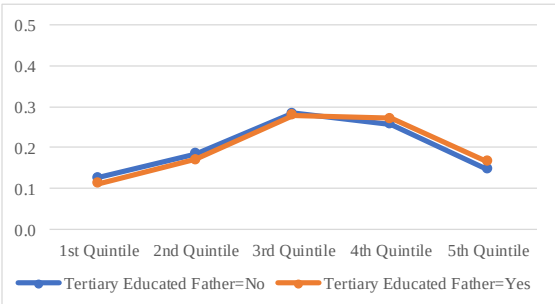
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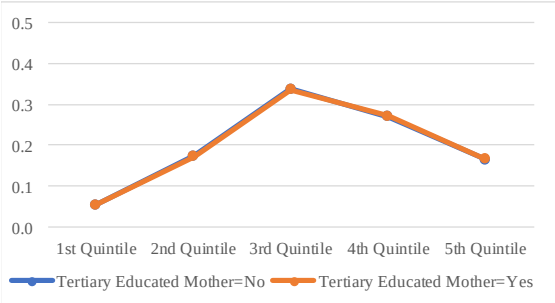

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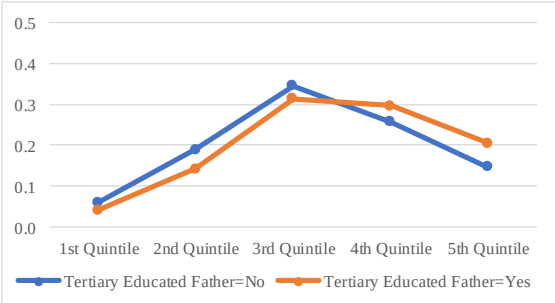
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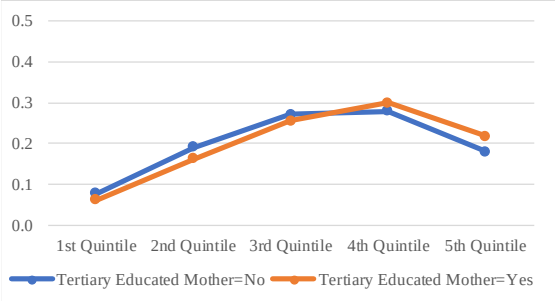

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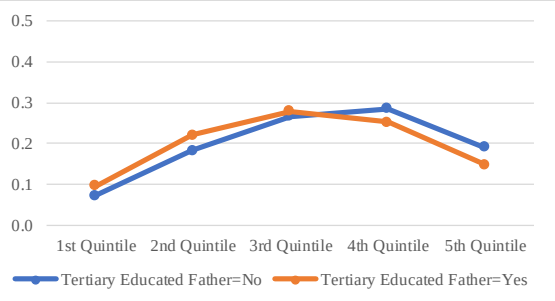
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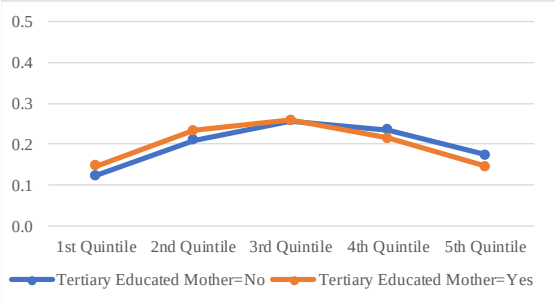

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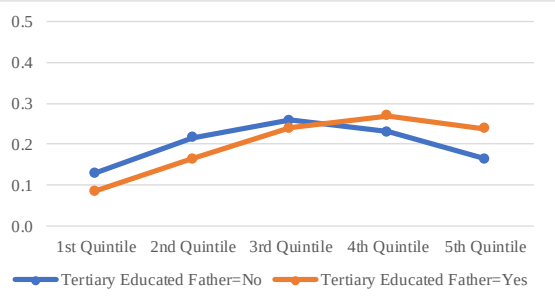
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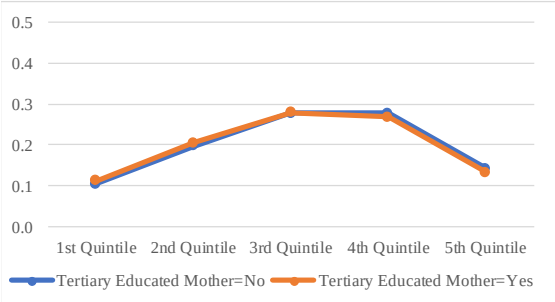

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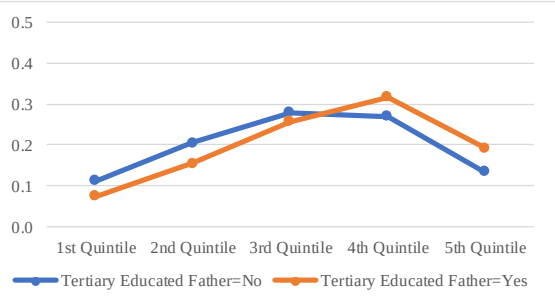
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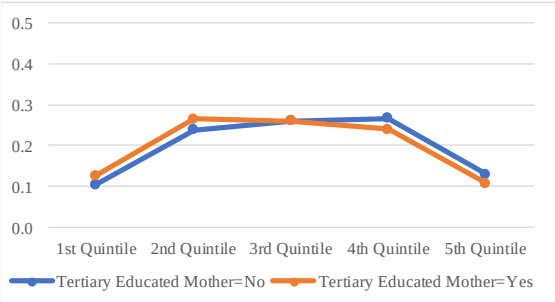

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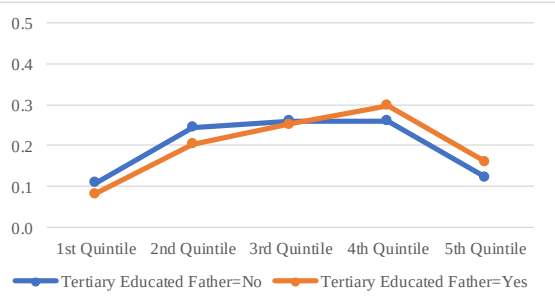
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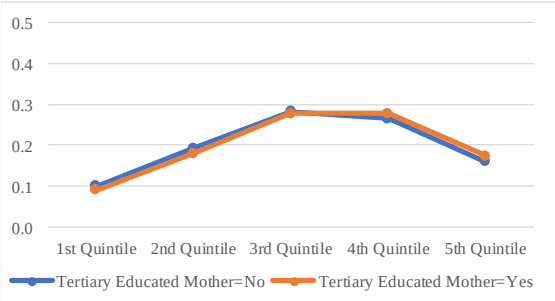

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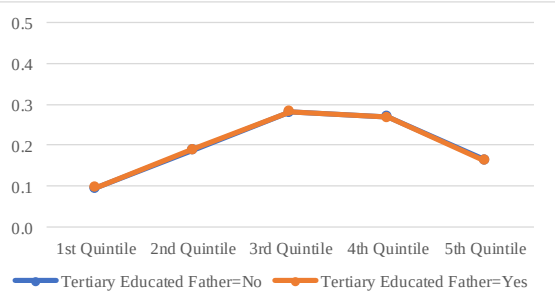
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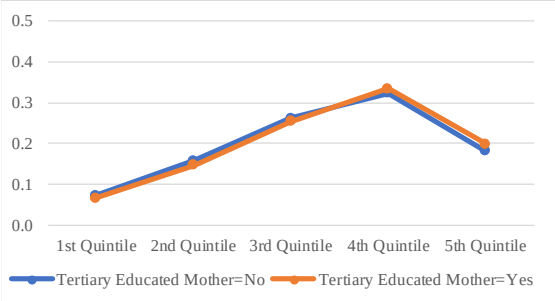

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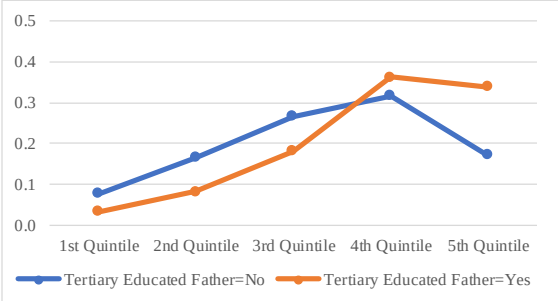
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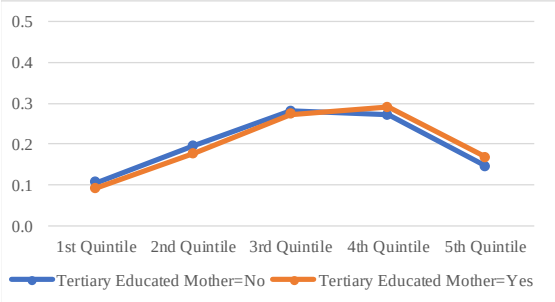

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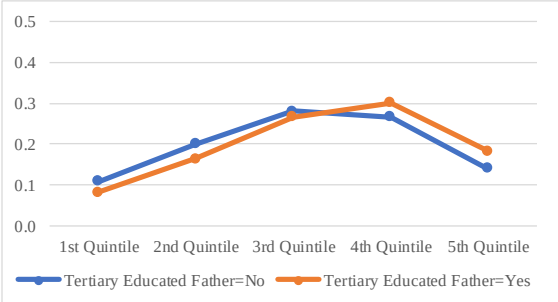
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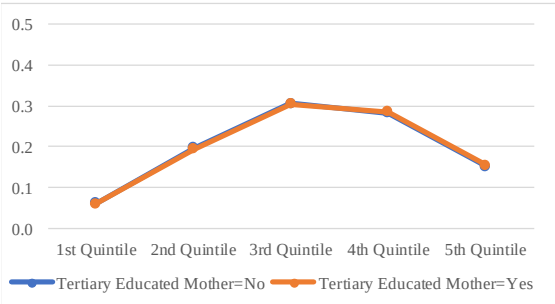

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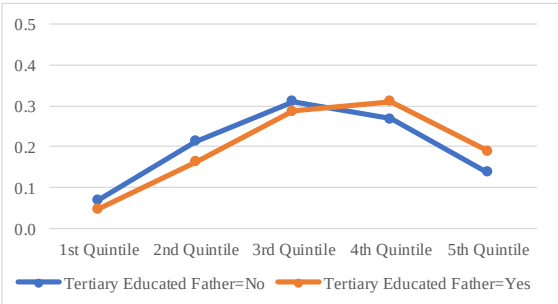
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V. Discussion and Conclusion

1. Scope of this Thesis

The function of education has long been discussed by social scientists and policy makers. In addition to direct effects of education in terms of development of cognitive and non-cognitive abilities of learners, research has revealed that education contributes to wide-ranging indirect socio-economic benefits at both individual and societal levels. That is, highly educated people are more likely than less educated counterparts to enjoy better occupations, incomes, health, social contacts, civic engagement, and subjective well-being, leading to macroeconomic growth and innovation, increasing tax revenues, decreasing public spending on social security, and promoting democratic peaceful societies among other things.

While these associations between education and various outcomes have been advocated, researchers have also cast doubt on such positive notions. Indeed, social scientists have argued that education plays a significant role in maintaining and/or intensifying the existing inequitable social systems whilst depriving learners of freedom and critical thinking. In line with an epoch-making empirical study by Coleman and colleagues (Coleman et al. 1966), well-cited concepts behind these arguments include “deschooling” (Illich 1971), “consciousness” (Freire 1972), “correspondence” (Bowles and Gintis 1976) “discipline” (Foucault 1977), “cultural capital” (Bourdieu and Passeron 1977), and “codes” (Bernstein 1996).

Among wide-ranging positive and negative functions of education, sociologists have paid close attention to the role of education within the broader perspective of social stratification and mobility. The gold standard for this investigation is the so-called “OED triangle,” shedding light on the association between 1) parental education/occupations (origins: O), 2) children’s education (education: E), and 3) children’s labour market outcomes (destinations: D) (see Figure I-1). Based on this framework, the sociological literature has elucidated how and to what extent education

is associated with destinations as well as origins and hence affects the formation of social (in)equality.

Herein, one of the most significant contributions of sociological research is its focus on the interaction between individuals and societies. In particular, in addition to analysing the relationship among individual-level variables related to OED, sociologists have examined how the OED association changes in response to educational expansion in a given society. As a result, evidence has suggested that education operates as an equaliser in a way to mitigate the link between origins and destinations as educational expansion progresses (Breen 2004, 2010; Breen and Jonsson 2007; Breen and Luijkx 2007; Devine and Li 2013; Gil-Hernández et al. 2017; Marks 2013; Pfeffer and Hertel 2015). In the meantime, researchers have also argued that education does not necessarily contribute to promoting social equality and mobility whilst maintaining social stratification, even though educational opportunity has expanded in some societies (Bukodi and Goldthorpe 2019; Goldthorpe and Jackson 2007; Goldthorpe and Mills 2008; Sturgis and Buscha 2015).

Although the function of education and much broader social mechanisms have been markedly detected with the concept of OED triangle, there are two important perspectives that have been inadequately taken into account by previous research. Firstly, skills that individuals possess are not necessarily consistent with educational attainment. For decades, in investigating the association between origins, education, and destinations, sociological studies have favoured educational attainment as a measure of the level of education, using types of credentials (e.g. whether individuals are tertiary graduated; what fields of study individuals completed) or years of schooling. One assumption behind this approach is that highly/less educated people (those with higher/lower educational attainment) possess high/low skills and vice versa, regardless of whether educational attainment actually nurtures skills (i.e. human capital theory) or merely sends a signal (i.e. signalling theory). However, research has also argued that

credentials and lengths of education do not guarantee actual skills levels (e.g. Dore 1976; Hanushek and Woessmann 2015). In the meantime, most empirical studies on skills have not necessarily paid adequate attention to the function of educational credentials, and hence failing to figure out the relative impact of educational attainment and skills. This means that the literature cannot answer one simple question: to what extent what we have understood as the function of "education" is attributed to educational attainment and skills respectively. Thus, to investigate the OED triangle, this paper introduces a concept of educational specifications, which is defined as the combination of educational credentials and skills that individuals possess.

Secondly, in line with the said perspective, societal educational expansion (i.e. the larger share of highly educated people in a given society) does not always imply skills diffusion (i.e. the larger share of highly skilled people in a given society). Indeed, Figure II-2 illustrates a variation in these two dimensions across OECD countries, although there is a moderate correlation between the two indicators. However, as reviewed, previous research has primarily shed light on educational expansion whilst overlooking the other facet of societal educational conditions. Here it is important to pay close attention to this discrepancy lest we misunderstand social mechanisms that are significantly influenced by skills diffusion as the consequence of educational expansion. In particular, given the possibility that both educational expansion and skills diffusion affect the value of individuals' educational attainment and skills via determining their scarcity, the distinction of these two societal conditions becomes an essential perspective to better understand the OED triangle.

In light of the aforementioned backgrounds, using the internationally comparable OECD data (PIAAC), this piece empirically examines the association between origins, education, and destinations with particular focus on the difference between educational attainment and skills at both individual and societal levels. I first investigate the relationship between education and labour market outcomes (the ED association) in

Chapter 2, followed by analyses of the OE association (Chapter 3) and the OD association (Chapter 4) respectively. Through this sociological study, a new dimension of the OED triangle is detected.

2. Main Findings and Implications

In analysing the OED association, educational specifications are defined depending on whether individuals possess 1) both high educational credentials and high skills (HCHS), 2) only high educational credentials unaccompanied by high skills (HCLS), 3) only high skills unaccompanied by high educational credentials (LCHS), and 4) neither high educational credentials nor high skills (LCLS) (see Figure II-1). Here the possession of high credentials is quantified in accordance with the International Standard Classification of Education (ISCED) 2011 Level 5 and above, whereas that of high skills refers to the definition of proficiency level 4 and 5 in PIAAC instead of raw scores that are not appropriate to be used as substantive values (OECD 2013c). Although this dichotomisation might lose flexibility and mathematical elegance of analyses to some extent, it allows us to compare the relative impact of high credentials and high skills in an internationally comparable way.[58] Meanwhile, considering the generalisability as well as data constraints, the differences in the share of population with high credentials and that with high skills across countries are used as the degree of educational expansion and skills diffusion respectively, rather than time-series changes in specific countries. The primary focus of each chapter is on 1) how the OE, ED, and OD associations vary across individual educational specifications, and 2) how such relationships differ depending on the degree of educational expansion and skills diffusion at a societal level.

In Chapter 2, using approximately 30,000 individuals in 26 OECD countries where

[58] It is also important to note that key findings derived from this approach with categorical measures for individual educational specifications are generally consistent with the analysis results using the continuous skills measure (see Appendix A in Chapter 2).

public data are available online, multilevel logistic regression analyses are conducted to reveal the association between educational specifications and labour market outcomes (occupational attainment and earnings). This cross-country approach does not necessarily provide evidence concerning causality nor dynamic changes of the ED association in the process of educational expansion and skills diffusion. Yet, from the perspective of generalisability of analysis results as well as data limitations, multilevel analyses using the difference across countries as the degree of societal conditions become appropriate approaches as long as key variables at both individual and societal levels are properly taken into account. Specifically, as discussed in Chapter 2, in conjunction with gender, age, immigrant background, parental education, work experience at an individual level, the strength of educational tracking, GDP per capita, economic structures, and union density in each society are controlled for.

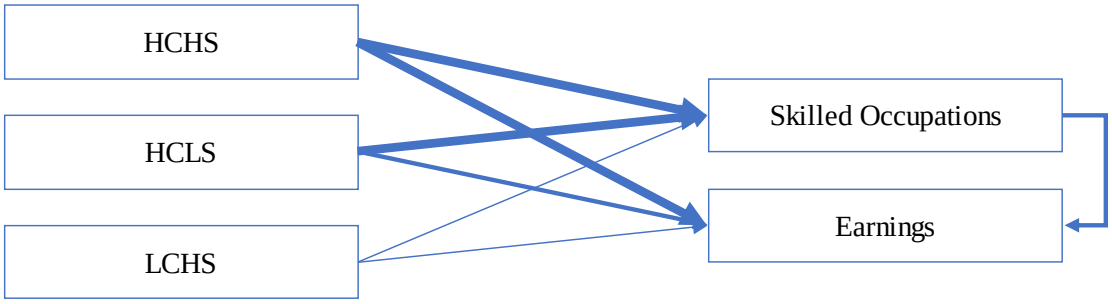
The multilevel binary/ordered logistic regression analysis of the ED association, using skilled occupations and earnings quintiles as outcomes respectively,[59] reveals that both high credentials and high skills contribute to children obtaining skilled occupations and better earnings. In particular, the impact of high credentials far outweighs that of high skills.[60] Marginal effects of educational specifications also suggest that those with high credentials are likely to enjoy a high probability of skilled occupations and better earnings, whereas high skills improve the chance only when individuals do not possess high credentials (see Figure II-4, Figure II-5, and Figure II-6).[61] Figure V-1 below conceptually illustrates this result.

[59] I concurrently conduct multilevel linear regression analyses using continuous measures for outcomes (i.e. International Socio-Economic Index of Occupational Status and the logarithm of earnings respectively). As described in Appendix B and C in Chapter 2, main findings/implications are generally consistent between the analysis with categorical outcomes and the one with continuous dependent variables.

[60] As discussed, it is important to note that high skills quantified in this paper are merely general information processing skills. This means that other types of skills such as occupation-specific skills and non-cognitive abilities may significantly contribute to attaining better economic outcomes.

[61] It is also important to note that the difference in impact between HCLS and LCHS on earnings is smaller than that on skilled occupations. In particular, the final model of earnings analysis with occupational data as control variables reveals that HCHS enjoys a high chance of better earnings

Figure V-1 The ED Association (individual-level variables)



Note: Arrows describe significant associations between educational specifications and labour market outcomes. The thickness of lines reflects the relative strength of each association (i.e. thicker/thinner lines mean relatively larger/smaller magnitude).

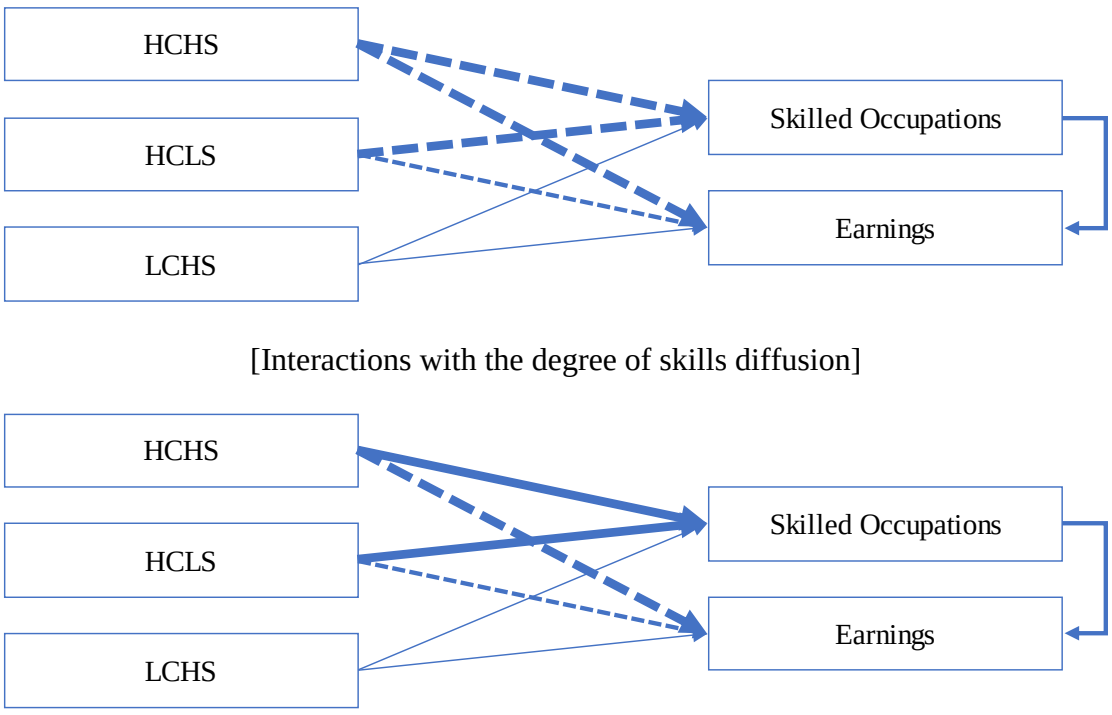
However, once societal educational conditions are taken into consideration, high credentials are significantly devalued in association with a higher degree of educational expansion. Put differently, in societies where the scarcity of high credentials is low, economic returns to such qualifications are likely to be small. However, this type of depreciation is not confirmed for high skills. That is, whereas the interaction terms between high credentials and the degree of educational expansion show significant negative coefficients, high skills do not significantly demonstrate a negative association with the degree of skills diffusion. This implies that high skills operate as absolute goods whose economic values are not necessarily determined by their rarity in a given society.

Moreover, as far as earnings are concerned, the significant devaluation of high credentials (both HCHS and HCLS) is confirmed in association with the degree of skills diffusion as well as educational expansion. This suggests that the devaluation of high credentials in the form of earnings, which has been explained with the notion like credential inflation, is significantly influenced by the share of highly skilled people in

whereas there is no significant difference in the probability between HCLS and LCHS.

a society. Here one may assume that the monetary value of credentials is undermined in societies where the degree of skills diffusion is relatively high because monetary rewards are more likely to be allocated based on individuals' competences rather than the level of credentials. However, this argument does not fully explain the reason why those who possess both high credentials and high skills (HCHS) are also penalised due to the higher degree of skills diffusion. Further research is therefore required to elucidate the social mechanism behind these results. Figure V-2 shows the said depreciation of educational specifications associated with societal educational expansion and skills diffusion.

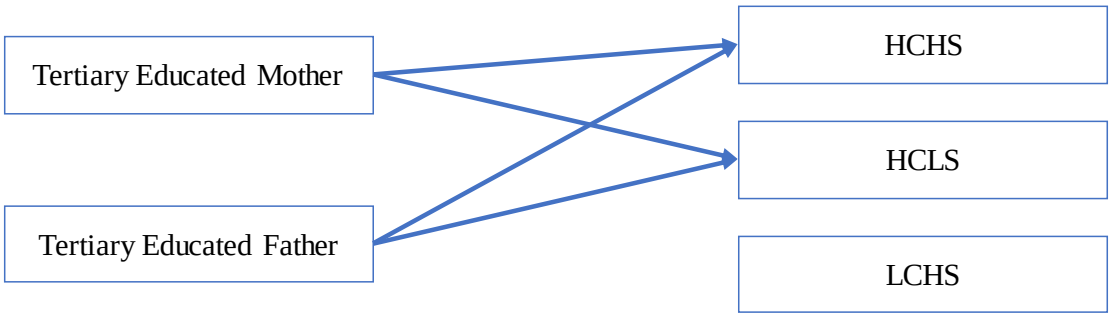
Figure V-2 The ED Association (with country-level variables)



Note: Dotted lines mean that the association is undermined due to the higher degree of educational expansion (top) and skills diffusion (bottom) respectively.

In Chapter 3, using the same dataset as the occupation analysis in Chapter 2, the association between parental education and educational specifications is investigated. While traditional research on inequality of educational opportunity (IEO) focuses on educational attainment, this is the first to pay close attention to skills as well as credentials at both individual and societal levels. The multilevel multinomial logistic regression analysis indicates the significant positive association between parental education and the acquisition of high credentials regardless of skills levels (both HCHS and HCLS). In other words, the probability of obtaining high credentials is likely to be high if children have tertiary educated mother and/or father. Meanwhile, this type of advantage is not confirmed with regard to high skills per se (LCHS). Figure V-3 summarises these relationships.

Figure V-3 The OE Association (individual-level variables)



Note: Arrows describe significant associations between parental education and educational specifications.

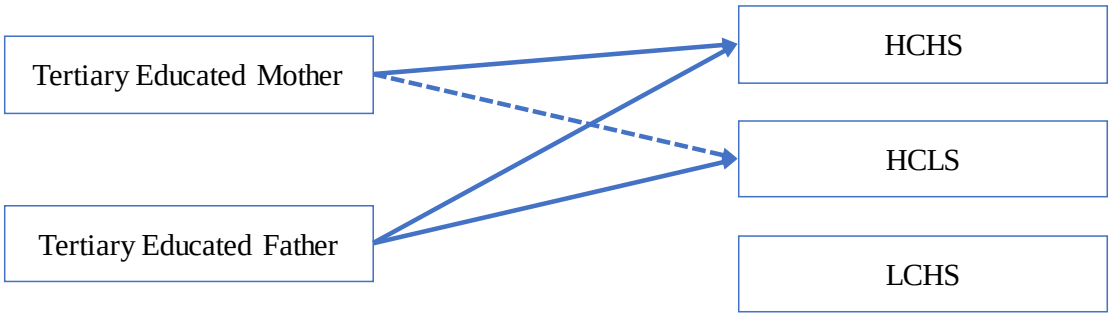
Nevertheless, the more nuanced structure is detected once the degree of educational expansion and skills diffusion is taken into account. In a model where societal-level skills diffusion is not controlled for as with traditional IEO research, the impact of parental education seems to be smaller due to a larger share of highly educated people in a given society. However, in the final model that incorporates the degree of skills diffusion as well as educational expansion, the devaluation of parental education is confirmed in association with skills diffusion, rather than educational expansion

(except for the influence of mother's education on the probability of HCLS). Figure V-4 illustrates the concept of this depreciation.

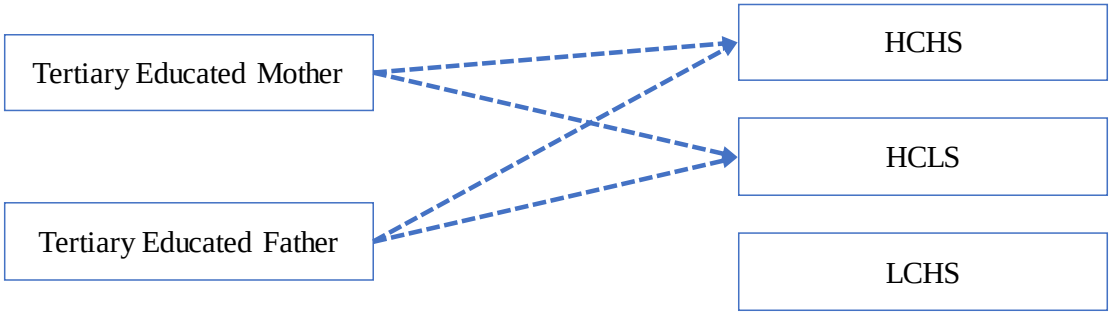
These results suggest that, as discussed in Chapter 2, what we have understood as the consequence of educational expansion (i.e. the expansion of access to educational opportunity operates as an equaliser in a way to mitigate the impact of parental education) might be significantly determined by the degree of skills diffusion. Put differently, educational expansion is assumed to be associated with the diminishing power of origins only when it progresses in conjunction with skills diffusion, whereas educational expansion as such does not necessarily contribute to promoting social equality. To test this hypothetical argument, a longitudinal analysis focused on specific societies, rather than a cross-country approach demonstrated in this chapter, is required.

Figure V-4 The OE Association (with country-level variables)

[Interactions with the degree of educational expansion]



[Interactions with the degree of skills diffusion]



Note: Dotted lines mean that the association is undermined due to the higher degree of educational expansion (top) and skills diffusion (bottom) respectively.

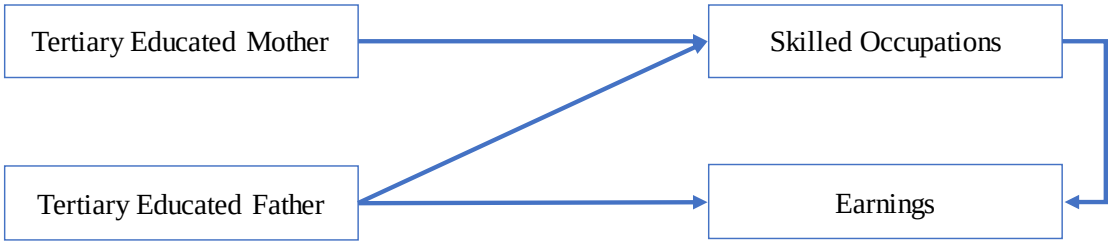
In Chapter 4, extending the framework of Chapter 2 and Chapter 3, the association between origins (parental education) and destinations (labour market outcomes) is examined. In so doing, particular attention is paid to 1) direct effects of origins on destinations (rather than the overall OD association including the indirect one mediated by educational specifications), and 2) the variation in impact of parental education across educational groups (i.e. individuals with different educational specifications).

The multilevel binary/ordered logistic regression analyses confirm the significant influence of father's education on both occupational attainment and earnings, while mother's education demonstrates its significant impact only on skilled occupations (see Figure V-5). This means that having a tertiary educated mother and/or father (especially father) functions as an advantage in terms of a higher chance of obtaining preferable economic rewards, even after accounting for the effect mediated by education. Herein, assuming that economic resources are more likely than other types of capital to be reproduced in the form of children's economic class (Blanden et al. 2013; Torche 2015), one may argue that father's education operates not only as educational and cultural assets, which mother's education also represents, but also as economic capital.[62]

In the meantime, it is important to note that the contribution of parental education to occupational attainment is significantly smaller among those with high credentials and/or high skills as compared to those who possess neither of them. This result is consistent with previous research which has argued that the effect of origins on destinations is smaller among highly educated groups (Breen and Jonsson 2007; Gil-Hernández et al. 2017; Hout 1988; Mastekaasa 2011; Pfeffer and Hertel 2015; Torche 2011, 2018).

[62] Given that parental earnings as well as occupations are not included in the analysis, one may also argue that the significant association between paternal education and monetary rewards is confirmed simply because father's education functions as a proxy of earnings (i.e. its impact might become insignificant once father's economic statuses are taken into account).

Figure V-5 The OD Association (individual-level variables)



Note: This figure illustrates direct effects of parental education (DESO). Arrows describe significant associations between parental education and labour market outcomes.

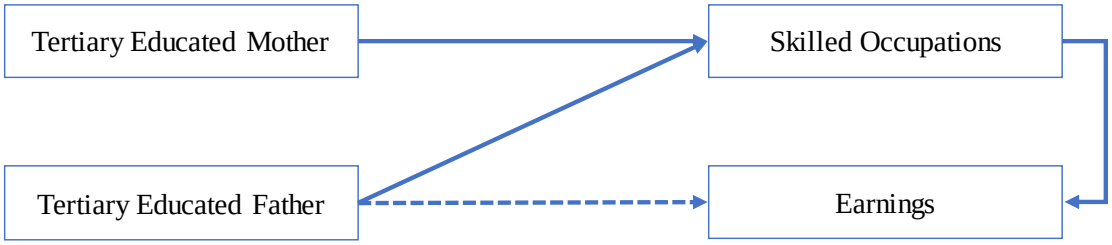
As with the OE and ED associations, the OD association also varies depending on the degree of educational expansion and skills diffusion at a societal level. Although the direct effect of mother's education on occupational attainment is not significantly influenced by societal educational conditions, that of father's education is undermined due to the higher degree of skills diffusion. Likewise, the contribution of tertiary educated fathers to earnings is likely to be smaller in societies where the share of highly educated people is relatively large (see Figure V-6 for a summary). The analytical model adopted in this paper does not necessarily imply causality, yet one may assume that educational expansion and skills diffusion might operate as equalisers to alleviate the direct link between father's education and labour market outcomes in a nuanced manner.

One interesting fact here is that maternal education, unlike paternal education, is not significantly influenced by societal-level educational expansion and skills diffusion. Incorporating the aforementioned discussion about the function of father's education as economic capital (or at least its proxy), one may speculate that educational and cultural assets delivered by maternal education as well as paternal education are more resilient against societal conditions as compared with economic capital. Another possibility is that, as recent research has detected (e.g. Liu 2018), the influence of

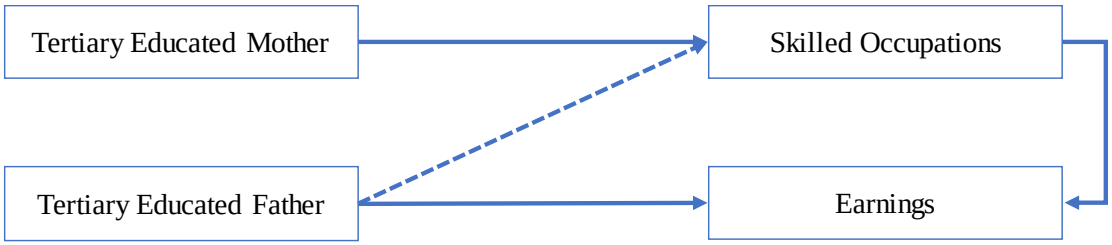
grandparents is reflected in mother's education more significantly than in father's education, resulting in the robust impact of maternal education. Furthermore, this might be because tertiary educated mothers are more likely than tertiary educated fathers to transmit valuable skills such as non-cognitive and occupation specific skills, which are not captured by educational variables used in this analysis. Nevertheless, these speculations are not necessarily consistent with other empirical results (e.g. maternal education is significantly devalued in terms of educational attainment; the main effect of mother's education is not originally larger than that of father's). It is therefore essential to further examine these relationships with more elaborate data on (grand)parental occupations and economic statuses as well as multidimensional skills.

Figure V-6 The OD Association (with country-level variables)

[Interactions with the degree of educational expansion]



[Interactions with the degree of skills diffusion]



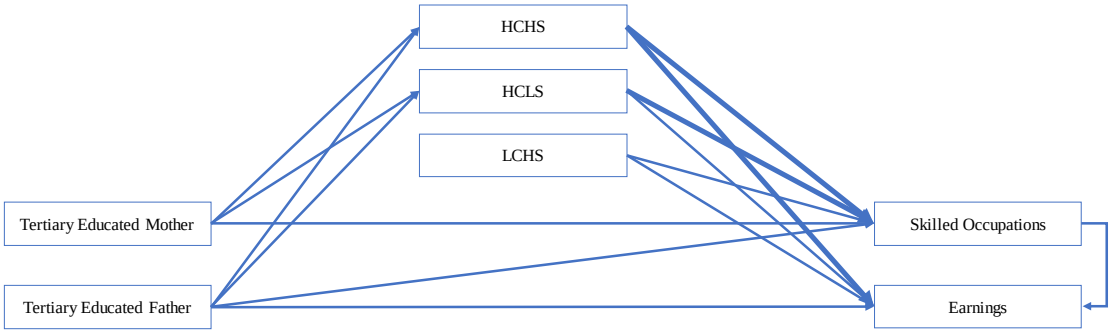
Note: Dotted lines mean that the association is undermined due to the higher degree of educational expansion (top) and skills diffusion (bottom) respectively. These figures are based on Model 5 where three-way interaction terms are not included.

Meanwhile, once three-way interactions between parental education, children's educational specifications, and societal educational conditions are accounted for in Chapter 4, a more complex structure emerges. For example, the devaluation of father's education associated with skills diffusion in the occupation analysis is confirmed only among individuals who possess high skills unaccompanied by high credentials. This means that, not for highly educated people but for those with high skills despite low educational attainment, the influence of having a tertiary educated father in the form of a high chance of obtaining skilled occupations is likely to be smaller in highly skilled societies. In addition, one three-way interaction term between educational expansion, mother's education, and HCLS shows a significant positive coefficient for earnings quintiles. Given the significant negative association between educational expansion and HCLS in conjunction with insignificant links between other two-way interactions, it is assumed that tertiary educated mothers underpin monetary rewards for high credentials as such via mitigating the devaluation of HCLS associated with the higher degree of educational expansion, although mother's education does not demonstrate a direct effect on earnings. Furthermore, another interaction between skills diffusion, tertiary educated mother, and HCLS demonstrates a significant negative coefficient. Considering that the two-way interaction between skills diffusion and tertiary educated mother is significantly positive, one may argue that the intensified contribution of mother's education to better earnings in highly skilled societies is relatively smaller among those who possess only high credentials unaccompanied by high skills. While the results of these three-way interactions should be carefully interpreted given their elasticity, the mechanism behind the aforementioned variation is an important topic for future research.

Figure V-7 and Figure V-8 summarise the said empirical results. As confirmed in Figure V-7, the association between origins and destinations is significantly mediated by educational credentials (both HCHS and HCLS), while the magnitude of high skills

as such (LCHS) in the formation of OED triangle is relatively small. This means that, although some recent research has aggressively advocated that skills are the key to economic success of individuals (and societies), policies focused on skills acquisition (at least general information processing skills that are evaluable in PIAAC) *instead of* educational attainment might not be effective in terms of promoting social equality/mobility. This is primarily because 1) the impact of skills on labour market outcomes is limited as compared with credentials, and 2) origins (at least in the form of parental education) do not have significant influences on the acquisition of high skills per se (LCHS) in the first place. Nonetheless, given the strong association between HCHS and parental education as well as destinations, it seems meaningful to develop individuals' high skills *along with* educational attainment in order to mitigate intergenerational inequality.

Figure V-7 The OED Triangle (individual-level variables)



Note: Arrows describe significant links between parental education, educational specifications, and labour market outcomes. The thickness of lines reflects the relative strength (magnitude) of each link within the OE, ED, and OD associations respectively.

In the meantime, Figure V-8 also indicates that the OED structure is not static, but rather dynamic in association with societal-level educational expansion and skills diffusion. That is, the impact of high credentials becomes smaller in association with the higher degree of educational expansion and skills diffusion in a nuanced way,

whereas high skills as such do not necessarily lose their influence on occupations and earnings. Furthermore, the advantage of having a tertiary educated mother/father is also undermined due to the two societal educational conditions.

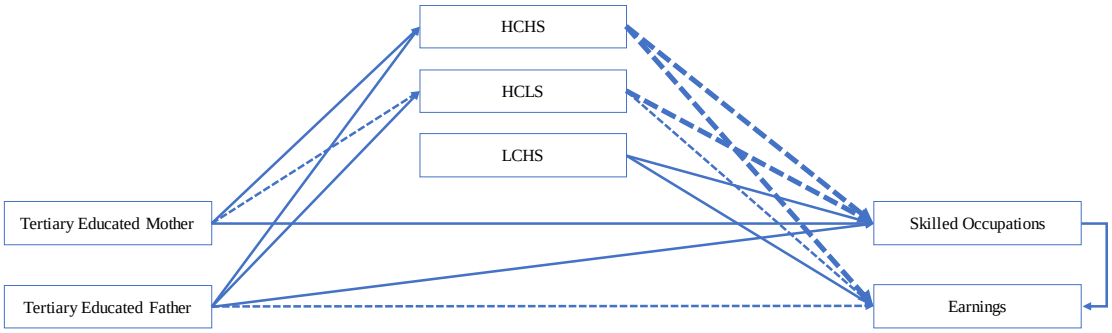
More specifically, in societies where the share of tertiary graduates is relatively large, the impact of origins on destinations is likely to be small because of 1) diminishing returns to HCHS in conjunction with the persistent influence of parental education on HCHS, 2) diminishing returns to HCLS along with the persistent association between father's education and HCLS, and 3) diminishing direct effects of father's education on earnings. However, it is also important to note that 1) the contribution of mother's education to obtaining HCLS also becomes small, 2) tertiary educated mothers are considered to still benefit children via reducing/offsetting the devaluation of HCLS in association with the higher degree of educational expansion (see the three-way interaction in Model 6 in Table IV-5), and partly because of which, 3) the diminishing overall OD association due to educational expansion is not statistically confirmed for the one between father's education and skilled occupations and the one between mother's education and earnings (see Model 3 in Table IV-1 and Table IV-3 respectively).

Likewise, in societies where the share of highly skilled people is relatively large, the association between origins and destinations is assumed to weaken due to 1) diminishing impact of parental education on HCHS and HCLS in conjunction with persistent occupational rewards for these two educational specifications, and 2) diminishing direct effects of father's education on occupational attainment. Nonetheless, while the total effect of paternal education on both occupations and earnings becomes significantly smaller in accordance with the higher degree of skills diffusion, the diminishing overall association between mother's education and both types of labour market outcomes is not statistically observed (see Model 3 in Table IV-1 and Table IV-3 respectively). Although hypothetical discussions are possible with

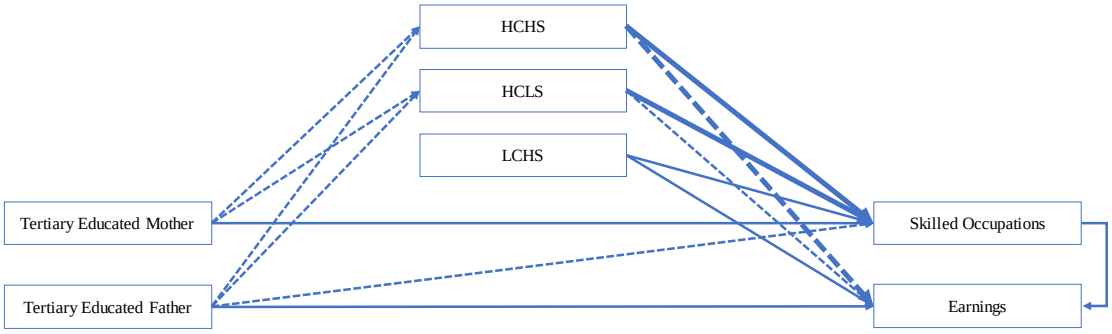
regard to this insignificant association, including the very strong link between maternal education and occupational attainment as compared with other arrows, these are not testable with the current dataset. It is therefore crucial to further scrutinise which relationships (i.e. arrows in figures) play more/less significant roles in determining the total structure of OED.

Figure V-8 The OED Triangle (with country-level variables)

[Interactions with the degree of educational expansion]



[Interactions with the degree of skills diffusion]



Note: Dotted lines mean that the association is undermined due to the higher degree of educational expansion (top) and skills diffusion (bottom) respectively.

Here it is important to note that, as discussed earlier, educational expansion and skills diffusion differently affect the OED association in accordance with educational specifications. In other words, what we have understood as the consequence of educational expansion is, in fact, significantly associated with skills diffusion. Among

other things, one interesting fact is that skills diffusion seems to function as an equaliser in a way to mitigate the impact of origins without weakening the economic value of high skills per se despite their diminishing/small scarcity, whereas educational expansion undermines the contribution of parental education in conjunction with the devaluation of high credentials. This might imply that, although the relative magnitude of high skills is significantly small as compared with high credentials for the moment, societies that manage to accumulate highly skilled people would promote social equality whilst maintaining economic rewards for individuals with high skills. This is apparently a different type of societal phenomenon from the one promoted by educational expansion, in which highly educated people are penalised.

These arguments are still hypothetical, particularly given that the analyses demonstrated in this paper do not capture changes nor causality. Nevertheless, should the aforementioned interpretations reflect the reality of our societies to a certain extent, one may also theoretically argue that meritocracy can be intensified by accumulating highly skilled people in a given society rather than expanding access to higher-level education. For decades, not a few sociologists have criticised the positive notion that educational expansion contributes to forming a meritocratic society and promoting social mobility, with particular focus on various types of capital. That is, it has been argued that, even though access to higher-level education has increased, the advantaged have maintained preferable socio-economic statuses by mobilising economic, cultural, and social capital among others to provide children with better education whilst changing social rules in a way to benefit those with advantaged backgrounds. Consequently, meritocracy has been taken just as a conceptual framework rather than an actual society.

Indeed, inequality associated with origins might persist and hinder the formation of meritocracy. Nonetheless, according to the empirical evidence demonstrated in this paper, there is another potential factor of the persisting nonmeritocratic society: the

lack of skills diffusion. That is to say, educational expansion is considered to mitigate economic returns to individuals' high credentials, while allowing the advantaged to make use of their capital to compensate/intensify the diminishing rewards for education. By contrast, skills diffusion weakens the impact of origins whilst retaining returns to individuals' high skills. This means that there is little room for social backgrounds influencing on the allocation of labour market outcomes. This societal transformation can be realised when high skills are widely accumulated in a given society so that they become tangible enough to be used in the world of work as criteria for the distribution of economic rewards. At the same time, in addition to the increasing demand for highly skilled human resources, it is crucial that the labour market holds adequate ability to precisely assess whether or not individuals possess high skills as foundations for economic activities. In this sense, societal-level skills diffusion (particularly in the form of general information processing skills) may become an essential input not only for increasing highly skilled workforces but also for cultivating an eye for talent in the world of work. Once these conditions are met, it becomes difficult for the society to ignore actual skills and to favour various types of socio-economic statuses that the advantaged boast. In short, only when the supply of high skills and the demand for high skills appropriately encounter, meritocracy starts to emerge as one dimension of a real society. Skills diffusion operates as the key to this development.

As mentioned, the said hypothetical discussion is not empirically testable at the moment. Notwithstanding, facing the fact that the OED triangle is significantly influenced by educational specifications and skills diffusion as well as educational expansion, I argue that it is essential to pay close attention to the distinction between educational credentials and skills at both individual and societal levels in elucidating the relationship between origins, education, and destinations.

3. Challenges and Potential for Future Research

A new dimension of the OED triangle is thus detected by employing educational specifications and skills diffusion in addition to conventional approach focused on educational attainment and educational expansion. Yet, due to some technical constraints, this research leaves one simple but important question unsolved: why is the said structure existing (i.e. what kinds of social mechanisms are operating in generating this complicated OED association)? Although several hypotheses are discussed in the previous sections, the following challenges need to be addressed to better elucidate the OED triangle and much broader social mechanisms.

Firstly, with the framework and findings of this research as reference, more detailed analyses focused on specific countries should be carried out. As discussed earlier, the association between origins, education, and destinations is considered to be significantly influenced by education and other socio-economic systems in each society. Although generalisability is not necessarily guaranteed, country-specific analyses would therefore provide insights into how and why the OED association changes (or does not change) in response to educational expansion and skills diffusion in a given society over time. In so doing, longitudinal surveys/analyses, including work/life histories of individuals, qualify as meaningful and robust approaches to investigate causality. This perspective is important particularly given the possibility of reverse causation concerning the ED association. Indeed, researchers have argued that skills are malleable and cultivated through work/life experience (e.g. Cunha and Heckman 2007; OECD 2015c). Likewise, one may also assume that individuals with an adequate amount of earnings can invest their financial resources to promote their educational attainment and skills. To examine these notions, country-specific analyses using longitudinal data are essential.

Secondly, the elaboration of variables is required. Although this paper uses mother's education and father's education as measures of origins, the impact of parental

occupations and monetary statuses are also worthy of investigation. At the same time, it is an idea to employ other stages of education such as secondary and post-secondary nontertiary as thresholds of parental education in addition to/instead of tertiary education. Likewise, children's educational credentials can be further detailed based on their fields of study, educational ladder/track, and prestige of educational institutions among others. In addition, considering wide-ranging facets of skills as illustrated in Figure I-2, it is indispensable to elucidate the formation and influence of non-cognitive skills and occupation-specific skills. In so doing, while a dichotomised measure is used in this research with the aim of comparing the impact between high skills and high credentials, continuous measures of individuals' skills would provide more clear pictures about the extent to which labour market outcomes are expected to change in response to skills levels. Appendix A in Chapter 2 would be one foundation for this elaboration. Furthermore, not only the OE association and the ED association, but also the interaction within education (i.e. how individuals' educational specifications, including different types of credentials, affect skill formation, and vice versa) could be another line of further exploration.

Thirdly, a variation across different social backgrounds should be scrutinised. Although this paper focuses on people aged 30 to 39 in order to minimise the risk of reverse causation whilst taking into account the time-series change of educational and socio-economic systems, one may assume that the OED association varies across cohorts. Similarly, the relationship between origins, education, and destinations might differ depending on gender, ethnicity, and immigrant backgrounds, among other things. Indeed, Appendix E in Chapter 3 reveals that the OE association is not necessarily the same between women and men. By exploring such details with the results of this paper as reference, it becomes possible to better understand the structure and mechanism of the OED association.

Fourthly, as discussed in Chapter 3 and Chapter 4, a prospective approach rather

than a retrospective one should be effective to precisely calculate the impact of origins on outcomes. Given that the literature has uncovered the significant difference between these two approaches (e.g. Breen and Ermisch 2017; Lawrence and Breen 2016; Song and Mare 2015), it is important to incorporate this perspective so that the structure of social (in)equality is delineated without under/overestimating the influence of origins.

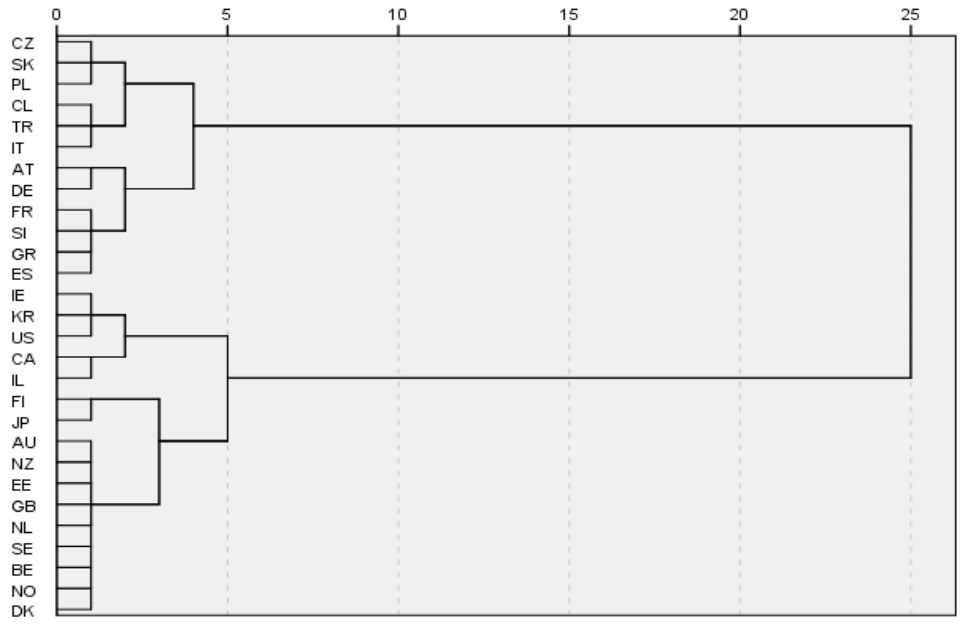
Finally, the combination of educational expansion and skills diffusion should be focused on. While this paper uses the degree of educational expansion and that of skills diffusion as continuous measures respectively, societal-level educational conditions are in reality existing as a compound. Put differently, educational expansion might affect the OED association not independently but in tandem with skills diffusion, and vice versa. Thus, in addition to the approach demonstrated in this paper, it is imperative to pay close attention to the variation in the OED triangle across societal educational conditions defined as the mixture of educational expansion and skills diffusion. This investigation would also lead to discussions on a typology of societies (see Appendix J for more specific concepts of this exploration).

In sum, this research significantly contributes to better understanding the association between origins, education, and destinations. While much research has elucidated the structure and mechanism of the OED triangle, this is the first to empirically pay close attention to the distinction between educational credentials and skills at both individual and societal levels. Consequently, it is suggested that the OED association is formed in accordance with individual educational specifications and societal skills diffusion as well as educational expansion. Despite several challenges and potential for future research, the analytical concept and framework, in conjunction with findings and implications put forward in this paper, provide one small but novel step toward the development of sociology and beyond.

Appendix

J. Type of Society (a compound of educational expansion and skills diffusion)

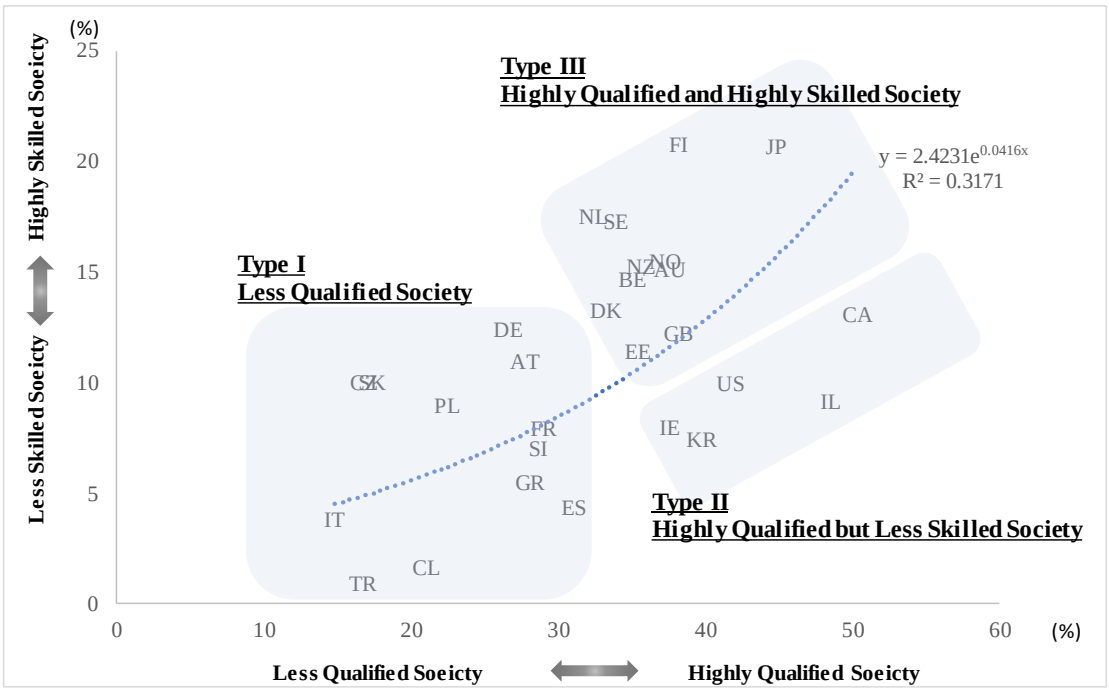
As discussed in the preceding section, by paying attention to the combination of the degree of educational expansion and that of skills diffusion in each country, it becomes possible to discuss a typology of societies. For example, the dendrogram below is the result of a hierarchical cluster analysis (Squared Euclidean Distance with Ward Linkage) using country-level data on the share of tertiary education graduates and that of those who attained proficiency level 4 or 5 for literacy and numeracy respectively in PIAAC. Country codes are the same as Figure II-2.



According to the analysis above, countries are firstly divided into two categories: 12 countries from Czech Republic (CZ) to Spain (ES) and 16 countries from Ireland (IE) to Denmark (DK). The former group can be described as less qualified societies (Type I) where the share of population who attained tertiary education is relatively small, while the latter can be classified as highly qualified societies that have achieved the relatively large proportion of tertiary graduates. Subsequently, two different groups are suggested within highly qualified societies: five countries from Ireland (IE) to Israel

(IL) (Type II) and 11 countries from Finland (FI) to Denmark (DK) (Type III). Type III countries are likely to show the larger share of population with high skills compared to Type II countries. Although the proportion of highly skilled people in Canada (classified in Type II) is larger than that in the United Kingdom and Estonia (both in Type III), the exponential curve in the figure below suggests that the relative share of highly skilled people as compared to that of tertiary graduates in Type III is likely to be larger than that in Type II. Thus, Type III can be categorised as highly qualified and highly skilled societies, whereas Type II can be named as highly qualified but less skilled societies.

This typology is still crude without adequately accounting for the variance in education and socio-economic systems across countries. Nevertheless, considering that the relativity/positionality of educational specifications (and hence their economic values) might differ depending on these dimensions, it is worthwhile to develop empirical and theoretical discussion on the compound of educational expansion and skills diffusion (and typology) as demonstrated in this section.



Note: This figure is based on Figure II-2 and the cluster analysis as explained above.

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