How adult skills are configured?

Abstract

This article examines the relationship between family background, education, skills use and direct measures of literacy skills in five countries: the United States, Japan, Germany, Denmark and Spain. The main aim is to contribute to the research on skills acquisition by providing a comprehensive analysis of literacy skills. We employ a structural equation modelling and use PIAAC data. Results show that skills are configured in a highly complex manner and that significant differences emerge across the five countries, reflecting their historical and institutional characteristics. Intergenerational transmission of educational inequality is a crucial factor in shaping skills outcomes, although this factor varies considerably between countries. The effects of family background, educational attainment, and skills use in daily life on literacy respond to country specific equilibria.

Keywords: literacy, education, skills, OECD, structural equation model.

1 Introduction

High income countries stress the importance of upgrading skills levels for their economic competitiveness, a process in which the individual is not simply one more factor in the production line, but the primary source of value added (Reich 1992). In today's economy, a skilled workforce constitutes a critical component of a country's economic performance. However, whilst the links between skills and the macro economy have been widely studied (Barro & Sala-i-Martin, 1995; Manuelli & Seshadri, 2000), a thorough understanding of how skills are actually formed is only now beginning to emerge. As such, the objective of this paper is to show how literacy skills are configured by employing a comprehensive framework that compares the experiences of five countries.

Extensive literature from the sociology and economics of education (Hanushek and Woessmann, 2011; Van de Werfhorst and Mijs, 2010) show that individual chances of skill formation are strongly affected by social background, and that educational institutions and policies are not neutral in this respect. Indeed, there is considerable evidence indicating that the countries' historical and institutional equilibria have an effect on their economic and social performances. Research in comparative education has also shown that education and training systems form part of these complex institutional designs, which are closely linked to state formation and the basic idea of citizenship. As such, these elements shape divergent educational and social outcomes (Brown, 2013; Dupriez, Dumay, & Vause, 2008; Green, 2013). The institutional characteristics of education and training respond to social and economic processes and, to some extent, condition their evolution in the long run. Recently, a growing literature has concluded that the formation of skills and their availability is strongly conditioned and reflected by context-specific political economy equilibria (Busemeyer and Trampush 2012; Solga 2014; Morel 2012). Dimensions such as levels of stratification or standardisation, degrees of access and accessibility, levels of state control and expenditure have been used to devise different typologies of education systems (Allmendinger & Leibfried, 2003; Busemeyer, 2015; Janmaat & Green, 2013). Overall, these studies have concerned themselves with what constitutes an effective institutional architecture for education and training provision, focusing

on macro institutional differentiation.

Assuming an institutional understanding of Economics, then institutional structures can be considered to constitute the framework of a nation's political economy (Busemeyer & Trampusch, 2012). These structures give shape to different political economies and determine how they coordinate, and interrelate with, their institutions. The results are different "varieties of capitalism" that display strong heterogeneity in corporate finance and labour markets and can be distinguished according to two heuristic archetypes: liberal market economies and coordinated market economies (Hall & Soskice, 2001). The "varieties of capitalism" literature argues that education and training systems are strictly connected to investment in different types of skills - general versus occupation- or industry-specific (Iversen & Stephens, 2008). However, studies of differences in training and skills formation have typically adopted a single country perspective and lack a broader analytical, comparative approach.

Following Collins & Evans (2007), skills formation can be seen as a multistage developmental process which is neither fixed nor exogenously produced. It is the result of a complementary sequence of effects embedded in the individual context, and for these reasons it should be examined as an inherently social process (Cunha, Heckman, & Schennach, 2010). Moreover, skills are plural and for this reason different domains are considered. Hence, the study reported here undertakes a comprehensive examination of the phenomenon of skills formation by analysing five countries with marked differences in their respective education and training and labour market settings. In this context, literacy skills are deemed central to ensuring employability, providing a foundation for skills development, while failing to attain a basic level of literacy is considered a new social risk in a "schooled society" (Allmendinger & Leibfried, 2003).

The empirical foundation of the analysis reported here builds on important insights from Desjardins (2003) and of a recent paper by (author), in which an extensive review of the literature is provided and applied to the OECD countries. The core of the resulting model draws on the social mobility literature concerned with analysing socio-economic disparities in educational achievements

and labour market outcomes (Breen & Karlson, 2014; Erzsébet Bukodi & Goldthorpe, 2013). Skills formation is seen therefore as a cumulative process in which educational attainment mediates between family background and future occupation, on the one hand, and future social outcomes, on the other. Specifically, our analysis focuses on the following factors associated with adult skill configuration: a) the relationship between the education of a person's parents and his/her educational attainment (i.e. inequality of educational opportunities); b) the correspondence between education and skills acquisition (i.e. the relationship between skills and qualifications obtained); c) the association between education and skills use in the labour market (i.e. subjective measure of skills mismatch); d) the long-term differential in educational attainment (the effect of age on parental education).

The research draws on the Programme for International Assessment of Adult Competencies (PIAAC), which provides direct measures of literacy skills and facilitates cross-country analyses and the examination of educational outputs and related social outcomes.

The main aim is to analyse the complexity of the configuration of literacy skills and to evaluate the different channels via which skills are acquired. We seek to determine whether and, if so, these elements of literacy skills differ across countries, and the extent to which they differ, by analysing the cases of the United States, Japan, Denmark, Germany and Spain. Many studies point to a divergence in the institutional designs of education and training systems (Allmendinger & Leibfried, 2003; Bol & van de Werfhorst, 2013) and these claims are upheld by recent research employing PIAAC (Green, Green, & Pensiero, 2015; Heisig & Solga, 2015; Jerrim & Macmillan, 2015; Solga, 2014).

The five countries have quite distinct education and training systems in addition to different institutional and economic designs, as emphasized in the literature (Busemeyer & Trampusch, 2012; West & Nikolai, 2013; Willemse & de Beer, 2012). These can be identified as a) the Liberal model (e.g. the United States), an incomplete and highly marketed, academically-driven, comprehensive model with a clear emphasis on school choice; b) the East Asian model (e.g. Japan), a comprehensive, competitive model with a highly reputed public schooling system with firm-specific investment in

vocational programs; c) the German, collective and coordinated skills model, with a dual and highly tracked education and training model centred on the provision of specific skills; d) the Nordic, Social Democratic model (e.g. Denmark), characterized by its statist skill formation regime and with a full comprehensive education system and universal and inclusive social programs; and e) the Southern European model (e.g. Spain), with its incomplete comprehensive schooling and welfare systems and a highly segmented labour market. Initially, the East Asian model did not form part of this classification, as the comparison was centred primarily on European and the English-speaking countries. In recent decades, there has been a growing interest in East Asian countries, in part due to their outstanding performances on large scale educational assessment instruments. Some authors, drawing on previously established typologies and recent evidence, conclude that East Asian countries are characterised by certain inner traits, which constitute a distinct model. Among other characteristics, Japan has a high standard of general education and invest heavily in enterprise-based training (Aizawa, 2016). Likewise, these countries have undergone quite distinct historical processes in the expansion of their respective schooling systems. Moreover, in recent decades, different trends have emerged in terms of access to tertiary education if we compare young and older cohorts across the five countries. Thus, both the distribution of education certifications and their associated skills are highly unequal and at times polarized across the active population cohorts (author). The approach we adopt here contributes to the research on comparative education and skills formation by providing a rich analytical framework of how skills are configured.

The rest of the paper is organized as follows. In Section 2, we describe the main features of the education and training systems of the countries selected, while in Section 3 we present the data and the model used to conduct the empirical analysis. In Sections 4 and 5 we report and discuss our results, while in Section 6 we state our conclusions.

2 Brief description of the education and training systems of the selected countries

Extensive literature has shown how economic and social systems respond to the skill enhancements of post-industrial societies against the backdrop of globalization. There is considerable evidence

indicating that the specific historical and institutional equilibria of Western capitalist countries have an effect on their economic and social performances. Two main streams in the literature have sought to account for these differences. The "varieties of capitalism" approach (Hall & Soskice, 2001) highlights the presence of economic, institutional and social complementarities, while that of "welfare regimes" (Esping-Andersen, 1999) focuses on class struggle and the historical organization of systems of production. Research in comparative education has also shown that education and training systems form part of these complex designs, which are closely linked to state formation and the basic idea of citizenship. As such, these elements shape divergent educational and social outcomes (Brown, 2013; Dupriez, Dumay, & Vause, 2008; Green, 2013). The institutional characteristics of education and training respond to social and economic processes and, to some extent, condition their evolution in the long run. Recently, a growing literature has concluded that the formation of skills and their availability is strongly conditioned and reflected by context-specific political economy equilibria.

In this section, we describe the main characteristics of the education and training systems of the selected countries. In so doing, we draw largely on the literature on comparative education and we provide a brief selection of key indicators in **Tables 1 and 2.**

<<Insert about here. Table 1 Education and training system indicators>>.

United States

The United States was a forerunner in comprehensive education and training. The route into higher secondary education is fairly linear. Following elementary school, students move from middle school to junior and then senior high school, which terminates after grade 12 and gives access to post-secondary education. There is no formal secondary school tracking and vocational components are limited[1], but there is a strong ability-based sorting of pupils. The education system is highly

[1] In common with Germany, the United States first introduced vocational programs in the nineteenth century, although such programs were limited and marginalized. The lack of development of vocational programs is due to both the low degree of public commitment and the low level of firm involvement in liberal skills regimes (e.g. US and UK). These systems are based primarily on the promotion of academic skills (Busemeyer, 2015).

decentralized and subject to local regulation in nearly all states. Local school boards have considerable control over educational content and financial resources are obtained primarily from local property taxes and distributed among local school districts. Curriculum regulation is largely unstandardized across the system and the disparity in teaching quality is high (Merry, 2013). The level of education has, historically, been among the highest in the world, although this advantage has been reduced in relative terms if we consider the change in the average number years of schooling among the older and the youngest cohorts (**Table A3**).

The United States' education system, founded on school-based competition among individuals, constitutes a classic example of a system providing students with general skills. When specific skills are required, responsibility for providing them falls on the country's firms. In the US system, private investment in education is heavy and there is a strong differentiation between those individuals that have access to college and who work hard and those that are not academically inclined and who do not access higher education. For the individuals in this latter group, their opportunities for acquiring additional skills shrink drastically and they are likely to end up in precarious and poorly paid jobs (Iversen and Stephens 2008).

The US social welfare model is one of relative statelessness with a central state apparatus and a budget that are markedly smaller than those of their European counterparts. Social insurance benefits and services are modest and means tested. Generally, benefits target low-income members of the working class. The entitlement rule is very strict and social rights are only partially recognized. The United States has very high income inequality and a high proportion of the population lives in poverty, with poor access to health care. The country has a moderate unemployment rate and a very high proportion of the active population has a skilled occupation. The economy is very open and concentrated particularly in intensive, high value-added sectors.

<<Insert about here Table 2. >>

Japan

At the end of World War II, Japan introduced a comprehensive school system similar to that operated in the United States, comprising six years of primary education (from the age of 6), three years of lower secondary education, three years of upper secondary, and tertiary education. Japan has experienced a rapid expansion of its education system in tandem with marked economic growth during a period of late industrialization (Green, 2013). During this period, public secondary schools were founded, a process that was accompanied by a sharp increase in demand for manual and non-manual workers (Kariya, 2013). Indeed, public secondary schools are generally held in higher prestige than private schools.

Academic vs. vocational tracking takes place in senior high schools by means of selective, entrance examinations and about a quarter of students opt for vocational training. A highly selective system is operated in upper secondary education based on entrance examinations. Additionally, firms tend to judge their recruits according to the schools or universities they attended (Amano, 1997). Vocational track graduates occasionally enrol in tertiary education.

Central and local authorities are the main decision-making bodies and the schooling system has one of the highest levels of autonomy among the OECD countries as regards curriculum and student assessment policies. Access to the teaching profession is highly regulated. Moreover, Japan has a very low degree of socioeconomic segregation in its schooling system. Overall investment in education is high and is mainly private. Around 55% of the total expenditure on early childhood institutions comes from private sources, which are primarily households. Tertiary students face high tuition fees. Despite its peculiar traits, Japan has many similarities with the Liberal skill formation regimes (e.g. high levels of private spending and a comprehensive school system), characteristics that can be traced back to US occupation in the post-war years. However, one important difference in the Japanese skills formation model is that employers invest significantly in vocational education and training (VET), on the condition that such programs are connected to firm-specific internal labour

demand; yet, the recognition and certification of these skills are not as well as developed as they are in dual systems (e.g. Germany), thus reducing overall job mobility (Thelen 2004).

Japan has a highly educated population with a low dropout rate (the high-school graduation rate is 96.7% compared to 83% for the OECD) and a high rate of access to tertiary education (Grossman, 2006). In 2017, 60% of adults aged between 25 and 34 had attained a tertiary educational qualification, while in the OECD the share was 44% (OECD, 2018). For the oldest cohort of the active population, the average number of years of education was slightly below that of the most advanced economies, but in recent decades education has expanded markedly because of the exceptional increase in tertiary access, which is now among the highest in OECD.

Japan's welfare model is not fully developed and is employment-centred. Its conservative system is generally considered as being similar to that of Germany, based on a male breadwinner model, although it retains certain differential features. The country has a very low rate of unemployment and only a small proportion of its active population, compared to the rest of the OECD, has a skilled occupation. There is also quite a marked gender disparity and a tertiary-educated woman earns, on average, just 48% of what a similarly educated man earns, this being the lowest figure among all countries for which data are available. Traditionally, Japan is not a migration destination, having one of the lowest migration rates in the OECD area.

Germany

Germany has a highly decentralized education system, with responsibilities being shared between administrative authorities. Although the *Landers* (federal states) have strong powers in this jurisdiction, a high degree of standardization guarantees coordination through a standing conference of educational decision-makers.

The system is one of the most important examples of a tracked and vocationally oriented education and training model. Students are sorted into one of four clearly hierarchical secondary school types at the age of 10. The *Gymnasium* prepares pupils for post-secondary education and finishes with the final examination (*Abitur*). The *Hauptschule* prepares pupils for subsequent

vocational education in the form of apprenticeships. The *Realschule* lies in between these two types and is most often followed by attendance at higher vocational schools. The *Gesamtschule* combines all three types of education.

The apprenticeship system (the so-called dual model) developed out of the guilds of arts and professions of the Middle Ages. It is coordinated by various social actors, including the chambers of commerce and the unions, which actively participate in its governance. Vocational training lasts between two and three years and 70% of these activities are carried out in the workplace. The costs of apprenticeship are shared between the private and the public sector and apprentices have formal working contracts and fair job conditions controlled by the local authorities.

Germany's skill system is highly stratified and vocationally specific with effective and systematic mechanisms of certification of vocational skills. In this system, the more transparent the employee's qualification, the stronger the match between education and occupation (Breen, 2005; Shavit & Muller, 1998). The dual system, with its strong focus on specific skills, works as a safety net, enhancing access to the labour market (Van Welfhorst, 2011) and reducing the length of job search (Wolbers, 2007), ultimately strengthening the link between educational attainment and occupational status. In this system, however, inequality of opportunity is stronger, since students are sorted at an earlier age with social background playing a more decisive role in individual educational choices (Horn, 2009), expectation and motivations (Van Houtte and Stephens, 2009).

The German system is characterized by its vertical differentiation and has traditionally separated academic and vocational educations. High school leaving certificates enable students to enter vocational training as well as university. Germany was one of the first countries to introduce compulsory education (at the time of the Prussian Empire) and the average number of years of education is historically one of the highest in the OECD. More than half the population aged between 25 and 65 has an upper secondary education certificate, which is almost a third higher than the OECD average. However, over the last two decades, access to tertiary education has not had a comparable rate of growth to that experienced in the OECD.

The labour market is extremely stable with a very high rate of employment and approximately a quarter of the active population is in a skilled job. Germany was a pioneer of social insurance, as promoted by the conservative reformers of Bismarck and von Taaffe during the nineteenth century. The welfare model is largely dependent on the contributions of the workers and is based on the historical male breadwinner model. Traditionally, it has been a country of immigration, attracting constant inflows over the last few decades, due, among other factors, to its economic dynamism and low birth rate. This gives rise to a fairly consistent gender wage gap, where women earn 74% of their male counterparts.

Denmark

The Danish *Folkeskole* is a basic, comprehensive schooling system, comprising primary and lower secondary education that finishes at the age of 16, that shapes "an individualized model of integration" similar to other Nordic countries such as Sweden (Verdier, 2009). Since 1967, the upper secondary level has consisted in a traditional three-year, academically oriented *Gymnasium* or a two-year preparatory course for higher education (HF). Both options provide a general education and a route to post-secondary education. There is no barrier to tertiary education which is tuition-free and the welfare state generously supports childcare with universal-free kindergarten. The vocational and training system has deep historical roots and resembles the German dual system, although the percentage of young people choosing the vocational track is lower in Denmark. Unlike the other Nordic countries, Denmark has retained a selective system with two separate tracks: a general educational program leading to higher education, and a dual vocational program directed towards the labour market (Jørgensen, 2008). The Danish VET system has a very clear work-based component of learning and training and relies on the participation of social partners through the principle of occupational self-governance. VET provides young people with an effective transition from education to the workplace (Müller, 2005).

The Danish model represents a compromise between a corporativist, dual system, as operated in Germany, and a universal Nordic European model of integration with high access to continuing

education and training. Apprenticeships predominate, but educational outcomes (e.g. early school leavers or access to higher education) are not as unequal as those registered in Germany. Denmark is also a benchmark in terms of training and unemployment, being a point of reference in so-called *folkeoplysning* (popular education). In this system, education qualifications are used by employers in the screening process (as in the German case), although more individual chances are available for avoiding the reproduction of educational opportunities over the life-course. Moreover, adult education participation is among the highest in OECD countries.

The financing of education is centrally controlled and on-going investment in education is remarkable. The main curricular guidelines in the Danish system are relatively specific for upper secondary schools and are issued by the National Ministry of Education; however, some degree of local self-governance is allowed on educational matters.

Historically, the country's education system expanded moderately in line with other post-industrial economies. Recently, both the average number of schooling years and the rate of access to tertiary education have increased if we compare younger and older cohorts of the active population. This is, in part, related to the high access to tertiary education.

The Danish system is one of the most widely recognized of the Nordic universal welfare models, where all citizens are entitled to receive social security benefits and services, regardless of their relationship with the labour market. Social security is financed through general taxation and active social measures are promoted with a high degree of local decentralisation of social responsibilities. Moreover, Denmark is a migration destination with a quarter of its population being foreign born, mostly from non-Western countries, making Danish society highly heterogeneous.

Spain

The Spanish education and training system is comprehensive and partially decentralized at the regional level. Over the last decades, the governance of education has been devolved to the regions, with a limited amount of space for school autonomy. Full-time education is compulsory until the age of 16, although recent legislation seeks to lower this to 15. Spanish secondary education is four years

long, with students at the end of the third year being able to choose between either *Bachillerato* (Baccalaureate equivalent) or *Ciclo de Grado Formativo Medio*, the latter being geared towards vocational training. Indeed, there are two programs of vocational training, a shorter and a longer program, lasting three and five years, respectively. However, there is a marked separation between general and vocational programs, the latter traditionally being unattractive to both employers and students. Work-based programs are underdeveloped with a very low degree of involvement of firms, although since 2012 a number of initiatives have been taken to align VET with employers' needs[2]. Traditionally, vocational programs are considered a second opportunity for less academically driven students. All students successfully completing secondary education can access university after passing a general entry examination organized by each public university.

Spain is traditionally considered as operating a non-selective education and training system; however, different forms of selection, while receiving no formal recognition, are in fact employed (Mons, 2008). Spain has one of the highest retention rates for secondary education and an extremely high school leaving rate. By the age of 15, almost 1 in 3 students has repeated at least one school year while in the OECD the rate is approximately 1 in 10 (OECD, 2018). In 2017, Spain registered an early school leaver rate of 18.3% among those aged between 18 and 24, whereas in the EU28 it stood at 10.6% (EUROSTAT, 2018). There is a high private and government-dependent private provision in primary and secondary schools, due in part to the rapid expansion of education demands following the end of the dictatorship and the high provision of Catholic schools (Bonal, 2000).

In terms of years of schooling, Spain still lags behind its OECD partners. This is partially due to a highly unequal distribution of education across the age cohorts. Schooling has been consolidated in Spain since the seventies, and especially since the end of the dictatorship. This later process of educational democratization is also associated with some of the highest educational inequalities among birth-cohorts in Europe (Braga et al., 2013). The population aged 56-65 has the second lowest

[2] Royal Decree 1529/2012 of 8 November, 2012, introduced a new legislative framework for the implementation of pilot projects and on-the-job training contracts.

average number of years of schooling (after Italy) of the 24 countries sampled in PIAAC. However, over the last four decades, access to university increased until the mid-nineties, stagnating thereafter until the outbreak of the economic crisis, since when it has increased to account for almost 45% of the young adult cohorts.

Spain operates a family welfare system based primarily on the male breadwinner model, although, until the effects of the economic crisis were felt, there were signs of change, especially as regards the increasing access of women to paid employment. It is a country of recent immigration, above all from Spanish-speaking countries. Between 1994 and the third quarter of 2007, Spain's employment figures experienced sustained growth from 12 million to more than 20.5 million (Bernardi & Martínez-Pastor, 2010). Two main factors have contributed to this: first, the massive immigration flows; and, second, its radical transformation to a post-industrial society, during which the numbers employed in the primary sector shrank to a fourth between 1977 and 2007. The labour market has traditionally suffered from a very high unemployment rate, but this was gradually reduced in the 20-year period up to 2008. Spain suffered a remarkable job contraction during the Great Recession, mainly among low-educated workers, although from 2013 onwards employment recovered. Youth unemployment is especially high and the transition between education and the first job is especially precarious. There is considerable labour market segmentation between temporary and fixed-term contracts, which was strengthened by recent labour market reforms. Bernardi and Martínez-Pastor (2010) found that the rate of unskilled employment after school completion is among the highest in Europe and that the risk of being trapped in such jobs is very high. Moreover, the active population in Spain has one of the lowest rates of employment in skilled occupations and the mean value added over the last few decades is one of the lowest in the OECD.

3 Data and Methods

We draw on the first wave of the PIAAC, released in 2013, which provides rich information about the individual social environment of adults aged between 16 and 65 in 24 OECD members. The program assesses three skills domains: literacy, numeracy and problem-solving. The last domain was

not implemented for all countries. We consider literacy as our outcome variable, since it is deemed to be a key foundational skills domain, and we use numeracy to perform our sensitivity analysis.

According to the PIAAC framework, literacy is defined as "understanding, evaluating, using and engaging with written texts to participate in society, to achieve one's goals, and to develop one's knowledge and potential" (OECD, 2011). In PIAAC, literacy and numeracy are collected using 56 items divided across three task characteristics: medium, context and aspect (OECD 2013b). The underlying assumption is that the domains assessed represent a range of skills that enable both the introduction of higher order skills and retraining within a changing economy. Yet, we recognise that the concept and measurement of skills are still contentious topics in the social sciences (Vincent, 2014) and so throughout this paper any reference to skills is a specific reference to the skills measured by PIAAC. The proxy of literacy used refers to "core skills" and is deemed central in regard to cultivating the other, higher-level skills necessary to function at home, school, work, and in the community. This represents an intrinsic limitation of the study, although the measures provided by PIAAC are today the widest and most comparable proxies of adult skills.

We restricted the sample to workers aged between 26 and 55 during one of the most critical periods in the Great Recession (namely, the years 2011 and 2012). The reason for excluding those aged under 26 is that they are unlikely to have yet achieved their highest level of educational attainment. Those aged between 56 and 65 were excluded because they are approaching retirement age, depending, that is, on the specific provisions of country legislation. Thus, respondents have a higher level of educational attainment and, generally, present higher values for all the variables included in the model than those recorded for the country reference samples. In total, the sample includes 13,825 respondents. Our analysis is based on a comprehensive model of skills development and disentangles the effects of a range of social factors on skills, while accounting for any interactions between these effects. For a fuller theoretical and methodological explanation of the model see our recent paper (author).

To test the hypothesized relationships between the constructs and to evaluate the theoretical

model, we used a structural equation model (SEM). This is a set of statistical techniques that allows the representation of the constructs of interest and the measurement of the extent to which the data are consistent with a proposed theoretical model. We implemented a standard procedure in the SEM literature using a two-step modelling process which includes i) a measurement model, describing the way observed variables load onto latent constructs, and ii) a structural model, which estimates the pathways among all the variables, including the latent constructs (Kline 2016). Confirmatory factor analysis (CFA) was performed to check for the consistency of each latent variable.

Below, we report the decisions taken when selecting the variables for the modelling process. A detailed list of the manifest and latent variables is given in **Table 1**, while descriptive statistics are provided in the annex in **Table A3**. Given the lack of additional information about family income or parental occupation in PIAAC, a collapsed three-category scheme of father's education was used for the latent construct of the respondent's family background[3]. As some authors claim, parental education might be preferable to other proxies of family background, because it captures a wide range of family inputs (Bukodi & Goldthorpe, 2012). The latent education variable was constructed using two items: the first provides information about the number of years of education (quantity), while the second records, on a categorical scale, the age at which the highest formal qualification was obtained. Years of schooling are converted directly from the information reported on the highest qualification attained. Since the focus is on the degree to which education affects skills and their use, we tend to maximize this effect by handling a continuous variable. Hence, we use the imputed years of education on a continuous scale and a categorical variable for age on completion. We bypassed any instances of missing data concerning the age at which a qualification was completed by employing the multiple imputation technique, using the discrete variable of age and the covariates included in our model. The latent variable of skills use in the workplace was based on four items: three of these items record information about the frequency of use of core skills (that is, writing, numeracy and reading) and the fourth captures the influence of these skills on the respondent's co-workers. The latent variable of

[3] In the sample, we consider those born between the late 1950s and the late 1980s

skills use in daily life was constructed using records of skills use in the household. We included numeracy, reading, writing and the use of information technology. The items used to construct the latent factor are shown in **Table 1**. Many studies do not draw a distinction between the spheres of skills practice, basically because of their high correlation (OECD, 2000). In our model, however, we opted to separate these two spheres. The intensity of skills use was coded on a Likert scale and then log transformed. Finally, the latent construct of literacy comprises the ten plausible values of literacy[4].

The estimation process was conducted as follows: first, we tested a unique model (i.e., the same for all five countries selected) in which all the parameters are equal for all groups[5]. Hence, we apply the J-Rule, following the methodology proposed by Saris et al. (2009) when seeking to identify any misspecification in the structural parameters. The estimator selected was the robust weighted least square mean and variance (WLSMV), created to deal specifically with a combination of ordinal, discrete and continuous data and a small-to-medium sample size. All the results were estimated using MPLUS 7.4. **Figure 1** presents a path diagram of the model. Bootstrap estimation was performed using 2,000 iterations, providing very similar results to those obtained with the WLSMV estimation[6].

<<Figure 1. Path diagram, visual representation of the model>>

<<Table 1. Latent and observed variables used in the model>>

4 Results

The results are shown in **Tables 2 and 3**. The measurement model is presented in the annex in **Table A1**. The model shows that family background (F1) is a key factor, affecting all other factors in the model directly and indirectly. Additionally, both the effects of education (F2) on skills use in the

[4] Treating the ten plausible scores as items of a latent variable is equivalent to separately estimating ten models and taking the mean of the parameters.
[5] Table A2 reports the goodness of fit measures.
[6] Sensitivity tests were performed by estimating the model when excluding all missing data. However, the results of both models present the same coefficient signs and sizes. Sensitivity analyses are available upon request from the authors.

household (F3) and skills use in the workplace (F4), on the one hand, and on skills (F5), on the other, differ markedly between countries. In the following subsections, we offer a theoretical interpretation of the coefficients and discuss the results. In the discussion, for the sake of clarity, we use the term "effect", which could be erroneously interpreted as causality claims; however, we do not seek to make any causal claims given that our use of cross-sectional data represents an intrinsic limitation for disentangling causal links (Bollen & Pearl, 2013).

Intergenerational transmission of education and literacy inequalities

In this subsection, we interpret the paths that originate from the family background construct and which affect a) education (in our notation, that is, F2 on F1); b) skills (F5 on F1); c) skills use in the workplace (F4 on F1)[7].

The association between family background and individual education is indicative of the extent of the transmission of education and of the importance of family origin in shaping educational outcomes. In the OECD, this effect is highly relevant across all countries. Table 2 shows that Spain has the strongest correspondence between family background and individual education (standardized coefficient 0.85 $p<0.01$). The effect of the intergenerational transmission of education inequality is also strong in the United States, Japan and Germany (standardized coefficient of around 0.7 $p<0.01$). However, these outcomes are low compared to that reported for Spain for, at least, 10 per cent of a standard deviation. Denmark is the country with the lowest intergenerational transmission of education inequality (standardized coefficient 0.589 $p<0.01$) among the five countries considered, but the effect is still substantial.

The relevance of family background for skills can be associated with a critical period[8] (early stages of life) in the lifespan of the individual. Moreover, these results highlight the extent to which family background is directly associated with individual skills at a later stage in their life. In our

[7] In the framework of SEM notation, F2 on F1 means that F1 is regressed onto F2. We retain this notation for a matter of clarity.

[8] In PIAAC, proxies of family background are limited. We have used father's highest level of educational attainment, which is deemed a good proxy for capturing family background and social status, especially because we consider those born between the late 1950s and the late 1980s.

model, this effect is strong in the United States (standardized coefficient 0.365 $p<0.01$), while in Spain, Denmark and Germany, it is moderate (standardized coefficient between 0.214 and 0.137 approx. $p<0.01$). Only in the case of Japan is this effect nonsignificant.

The correlation between an individual's family background and his/her use of skills in the workplace is a measure of the influence of individual origin upon labour market outcomes. Indeed, it might be considered an influence on the level of occupation, since the use of skills in the workplace can be considered a proxy of the actual tasks performed by the individual in their job. Hence, it represents a similar measure to what, in the social mobility literature, is referred to as the effect of social origin on labour market destination. In our model, the effect on the unequal use of skills in the workplace in Germany is increasing, while in the case of Denmark it is falling slightly.

As the measure of family background is defined by the father's educational attainment, the complementarity effect between education (F2) and family background (F1) can be interpreted as a cumulative effect of education across generations. The unequal distribution of education between age cohorts consistently affects the education level and has an indirect effect via family background. We analyse this in greater depth below.

The link between education and literacy

An individual's education is critical in terms of its effect on his/her labour market outcomes and skills. As expected, this path (F2 on F5) is relevant in all the countries considered, since a greater amount of education provides individuals with skills and favours their formation (see Table 2). However, differences emerge between the countries selected, the effects being especially strong for Japan and Germany (standardized coefficient 0.376 and 0.356 $p<0.01$). This reveals a strong and positive association between education and skills. In contrast, a comparatively moderate relation is found in the case of the United States, Spain and Denmark (standardized coefficient between 0.231 and 0.186 $p<0.01$).

The relation between an individual's education and his/her skills use in the workplace (F2 on F4) reflects the effect of the level of education on the daily use of skills in the labour market.

Additionally, the intensive use of job specific skills can be interpreted as skills that are employed in a higher-level job. For Spain this effect is strong, i.e., having a higher level of education matches well with the use of skills in the workplace (standardized coefficient 0.739 $p<0.01$). For the United States, Germany and Denmark the effect is moderate (standardized coefficient of around 0.5 $p<0.01$), while in Japan, the effect is comparatively low (standardized coefficient 0.389 $p<0.01$).

The results show evidence of inequality in educational achievement by gender and country origin. Ceteris paribus, women are more likely to have a higher education than are men, although the effect is moderate for the cases of the United States, Denmark and Spain. In Germany, women present a low educational disadvantage and in the case of Japan the relation is statistically nonsignificant.

Being born in a foreign country has a moderate effect on the individual's education level in the case of Spain (standardized coefficient -0.175 $p<0.01$). In Germany, Denmark and the United States, however, these differences are very weak and indicate that foreigners are likely to have higher intakes of education. The effect is nonsignificant in the case of Japan, given that less than 1% of respondents had been born in a foreign country.

The effects of age on literacy

Both individual life-cycle factors and over-time variations affect skills. On the one hand, skills are likely to increase in an individual's early years, when the highest level of education is being attained, or upon entering the labour market. Skill losses might also occur during employment: specific applied sets of competencies are more likely to be used in the workplace, for example, than other skill sets that are likely to become obsolete. On the other hand, a range of other factors might affect skill levels. Specifically, two different effects of ageing might be relevant: first, the ageing process and its associated biological causes may result in the deterioration of individual cognitive abilities; and second, the asymmetry in access to education at different points over time may affect skill levels. Generally, younger OECD cohorts experience longer periods in the education system than their older counterparts. The evidence indicates that the progressive expansion of education across younger cohorts has had a positive association with skills levels, partially offsetting the negative effect of the

biological processes. However, given the cross-sectional nature of the data, we are not able to disentangle educational quality, cohort and age effects.

A negative and direct effect of age on skills is shown in the cases of Denmark, Germany and Japan, which present very similar estimates (standardized coefficient around -0.1 $p<0.01$). For Spain and the United States, the effect is statistically nonsignificant. However, there is a general and relevant effect of age on family background, indicating that older parents are likely to have a poorer education. This effect is strong for Japan (standardized coefficient -0.388 $p<0.01$), moderate for Spain and Denmark (standardized coefficient -0.27 and -0.29 respectively $p<0.01$) and weak for the United States and Germany (standardized coefficient -0.17 and -0.08 respectively $p<0.01$), which historically both present very high rates of education access. The differences between age groups in terms of education are very marked in the case of Japan and Spain, and only moderately so in the United States and Denmark. In Germany, the differences are smaller and negative, indicating a very stable level of education across cohorts. Furthermore, Spain has a very high indirect effect on education through age (standardized coefficient -0.232 $p<0.01$), showing the country's delayed expansion of education and its unequal distribution.

Skills use in daily life

In this subsection, we interpret the paths that originate from skills use at home (F5 on F3) and in the workplace (F5 on F4) and their effect on literacy. Skills use at home has a positive and very similar effect on skills in all five countries (standardized coefficient between 0.16 and 0.24 $p<0.01$). However, in the case of the association between skills use in the workplace and literacy, a positive effect is found only in the case of Denmark (standardized coefficient 0.136 $p<0.01$), while the effect is nonsignificant in the other four countries. This is a highly relevant difference in Danish skills configuration, pointing to a stronger association between skills use in the work-place and direct measures of literacy and giving evidence of some inner trait of the Danish skills formation model that provides for strong skills-coupling.

Women are likely to present a lower use of skills in the workplace than are men, the difference being most notable in Japan (standardized coefficient -0.299 $p<0.01$). For the rest of the countries, the gender difference in skills use in the workplace is small (ranging between standardized coefficient -0.185 for Spain -0.104 and for Germany $p<0.01$), indicating a smaller gender gap in terms of skills use in the labour market.

<<Insert about here Table 2. Model Direct effects>>

<<Insert about here Table 3. Model Indirect effects>>

5 Complementarities of education and training systems

The model yields results that point to historical rifts and markedly distinct processes in the education and social systems of the countries selected. Of particular note is the variation in the intergenerational transmission of inequality both in education and skills. Additionally, the relation between education and skills use in the workplace and skills varies substantially across the five countries. Overall, the level of historical access to education is especially relevant in explaining the structure of skills formation. The main results of the analysis can be summarised on this basis and in conjunction with the education and social systems of each of the five countries. We should stress that the countries were selected based on the external typology of their respective education and training systems, which in turn are closely connected to their welfare systems. The typology employed emerges from an extensive literature on comparative education which highlights this institutional differentiation (Busemeyer & Trampusch, 2012; Janmaat, Duru-Bellat, Méhaut, & Green, 2013; Mons, 2007; West & Nikolai, 2013).

The United States is a highly unequal country in terms of educational achievement, and family background is a key determinant of educational qualifications and skills. The differences between those that access college and those who do not are highlighted in their respective chances of developing and maintaining skills. The skills formation system is essentially academic driven and the welfare state is poorly equipped to alleviate social inequality. Moreover, the link between education,

skills and skills use in the workplace is only moderate, highlighting that inequalities are produced at the early stages of life. In the United States, educational attainment is more homogeneous across the age groups examined, reflecting the very early expansion of education. Despite the country's historical tradition of migration and the development of education, foreigners suffer disadvantages in terms of both education and skills. Moreover, while the US operates a formal comprehensive education system, persistent barriers remain in the accessibility of educational opportunities across social groups and this affects the distribution of adult skills.

Japan operates a quite distinct model of education and welfare, one that has often been excluded from European comparative analyses as its educational system is quite different from those in the developed West. Japan has one of the most highly educated labour forces in the OECD, with 47% of those aged between 25 and 64 having a tertiary education (OECD 2014). Moreover, it has a high rate of access to higher education and, thus, comparatively low differences in education access across cohorts. The level of education in the country has increased monotonically over the last five decades and Japan shows signs of a more homogeneous distribution of skills and a stronger association between the level of education and skills. The level of correspondence between education and skills use in the workplace is also lower, which is probably due to an overall use of skills that is higher yet more equal than in the other four countries. Yet, while family background is still relevant in explaining educational attainment, the overall intergenerational transmission is lower compared to that of the other countries. Japan has a particularly homogeneous population with one of the lowest percentages of foreign-born population. However, a high gender gap in its labour market persists, especially as regards access to high-skilled, prestigious jobs, compared to the situation in more advanced economies (Estevez-Abe 2013).

Germany has a moderately high historical level of educational attainment, as illustrated by the fact that the proportion of 55-64 year olds is 3% higher than that of the OECD average in the PIAAC sample. It also has a moderate intergenerational transmission of educational achievement and shows signs of social differentiation in the use of skills in the workplace and in the labour market system.

The effect of education on skills is very strong and this is partially due to the unequal access to highly qualified occupations on the basis of an individual's social origin. Germany has a tracked education system with a very early and clear differentiation in educational pathways. It is the classic case of a coordinated market economy in which the occupational-skills system is prevalent. This, on the one hand, helps to increase the labour market inclusion of the less affluent, while, on the other, early selection results in higher educational stratification (Pfeffer, 2008). Historically, it has experienced a moderate level of tertiary education access, maintaining instead a very high enrolment in secondary vocational education and training. Moreover, the welfare state is prominently based on employment conditions. This is highlighted by the unequal labour market conditions between sexes and foreigners, the consequence of the traditional male-bread winner model of Germany's welfare system. Indeed, foreigners still face moderate disadvantages in terms of educational achievement compared to those faced by their counterparts in the rest of the countries examined.

Denmark shows both the lowest intergenerational inequality in education and the lowest residual effect of family background on skills. These outcomes are similar to those reported elsewhere in terms of their very low levels of intergenerational persistence both in educational attainment and income when compared to the other OECD countries (Blanden, 2013). Denmark was the country in which the intergenerational transmission of education and skills inequalities were also the lowest in the International Adult Literacy Survey (IALS) reports. Furthermore, there is a moderate correspondence between education and use of skills in the workplace. This is accompanied by a lower match between education and skills. These outcomes are in line with the earlier results of the IALS reports which pointed to a more equal distribution of skills across the population compared to those in other OECD countries. This is the result of a coordinated market economy with strong universalist principles both in its education and training system and in its welfare state. Denmark is a country that traditionally promotes strong individual development through life-long learning programs and individual experimentation. Historically, this country has a high level of education and one of the highest percentages of access to tertiary education. A quarter of its population is foreign born, which

makes it highly heterogeneous. Denmark operates a universal model of welfare with a high recognition of social rights and with highly developed, active and inclusive intervention policies. These features are again reflected in very low disparities between the native and foreign-born population and the very narrow gender gap.

Spain has the highest intergenerational transmission of inequality in education among the countries compared, which is further reinforced by a very high correspondence between education and skills use in the workplace. This reveals how life chances are shaped basically by an individual's social origin, although formally Spain has not employed a tracked education system. Besides, there is a strong residual effect of parental education on skills. The match between education certification and skills is moderate, pointing also to a relatively unequal education system. In common with other Southern European countries, the expansion of education in Spain came late, but, between the 1970s and mid-90s, it rapidly caught up with the rest of the OECD by greatly expanding access to tertiary education. The expansion of education has led to a polarization of educational attainment, accompanied by a very high early school leaving rate. Moreover, initial access to a highly segmented labour market plays a key role in an individual's chances of maintaining and acquiring skills. The social and economic expansion of the past decades has only partially met the challenges of reducing the inequality associated with social origin. Spain is a country that attracts low educated immigrants, but the education level of this group is not very different from the average level of the native population. Women are likely to have a slightly higher education level, which is not reflected in their respective labour market conditions. Despite a remarkable decline in the gender employment gap, Spanish women are still less likely to work and are generally employed in less prestigious, and more precarious, jobs than men.

6 Conclusion

This study has analysed how literacy skills are acquired by employing a unified perspective that considers a range of social factors, including family background, educational attainment, and the use of skills at work and at home. The analysis compares the formation of literacy skills in five OECD

member countries: the United States, Japan, Germany, Denmark and Spain. A structural equation model was applied in order to account for the complexities of the plurality of relationships.

Our results show that differences in family cultural and social capital are relevant in explaining education and skills in the long run. Differences emerge in the ways in which countries deal with the unequal life chances of individuals, connected to their education and welfare arrangements and to their historical and institutional evolution. Moreover, the association of education with literacy skills varies greatly across countries and has both a direct and indirect effect on skills outcomes.

The findings support a lower intergenerational transmission of education in Denmark and Japan. Japan also presents the highest level of correspondence between educational attainment and literacy skills. In recent decades, both countries have experienced a greater expansion of education than that experienced by the other countries. In Spain, Germany and the United States, family background has greater relevance in the overall model. Spain is the country in which family background has the greatest effect on the overall process of skills accumulation. Additionally, Spain also presents the most unequal distribution of educational attainment across age cohorts. Germany and the United States historically enjoyed high access to education, although this does not seem to have had an impact in terms of reducing the effect of family origin on literacy skills compared to the situation in the rest of the countries analysed here.

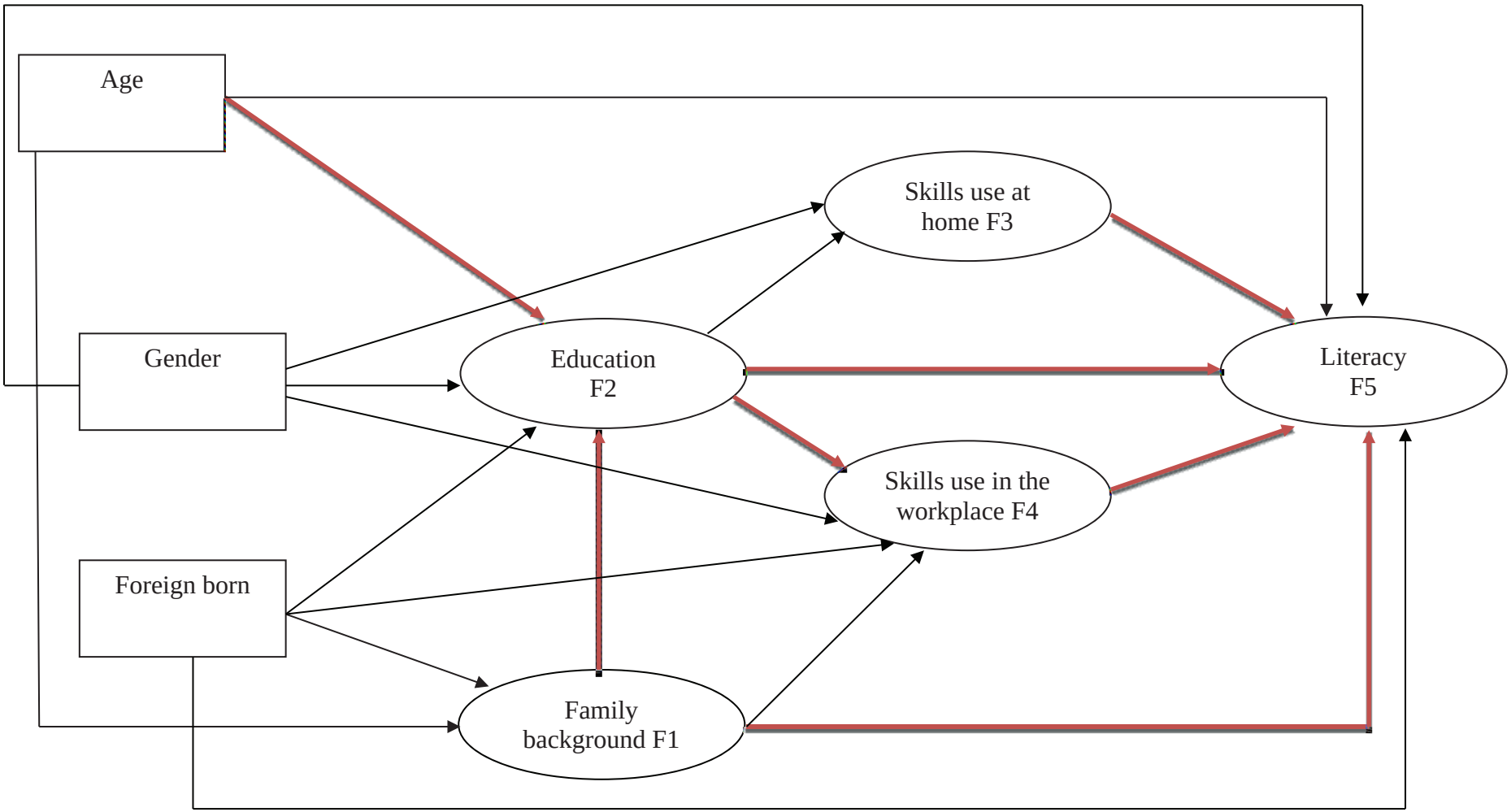
These results illustrate the need for an in-depth understanding of the configuration of literacy skills, at the same time as they highlight the complexity of the process and the cross-country differences in the shaping of skills outcomes. Studies in comparative education have provided considerable evidence of the fact that the countries analysed here exemplify diverse models of education and training. However, this body of literature has not specifically focused on the analysis of direct measures of literacy skills. While our findings cannot be used as evidence that these groups constitute different models of literacy skills configuration, they do suggest that the configuration of skills in the United States, Japan, Germany, Denmark and Spain do follow different paths, which in turn are complementary to their welfare arrangements. Specific education and training systems

emerge through micro and macro interactions and these equilibria of the social and educational structures form the space in which interactions and changes occur. The complementarities between social and educational institutions are critical to understand the social origins of educational systems and the processes of educational change. If educational systems and their related achievements are interwoven with the characteristics of welfare regimes, it seems relevant to make more visible these underlying connections. Hence, when considering a policy that seeks to enhance skills, it is essential to refer to the broader social system and to consider how groups of individuals might be affected.

An extensive literature, including recently published OECD reports, highlights that the countries that have been most successful in reducing inequalities in their education and training systems are those that have, at the same time, improved their educational outcomes. Thus, assumptions about the trade-off between equity and excellence have to be revised in the light of increasing evidence of the complementarity of these two objectives. As such, the pursuit of equity in education, as well as being an objective of distributive justice, should also be seen as a target of enhanced effectiveness.

Policy makers have emphasized the relevance of fostering better skills to face growing global economic challenges. Here, as the process of skills formation is cumulative, policy reforms need to focus on removing the sources of inequality in educational attainment, especially in the early stages of life. In this respect, direct measures of welfare state redistribution might be more effective than indirect measures of the educational systems (Solga, 2014). Eventually, this should result in a more equal skills distribution and so enable more people to actively participate in society and in the labour market.

Figure 1. Path diagram, visual representation of the model



* Circles represent the latent variables and rectangles the observed variables.

Table 1. Latent and observed variables used in the model

Latent variables			Observed variables		
Symbol	Label	Abbreviation	Symbol	Description	Type
ξ_1		Gender	x_1	gender	dichotomous
ξ_2		Age	x_2	age	ordinal
ξ_3		Bor_born	x_3	born in country	dichotomous
η_1	Family background	F1	y_1	Father Higher Education	ordinal
η_2	Education	F2	y_4	Highest Level of Education	continuous
			y_5	Time elapsed since achievement of hi qual.	ordinal
η_3	Use of skills in the workplace	F3	y_6	Use of Reading Skills at Work	ordinal
			y_7	Use of Numeracy Skills at Work	ordinal
			y_8	Use of Writing Skills at Work	ordinal
			y_9	Use of Influencing Skills at Work	ordinal
η_4	Use of skills at home	F4	y_{10}	Use of Reading Skills at Home	ordinal
			y_{11}	Use of Numeracy Skills at Home	ordinal
			y_{12}	Use of Writing Skills at Home	ordinal
			y_{13}	Use of ICT Skills at Home	ordinal
η_5	Literacy proficiency	F5	y_{14}	Plausible value Literacy pvlit1	continuous
			y_{15}	Plausible value Literacy pvlit2	continuous
			y_{16}	Plausible value Literacy pvlit3	continuous
			y_{17}	Plausible value Literacy pvlit4	continuous
			y_{18}	Plausible value Literacy pvlit5	continuous
			y_{19}	Plausible value Literacy pvlit6	continuous
			y_{20}	Plausible value Literacy pvlit7	continuous
			y_{21}	Plausible value Literacy pvlit8	continuous
			y_{22}	Plausible value Literacy pvlit9	continuous
			y_{23}	Plausible value Literacy pvlit10	continuous

Table 4. Model Direct effects

	United States			Japan			Spain			Germany			Denmark		
	Estimate	S.E.	P-Value	Estimate	S.E.	P-Value	Estimate	S.E.	P-Value	Estimate	S.E.	P-Value	Estimate	S.E.	P-Value
F5 on F1	0.365	0.054	0.000	0.042	0.051	0.407	0.214	0.099	0.030	0.137	0.050	0.006	0.178	0.036	0.000
F5 on F4	0.020	0.034	0.544	0.032	0.028	0.252	0.042	0.037	0.259	0.022	0.033	0.500	0.136	0.025	0.000
F5 on F2	0.231	0.051	0.000	0.376	0.039	0.000	0.221	0.093	0.017	0.356	0.044	0.000	0.186	0.032	0.000
F5 on F3	0.194	0.030	0.000	0.159	0.026	0.000	0.240	0.029	0.000	0.228	0.028	0.000	0.228	0.023	0.000
F2 on F1	0.714	0.037	0.000	0.689	0.032	0.000	0.850	0.037	0.000	0.697	0.031	0.000	0.589	0.034	0.000
F4 on F2	0.533	0.046	0.000	0.389	0.032	0.000	0.739	0.063	0.000	0.516	0.047	0.000	0.561	0.033	0.000
F4 on F1	0.030	0.056	0.591	0.004	0.039	0.907	-0.106	0.071	0.137	0.116	0.057	0.043	-0.087	0.039	0.025
F3 on F2	0.551	0.021	0.000	0.357	0.022	0.000	0.567	0.018	0.000	0.526	0.021	0.000	0.498	0.020	0.000
F1 on age	-0.179	0.034	0.000	-0.388	0.027	0.000	-0.272	0.035	0.000	-0.086	0.032	0.008	-0.294	0.028	0.000
F1 on for born	-0.255	0.030	0.000	-0.011	0.026	0.676	0.101	0.037	0.006	-0.263	0.029	0.000	0.049	0.021	0.022
F5 on age	0.015	0.021	0.452	-0.119	0.026	0.000	-0.023	0.027	0.401	-0.101	0.017	0.000	-0.094	0.017	0.000
F5 on gender	-0.021	0.018	0.247	-0.024	0.021	0.234	-0.069	0.021	0.001	0.024	0.016	0.147	0.012	0.017	0.491
F5 on for born	-0.165	0.017	0.000	-0.078	0.013	0.000	-0.211	0.024	0.000	-0.153	0.015	0.000	-0.301	0.011	0.000
F2 on age	0.084	0.032	0.008	0.236	0.031	0.000	0.152	0.034	0.000	-0.053	0.027	0.048	0.088	0.029	0.002
F2 on for born	0.005	0.026	0.854	-0.032	0.012	0.009	-0.175	0.035	0.000	-0.053	0.024	0.031	-0.059	0.017	0.000
F2 on gender	0.091	0.025	0.000	-0.038	0.023	0.102	0.112	0.022	0.000	-0.046	0.022	0.041	0.164	0.021	0.000
F4 on gender	-0.110	0.023	0.000	-0.299	0.020	0.000	-0.185	0.020	0.000	-0.104	0.020	0.000	-0.175	0.021	0.000
F4 on for born	-0.093	0.020	0.000	-0.025	0.020	0.211	-0.110	0.024	0.000	-0.087	0.019	0.000	-0.153	0.014	0.000
F3 on gender	-0.003	0.023	0.897	0.069	0.022	0.002	-0.124	0.021	0.000	-0.053	0.022	0.016	-0.156	0.021	0.000
F3 with F4	0.499	0.026	0.000	0.465	0.022	0.000	0.491	0.026	0.000	0.536	0.025	0.000	0.492	0.022	0.000

Source: PIAAC 2013, Authors' calculations

Table 5. Indirect effects

	United States			Japan			Spain			Germany			Denmark		
	Estimate	S.E.	P-Value	Estimate	S.E.	P-Value	Estimate	S.E.	P-Value	Estimate	S.E.	P-Value	Estimate	S.E.	P-Value
gender→F5	0.018	0.009	0.048	-0.042	0.042	0.324	-0.013	0.016	0.412	-0.031	0.009	0.001	-0.029	0.010	0.005
gender→F3→F5	-0.001	0.004	0.897	0.035	0.013	0.006	-0.030	0.006	0.000	-0.012	0.005	0.020	-0.036	0.006	0.000
gender→F4→F5	-0.002	0.004	0.550	-0.031	0.027	0.253	-0.008	0.007	0.265	-0.002	0.003	0.501	-0.024	0.005	0.000
gender→F2→F5	0.021	0.007	0.005	-0.046	0.029	0.109	0.025	0.012	0.032	-0.016	0.008	0.048	0.031	0.007	0.000
F2→F5	0.118	0.016	0.000	0.052	0.008	0.000	0.167	0.023	0.000	0.132	0.015	0.000	0.190	0.014	0.000
F2→F3→F5	0.107	0.017	0.000	0.043	0.007	0.000	0.136	0.017	0.000	0.120	0.015	0.000	0.114	0.012	0.000
F2→F4→F5	0.011	0.018	0.551	0.010	0.008	0.250	0.031	0.028	0.266	0.012	0.017	0.504	0.077	0.015	0.000
F1→F5	0.250	0.031	0.000	0.450	0.045	0.000	0.325	0.070	0.000	0.343	0.030	0.000	0.210	0.019	0.000
F1→F2→F3→F5	0.001	0.001	0.613	0.000	0.002	0.908	-0.004	0.005	0.401	0.003	0.004	0.498	-0.012	0.006	0.045
F1→F2→F5	0.008	0.013	0.550	0.013	0.011	0.252	0.026	0.024	0.267	0.008	0.012	0.504	0.045	0.009	0.000
F1→F2→F4→F5	0.076	0.013	0.000	0.057	0.010	0.000	0.116	0.015	0.000	0.084	0.011	0.000	0.067	0.008	0.000
F1→F4→F5	0.165	0.034	0.000	0.380	0.045	0.000	0.188	0.078	0.016	0.248	0.032	0.000	0.110	0.019	0.000
age→F5	-0.010	0.007	0.147	-0.011	0.009	0.218	-0.018	0.009	0.054	-0.040	0.010	0.000	-0.016	0.006	0.004
age→F1→F2→F5	-0.030	0.009	0.001	-0.098	0.014	0.000	-0.051	0.022	0.021	-0.021	0.008	0.011	-0.032	0.006	0.000
age→F2→F5	0.019	0.008	0.020	0.087	0.015	0.000	0.034	0.016	0.031	-0.019	0.010	0.058	0.016	0.006	0.005
for born→F5	-0.043	0.011	0.000	-0.387	0.183	0.035	-0.024	0.009	0.008	-0.086	0.013	0.000	-0.026	0.005	0.000
forborn→F1→F2→F5	-0.042	0.010	0.000	-0.069	0.166	0.677	0.019	0.010	0.069	-0.065	0.011	0.000	0.005	0.002	0.031
for born→F2→F5	-0.002	0.003	0.557	-0.020	0.023	0.400	-0.005	0.004	0.265	-0.002	0.003	0.513	-0.021	0.004	0.000
for born→F4→F5	0.001	0.006	0.853	-0.298	0.118	0.012	-0.039	0.018	0.029	-0.019	0.009	0.040	-0.011	0.004	0.002
gender→F4	0.048	0.014	0.001	-0.052	0.032	0.109	0.083	0.018	0.000	-0.024	0.012	0.045	0.092	0.013	0.000
gender→F2→F4	0.048	0.014	0.001	-0.052	0.032	0.109	0.083	0.018	0.000	-0.024	0.012	0.045	0.092	0.013	0.000
for born→F4	0.003	0.014	0.854	-0.336	0.133	0.012	-0.130	0.029	0.000	-0.027	0.013	0.034	-0.033	0.010	0.001
for born→F2→F4	0.003	0.014	0.854	-0.336	0.133	0.012	-0.130	0.029	0.000	-0.027	0.013	0.034	-0.033	0.010	0.001
F1→F4	0.381	0.039	0.000	0.429	0.050	0.000	0.628	0.065	0.000	0.360	0.034	0.000	0.331	0.030	0.000
F1→F2→F4	0.381	0.039	0.000	0.429	0.050	0.000	0.628	0.065	0.000	0.360	0.034	0.000	0.331	0.030	0.000
gender→F3	0.050	0.014	0.000	-0.039	0.024	0.107	0.063	0.013	0.000	-0.024	0.012	0.043	0.082	0.011	0.000
gender→F2→F3	0.050	0.014	0.000	-0.039	0.024	0.107	0.063	0.013	0.000	-0.024	0.012	0.043	0.082	0.011	0.000
age→F2	-0.128	0.026	0.000	-0.345	0.032	0.000	-0.232	0.033	0.000	-0.060	0.023	0.008	-0.173	0.020	0.000
age→F1→F2	-0.128	0.026	0.000	-0.345	0.032	0.000	-0.232	0.033	0.000	-0.060	0.023	0.008	-0.173	0.020	0.000
for born→F2	-0.182	0.024	0.000	-0.244	0.584	0.677	0.086	0.032	0.007	-0.184	0.023	0.000	0.029	0.013	0.024
for born→F1→F2	-0.182	0.024	0.000	-0.244	0.584	0.677	0.086	0.032	0.007	-0.184	0.023	0.000	0.029	0.013	0.024

Source: PIAAC 2013, Authors' calculations

DATA IN BRIEF TEMPLATE

***Title:**	*A structural equation modeling for the analysis of skills formation*
***Authors:**	*Rosario Scandurra*
***Affiliations:**	*Universitat Autònoma de Barcelona*
***Contact email:**	*Rosario.scandurra@uab.cat*
***Co-authors**:	*Jorge Calero, Jorge.calero@ub.edu*
***CATEGORY:**	*Education; Social Science*

Data Article

Title: ***A Structural equation modeling for the analysis of skills formation***

Authors: Rosario Scandurra & Jorge Calero

Affiliations: *Universitat Autònoma de Barcelona*

Contact email: rosario.scandurra@uab.cat

Abstract

This data article features supplementary tables related to the article "How adult skills are configured? A comparative analysis of five models of skills formation". The tables show the descriptive statistics of the variables included in the model together with the table of the measurement model. For further information please consult linked data.

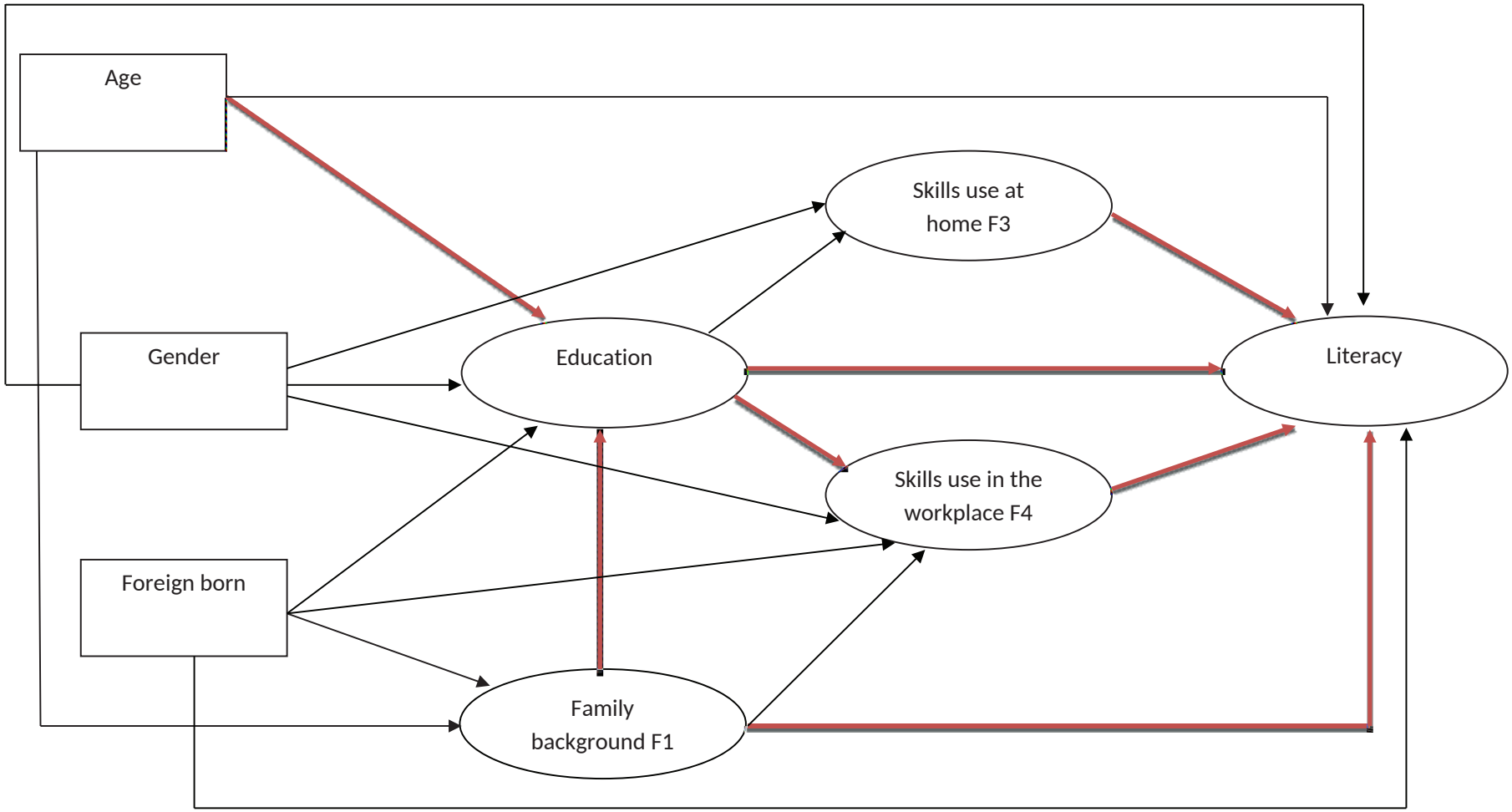
Specifications Table

Subject area	*Social sciences & Education*
More specific subject area	*Adult skills*
Type of data	*Tables and raw data*
How data was acquired	*survey*
Data format	*raw*
Experimental factors	
Experimental features	
Data source location	*Data is accessible through Mendeley data*
Data accessibility	*Data is accessible through Mendeley data*
Related research article	How adult skills are configured? A comparative analysis of five models of skills formation (in press).

Value of the Data

- Table 1 shows the distribution of each variable used in the study
- Figure 1 shows the path diagram of the model
- The measurement model provide insight on the modelling process

Figure 1. Path diagram, visual representation of the model



* Circles represent the latent variables and rectangles the observed variables.

Table 1. Descriptive statistics

	Denmark	Germany	Japan	Spain	United States
Age Recoded 5-Year Groups					
26-30	10.38	13.58	12.88	13.10	17.42
31-34	14.59	14.28	15.38	16.99	16.43
35-40	16.18	12.95	20.17	18.78	15.81
41-44	20.07	19.43	18.04	19.11	15.85
45-50	20.76	21.07	17.62	18.00	16.68
51-54	18.02	18.70	15.91	14.03	17.80
Missing	0.00	0.00	0.00	0.00	0.00
Background - Born In Country					
Yes	75.72	88.27	99.66	86.42	84.43
No	24.19	11.70	0.34	13.58	15.52
missing	0.09	0.03	0.00	0.00	0.04
Father Higher Education In 3 Categories					
Isced 1, 2, and 3C Short	35.79	9.99	27.27	72.58	21.10
Isced 3 (Excluding 3C Short) and 4	36.63	52.54	42.84	14.25	44.55
Isced 5 and 6	26.56	32.45	26.02	11.39	31.54
Missing	1.03	5.01	3.87	1.78	2.81
Gender					
Men	50.56	50.87	52.91	53.32	49.26
Women	49.44	49.13	47.09	46.68	50.74
Missing	0.00	0.00	0.00	0.00	0.00
Education - Highest Qualification					
Aged 15 or Younger	2.37	2.30	3.30	20.56	3.43
Aged 16-19	13.97	29.42	37.22	30.46	27.58
Aged 20-24	32.67	35.06	53.82	29.17	34.97
Aged 25-29	28.96	20.93	3.76	11.80	16.85
Aged 30-34	10.35	7.94	1.14	3.15	8.42
Aged 35 or Older	11.16	3.83	0.65	3.23	7.93
Missing	0.53	0.52	0.11	1.63	0.83
Index Of Use Of Reading Skills At Work					
All Zero Response	2.49	3.90	3.76	13.95	3.39
Lowest to 20%	10.10	12.64	12.53	19.89	10.94
More than 20% to 40%	14.15	14.73	19.37	17.59	17.51
More than 40% to 60%	22.63	19.25	19.83	15.40	19.12
More than 60% to 80%	25.31	24.03	19.83	13.65	21.47
More than 80%	25.16	25.42	24.42	19.15	27.46
Missing	0.16	0.03	0.27	0.37	0.12

- **Table 1. Descriptive statistics (continued)**

	Denmark	Germany	Japan	Spain	United States
Index Of Use Of Numeracy Skills At Work					
All Zero Response	15.68	15.11	9.57	26.90	12.96
Lowest to 20%	16.52	16.64	15.00	12.88	10.90
More than 20% to 40%	15.71	15.32	25.29	14.99	12.14
More than 40% to 60%	17.49	15.29	18.91	12.84	17.34
More than 60% to 80%	17.58	16.64	15.65	15.47	21.76
More than 80%	16.86	20.96	15.31	16.55	24.86
Missing	0.16	0.03	0.27	0.37	0.04
Index Of Use Of Writing Skills At Work					
All Zero Response	7.11	9.16	6.84	23.12	11.60
Lowest to 20%	12.38	12.05	10.03	13.58	12.68
More than 20% to 40%	21.66	18.04	14.28	15.44	13.34
More than 40% to 60%	22.85	21.48	18.31	13.58	15.57
More than 60% to 80%	19.92	20.89	24.08	16.18	21.02
More than 80%	15.93	18.35	26.21	17.74	25.76
Missing	0.16	0.03	0.27	0.37	0.04
Index Of Use Of Influencing Skills At Work					
All Zero Response	4.99	9.26	7.14	16.47	4.75
Lowest to 20%	11.10	16.43	20.17	23.45	12.14
More than 20% to 40%	15.74	19.67	22.71	16.03	15.98
More than 40% to 60%	19.76	22.11	19.03	15.40	16.02
More than 60% to 80%	24.41	19.78	17.28	13.58	20.89
More than 80%	23.85	12.67	13.41	14.73	30.10
Missing	0.16	0.07	0.27	0.33	0.12
Index Of Use Of Reading Skills At Home					
All Zero Response	0.31	0.14	0.46	1.45	1.07
Lowest to 20%	7.98	8.81	16.45	23.86	8.88
More than 20% to 40%	19.64	15.11	27.23	21.82	13.83
More than 40% to 60%	27.65	21.41	24.57	18.22	19.61
More than 60% to 80%	24.84	26.50	18.88	15.66	22.67
More than 80%	19.45	28.03	12.42	18.96	33.94
Missing	0.12	0.00	0.00	0.04	0.00
Index Of Use Of Numeracy Skills At Home					
All Zero Response	5.14	5.57	15.99	14.69	4.42
Lowest to 20%	16.74	16.09	29.70	22.52	10.03
More than 20% to 40%	19.45	17.69	24.69	18.70	13.91
More than 40% to 60%	22.04	20.89	15.38	14.69	20.23
More than 60% to 80%	21.51	23.96	9.68	16.03	25.93
More than 80%	15.02	15.81	4.56	13.36	25.47
Missing	0.09	0.00	0.00	0.00	0.00

- **Table 1. Descriptive statistics (continued)**

	Denmark	Germany	Japan	Spain	United States
Index Of Use Of Writing Skills At Home					
All Zero Response	3.40	2.44	7.25	15.81	9.29
Lowest to 20%	21.23	16.99	22.71	28.57	18.37
More than 20% to 40%	14.15	10.13	21.08	15.66	10.86
More than 40% to 60%	26.47	31.86	24.31	20.15	20.15
More than 60% to 80%	18.98	22.08	14.09	9.24	18.04
More than 80%	15.65	16.50	10.56	10.58	23.29
Missing	0.12	0.00	0.00	0.00	0.00
Index Of Use Of Ict Skills At Home					
All Zero Response	0.25	0.63	1.79	0.71	0.58
Lowest to 20%	10.44	15.46	32.66	16.03	10.57
More than 20% to 40%	14.59	17.37	24.84	16.33	15.52
More than 40% to 60%	21.73	19.95	14.01	14.55	17.51
More than 60% to 80%	24.41	20.72	6.80	13.36	18.79
More than 80%	24.75	16.33	3.91	13.21	20.85
Missing	3.83	9.54	15.99	25.83	16.18
(mean) Highest Level of Education (years)	13.65	14.44	13.75	12.34	14.24
(sd) Highest Level of Education (years)	2.63	2.72	2.26	3.48	2.92
(n) Highest Level of Education (years)	3,206	2,871	2,632	2,694	2,133
More than 20% to 40%	14.59	17.37	24.84	16.33	15.52
More than 40% to 60%	21.73	19.95	14.01	14.55	17.51
More than 60% to 80%	24.41	20.72	6.80	13.36	18.79
More than 80%	24.75	16.33	3.91	13.21	20.85
Missing	3.83	9.54	15.99	25.83	16.18
(mean) Highest Level of Education (years)	13.65	14.44	13.75	12.34	14.24
(sd) Highest Level of Education (years)	2.63	2.72	2.26	3.48	2.92
(n) Highest Level of Education (years)	3,206	2,871	2,632	2,694	2,133

- Source: PIAAC 2013, Authors' calculations

Table 2. Measurement model

		United States			Japan			Spain			Germany			Denmark		
		Estimate	S.E.	P-Value	Estimate	S.E.	P-Value	Estimate	S.E.	P-Value	Estimate	S.E.	P-Value	Estimate	S.E.	P-Value
F1	Fated	0.725	0.004	0.000	0.735	0.004	0.000	0.723	0.004	0.000	0.721	0.003	0.000	0.724	0.003	0.000
F2	Yrsqual	0.995	0.015	0.000	0.909	0.011	0.000	0.933	0.011	0.000	0.973	0.012	0.000	0.951	0.016	0.000
	B_Q01c1_C	0.682	0.015	0.000	0.906	0.013	0.000	0.760	0.013	0.000	0.695	0.014	0.000	0.636	0.016	0.000
F3	Readh_C	0.800	0.014	0.000	0.818	0.016	0.000	0.830	0.013	0.000	0.787	0.015	0.000	0.776	0.014	0.000
	Numh_C	0.718	0.017	0.000	0.707	0.018	0.000	0.655	0.017	0.000	0.718	0.018	0.000	0.702	0.015	0.000
	Writh_C	0.836	0.014	0.000	0.623	0.018	0.000	0.796	0.014	0.000	0.652	0.017	0.000	0.761	0.013	0.000
	Icth_C	0.733	0.017	0.000	0.683	0.020	0.000	0.716	0.018	0.000	0.687	0.019	0.000	0.752	0.015	0.000
F4	Readw_C	0.872	0.014	0.000	0.866	0.013	0.000	0.911	0.010	0.000	0.870	0.011	0.000	0.858	0.013	0.000
	Numw_C	0.688	0.019	0.000	0.716	0.016	0.000	0.708	0.016	0.000	0.753	0.015	0.000	0.712	0.016	0.000
	Writw_C	0.804	0.014	0.000	0.725	0.015	0.000	0.797	0.013	0.000	0.683	0.016	0.000	0.640	0.016	0.000
	Inflw_C	0.608	0.020	0.000	0.642	0.017	0.000	0.687	0.016	0.000	0.721	0.015	0.000	0.641	0.017	0.000
F5	Pvlit1	0.952	0.003	0.000	0.888	0.005	0.000	0.949	0.003	0.000	0.939	0.003	0.000	0.938	0.003	0.000
	Pvlit2	0.947	0.004	0.000	0.894	0.004	0.000	0.939	0.004	0.000	0.938	0.004	0.000	0.938	0.003	0.000
	Pvlit3	0.947	0.004	0.000	0.894	0.004	0.000	0.943	0.003	0.000	0.938	0.003	0.000	0.940	0.003	0.000
	Pvlit4	0.959	0.003	0.000	0.905	0.004	0.000	0.934	0.004	0.000	0.938	0.003	0.000	0.933	0.003	0.000
	Pvlit5	0.951	0.004	0.000	0.893	0.004	0.000	0.946	0.003	0.000	0.932	0.004	0.000	0.939	0.003	0.000
	Pvlit6	0.941	0.004	0.000	0.900	0.004	0.000	0.943	0.003	0.000	0.938	0.003	0.000	0.934	0.003	0.000
	Pvlit7	0.948	0.004	0.000	0.899	0.004	0.000	0.935	0.004	0.000	0.940	0.003	0.000	0.936	0.003	0.000
	Pvlit8	0.948	0.004	0.000	0.900	0.004	0.000	0.942	0.003	0.000	0.942	0.003	0.000	0.940	0.003	0.000
	Pvlit9	0.956	0.003	0.000	0.904	0.004	0.000	0.937	0.003	0.000	0.943	0.003	0.000	0.934	0.003	0.000
	Pvlit10	0.942	0.004	0.000	0.897	0.005	0.000	0.942	0.003	0.000	0.945	0.003	0.000	0.936	0.003	0.000

Source: PIAAC 2013, Authors' calculations

Data

The study is based on the first wave of the PIAAC, released in October 2013 and updated in March 2015. The data are made available on the OECD webpage and were retrieved in April 2017. The PIAAC provides direct measures of skills together with rich information on the individual social environment for adults aged between 16 and 65 in 24 countries, mostly OECD members.

Methods

To test the hypothesized relationships between the constructs and to evaluate the theoretical model, we used a Structural Equation Model (SEM). This is a broadly flexible set of statistical techniques, which allows the representation of the constructs of interest and the measurement of the extent to which the data are consistent with a proposed theoretical model.

Acknowledgments

We would like to thank Joan Guardia, Melanie Revilla for their thoughtful feedback.

References

How are adult skills configured? (in press).

Desjardins, R., 2003. Determinants of literacy proficiency: A lifelong-lifewide learning perspective. *International Journal of Educational Research*, 39, pp.205–245.

Kline, R. B. (2016) Principles and practices of structural equation modelling (4th edn) (London, Guilford Press).

Saris, W.E., Satorra, A. & van der Veld, W.M., 2009. Testing structural equation models or detection of misspecifications? *Structural Equation Modeling. Vol 16(4)*, 16(October), pp.561–582.