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Abstract

Lifelong learning over the life course is becoming important in order to compete in a knowledge-based global economy. Adult education and Training (AET) are a possible strategy of adjusting the skills of the adult population to the needs of either the changing occupational structure and aging societies. Nevertheless, despite the importance of AET, empirical evidence on the topic is still scarce, particularly as regards the cross-national comparative research. In this sense, this paper aims to contribute to this field of studies by gaining a better understanding of how AET can influence the level of skills in individuals. In view of this, I use data from Programme for the International Assessment of Adult Competencies (PIAAC) to investigate four different countries - Italy, France, UK and Sweden - the influence of individual characteristics on participation in formal and non-formal AET on one side and, on the other, the effect of both different types of AET on the skills (literacy and numeracy) of adult individuals.

The results from the four countries show that participation in both types of AET, on average, increases skills levels. I also found that, for both literacy and numeracy, on average the formal AET has a smaller impact on skills compared to non-formal AET. Another important finding is how the effect of learning activities varies across skills distribution: both of them take different trajectories in each of the countries selected. In conservative and southern countries, such as Italy and France, the effect of AET tend to be a bit unequal, being more efficient for groups of people at the top of the skill distributions, whereas, in Nordic and liberal countries, such as Sweden and the UK, the differences are less marked across all distributions, suggesting a fairer effect of both types of AET.

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Introduction

Recent challenges, such as the transition of modern economies to knowledge-based economies under globalisation, besides the demographic aging of societies, have pushed many countries and organizations to seek new ways to maintain competitive advantage. Enhancing the levels of skills in the population required for the jobs for now and for the future, is a strategic concern in the economic growth and social development of countries all over the world.

On the one hand, globalisation is speeding up technology and innovation: new occupations are emerging while replacing others; within each occupation, required skills and competencies are evolving, as the knowledge content of production processes and services is rising (ILO, 2011). At the same time, demographic processes related to increasing life expectancy and lower fertility rates are causing, on one side, problems for welfare state budgets; on the other, they increase labor shortage, due to the shrinking proportion of young workers (ILO, 2013).

In addition to these trends, there is strong evidence that poor cognitive skills, such as literacy and numeracy, have a negative impact on the quality of life of individuals, in particular on their earnings and employment prospects. A variety of surveys have shown that people with good skills, measured by standardised test scores, tend to have higher wages and better chances of being in work than people with low level of skills (Dearden et al. 2001, Vignoles et. al. 2010, Murnane et al., 2000, Hanushek and Zhang, 2008).

In this context the prevailing point is that the success of a country largely depends on the possibility to rely upon a labour force with higher levels of individual competences. As a result, many governments aim at investing resources in order to increase the skill level of their citizens. Adult education and Training (AET) are a possible strategy of adjusting the skills of the adult population to the needs of either the changing occupational structure and ageing societies (Cummins et al., 2015). AET also have important implications for social inequality. On the one hand, this objective has the potential to reduce inequalities emerged also in early life. Moreover, the mentioned macro-trends of globalisation and demographic changes are likely to have a strong impact on the need both for older and lower qualified people to take part in lifelong learning activities in order to update their skills to match labor market demands (Organisation for Economic Co-operation and Development, 2013). On

the other hand, AET may actually increases existing inequalities if well-educated people are the primary group taking advantage of these opportunities (Kilpi-Jakonen et al. 2014).

Cross-National Comparisons

Despite the importance of AET, empirical evidence on the topic is still scarce, particularly as regards the cross-national comparative research. In this sense, the aim of this paper is to contribute to this field of studies by gaining a better understanding of how adult education and training can influence the level of skills of individuals. In view of this, I use data from Programme for the International Assessment of Adult Competencies (PIAAC) to investigate in four different countries - Italy, France, UK (namely England and Northern Ireland) and Sweden - the influence of individual characteristics on participation in different types of adult education and training on one side, and, on the other, the effect of different types of adult education and training on the skills of adults individuals.

This paper, in particular, examines the outcomes for the four countries aforementioned - included in the PIAAC survey – regarding individuals who participated in formal and non-formal AET. In addition, comparisons of country levels are made between Italy, Sweden, the UK, and France. The choice of these countries is based on the considerable differences among them with respect to the characteristics of their educational, training, and occupational system; their labour market regulations; the nature of their employment-sustaining policies; the level of the decommodification offered by their national welfare systems. My hypothesis, indeed, is that the national institutional setting plays an important role in influencing trajectories of continued learning participation. In particular, following the well known welfare state typology (Esping-Andersen, 1990; Arts and Gellinsen 2002; Fenfer, 2007), combined with participation rates in adult education and training (Dännrich et al. 2014), it is possible to attribute each of these countries to a particular macro-group, presenting so broad common features, namely Social-Democratic/Nordic countries; the Central Conservative countries; Southern European countries and the Anglo-Saxon, liberal countries. I address each in turn.

The Social-Democratic/Nordic countries include *Sweden*, Denmark, Finland and Norway, which have high participation rates in AET (especially non-formal, with more than 60% on average). These countries invest a lot in lifelong learning programmes targeting low skilled-workers in order to ensure their employability. AET activities are largely

founded by though high taxes by governments. Which also provide incentives for employers in view of training as a nontaxable benefit.

The Central-Conservative countries feature moderate participation rates in both type of AET (ranging between 34% of France and 48% of Germany). These countries - Austria, Germany, *France* - put less emphasis on active labor market programmes promoting the re-employment chances of persons with problems (i.e., low-skilled workers); on the contrary, they tend to use public expenditure on different types of intervention, mainly support out-of-work income maintenance (i.e., long-lasting unemployment benefit payments, generous maternity leave and early retirement payments).

The Southern European countries include *Italy*, Spain, and Portugal with low level of participation rates in all type of AET (ranging between 24% of Italy and 47% of Spain). These countries share traditionally low employment rates and a closed employment system with very strong insider/outsider segmentation. The relative welfare state systems are characterized by high transfers to insiders. AET represent a very limited phenomenon even because only a few percentage of public expenditure is dedicated to training programmes aimed at improving individual employability.

The Anglo-Saxon/Liberal countries - such as the *UK* and Ireland - show high levels of participation in formal AET, but relatively low participation in non-formal lifelong learning activities. The main features of welfare systems there are a low level both of total state spending and of expenditure on social protection, facing high level of inequality. The low level of employment protection means that the labour market turnover is high, which means that employers may be put off from investing in their employee due to the fear of poaching from competing firms. On the other hand, at an individual level, low employment protection give individuals incentives to invest in their own skills in order to remain competitive in the labour market.

The four countries include in this study were selected based on: first, their belonging to one of the four macro-groups; second, data available (i.e., least amount of missing values); third, personal interest.

In order to capture only learning activities taking place after the completion of initial education, the current research focus on individuals aged 25-65. In this way I leave out from the sample individuals studying, for formal qualifications within the normal age range (18-24).

Research Questions

This paper intends to address the following questions:

1) Does participation in AET vary by age, gender and initial educational level between countries?
2) Is participation in AET associated with an improvement in individual cognitive skills? Are there any differences between countries?
3) Do cognitive skills vary by age, gender and initial education? Are there any differences between countries?
4) Does the relationship between participation in different types of AET and skills differ across various points of the skill distribution? Are there any differences between countries?

Literature Review

The Human Capital Framework

One of the most significant contribution of labour economics is the human capital theory (Becker, 1964). According to this perspective, people are considered valuable assets, somewhat recognised as a form of capital, like the physical capital. The OECD provides an efficient definition of this construct: it corresponds to any stock of "*knowledge, skills, competencies and attributes embodied in individuals that facilitate the creation of personal, social and economic well-being*" (OECD 2001, p.18). The possible source of human capital differences are *innate ability*, *school*, *pre-labor market influences and adult education and training* (Acemoglu and Autor, 2014). A brief description of each source follows.

Workers can have different amounts of human capital because of innate differences. Research in psychology and neuroscience has documented that there is some component of IQ which is genetic in origin (Plomin and Deary, 2014). Many economists believe that these "unobserved" variable is very important in understanding the distribution of wages. The problem is that we do not have good data on this component of human capital. However, the relevance of this observation for labour economics is that there is likely to be heterogeneity in human capital even when individuals have access to the same investment opportunities and the same economic constraints. Then the omission of this component in

the Mincerian equation can lead to biased estimates (*ability bias*) of the rate of return to schooling, linked to the "endogeneity" of education[1] (Griliches, 1977).

Since the seminal work of Mincer (1970, 1974) schooling has been the focus of much research, since the component of human capital investments is the most easily observable and readily tracked over time. The empirical results suggests that education, measured as educational attainment, confers significant advantages to individual. On average the economic rate of return to an additional education ranges between 5 and 10 percent (Card, 1999; Harmon et al., 2000). It is, however, widely accepted that what is learnt is equally, if not more, important than the quantity of schooling acquired (Glewwe 1996; Ishikawa and Ryan, 2002). In other words, what matters is not only the "quantity" of years of schooling acquired but, above all, the "quality" of this investment, measured by the level of cognitive skills. Today the cognitive skills, identified by test scores - such as those incorporated into the international assessments - are good measures of relevant skills for the human capital (Hanushek et al., 2011). In this respect consistent evidence indicates that better skills are significantly related to higher labour market earnings. According to Hanushek's estimate, a one-standard-deviation increase in numeracy skills is associated with an average increase in hourly wages of 17.8% (Hanushek et al., 2013).

In the main, schooling decisions take place while the young person is still living within the family environment, therefore it is widely accepted that the family plays a major role in determining the human capital development and subsequent inequalities between individuals (Cunha and Heckman, 2007). The empirical evidence reports a strong positive association between parental socio-economic status, typically measured by income or education, and the dimension of children's human capital, such as health and cognitive and non-cognitive skills (Blanden et al. 2007: Currie, 2009) at a given age; in turns it predicts key economic, social, health and behavioral outcomes in adulthood (Heckman, 2007). Besides the family, recognition is growing among economists that also peer group effects, to which individuals are exposed before they join the labour market, may also significantly affect their human capital. Some studies report positive influences of higher achieving peers, at least for some students, measured by test scores (Zimmerman, 2003:

[1] The problem of ability bias is basically that more able people could get more schooling and at the same time earn more not because of the additional schooling but just because they are more able. So if the individual's ability and educational attainment are correlated, estimation of economic return to education would give biased results.

Gaviria and Raphael, 2001). Probably the main difficulty inherent with this approach as detailed in Evans et al. (1992) is that families may choose their residence (and schools) based on observed characteristics of potential peer groups (self-selection). At the same time families may possess unobserved characteristics, such as greater motivation, that positively influence student outcomes. Thus peer variables could be positively correlated with unobserved individual determinants of outcomes, perhaps leading to upward biases in estimates of peer-group effects (Sacerdote, 2001).

A significant amount of human capital investment occurs through training or adult education courses, acquired by workers after schooling. In broad terms, there are three different types of AET: formal, non-formal and informal.

Formal AET *take place in education and training institutions, and lead to recognised credentials and diplomas* (Commission on European Communities, 2000).

Non-formal AET *can take place both within or outside of educational and training settings (i.e., on-the-job training), but do not typically lead to formal credentials* (Ibidem).

Informal AET is any activity involving the pursuit of understanding, knowledge or skill occurring without the presence of externally imposed curricular or pressure - i.e., learning by experience - (Livingstone, 2001).

In his classic book “Human Capital” (1964), Gary Becker distinguished between firm-specific and general training. The former provides a worker with specific firm skills, that is, such as capable of increasing his/her productivity only with the current employer; the latter will contribute to the worker general human capital, increasing his/her productivity with a range of employers. According to Becker, whether the firm or worker pays for this form of human capital depends on whether the job training is firm-specific or general. In perfectly competitive labour markets, workers pay for general training by receiving low wages during training period, but they will reap the returns of this investment by earning higher wages later. And, since general training is fully transferable, workers’ post-training wages will be the same across firms (Becker, 1964). In the case of specific training, the skills acquired will not be transferable to other firms; then, it is efficient for firms and workers to share the costs and the benefits of this kind of training investment (Hashimoto, 1981). Finally, if the training comprises a mix of general and specific components, there should be some sharing of costs (Albert et al., 2010).

Participation in AET

The belief among policy-makers, employers and individuals is that continual skill formation plays an important role in the accumulation process of human capital (Jenkins et al. 2002). Nevertheless, despite the increasing emphasis placed in the last two decades on the positive role of lifelong learning, most of the research attention has been on the acquisition of human capital by young people through formal education. This paper focuses on two different kinds of lifelong activities - *the formal and non-formal AET* - and it intends to investigate, for four countries (Italy, UK, Sweden and France), the factors influencing the participation of individuals in these components of human capital, and the effectiveness of AET in improving the level of individuals' basic skills – namely, numeracy and literacy. In this paragraph, I examine the literature concerning the determinants of the participation in AET and I derive some hypotheses. I focus on three factors shaping participation: age, gender, prior level of education.

Regarding age, the general pattern is that the likelihood of participation in AET decreases in time, which is primarily due to the lower perceived benefits of participation and possible incompatibility of learning with adult-life courses role (Hostetler et al. 2006; Elman and O'Rand, 2007). In line with these findings, my expectation with regard to age profiles is that the participation in all types of AET is concentrated among young adults, especially in Italy and France, where the age discrimination in the labour market is usually higher than Nordic and Liberal countries (Dämmrich et al., 2014).

Turning to prior education, there is a wide ranging evidence that individuals with higher educational attainments are more likely to participate in non-formal AET, regardless of the country taken into account (Bassanini et al., 2007; Dieckhoff and Steiber 2011; Albert et al., 2010). One possible explanation is that higher educated people tend to work in more demanding and knowledge-intensive jobs, which requires more training (OECD, 2013). In literature this is also known as "a cumulative advantage" (DiPrete and Eirich, 2006). According to Blundell et al. (1999), a strong complementarity exists indeed between the three main components of human capital – innate ability; qualifications and knowledge acquired through formal education; skills, competencies and expertise gained through workplace training. These findings, moreover, consistent with the cumulative and multiplier effects of learning, find further support in Heckman's research for whom 'skills beget skills' (Cunha and Heckman, 2007). In other words, this literature *"suggest that there should be strong investments in early childhood, both because the sensitive periods for acquiring*

several capabilities occurs early in life, but also because successful early in life is the foundation for successful later in life" (Carneiro et al. 2010, p. 256). As a result, I expect that individuals with higher initial education and those in better occupational positions be more likely to participate in non-formal AET.

On the other hand, formal AET should have a different pattern. In particular, the general expansion of tertiary education in the last years has also attracted more mature students (Schuetze and Slowey, 2002). Some studies, indeed, show that individuals with no diploma or degree but rich in earlier experience are more likely to return to education as adults. (Elman and O'Rand 2004, Hällsten, 2011). At the same time, we can expect that those already owning a high qualification have less incentives to return to formal education, especially for the high opportunity costs of this investment: acquiring a formal qualification typically last for one or more years, therefore it can be a big deterrent, in terms of time commitment. On the contrary, those with low levels of education may face dispositional barriers to re-entering a formal education system due to the lack of necessary entry qualifications (Kilpi-Jakonen et. al, 2014). Moreover, although the opportunity cost could be lower for lower educated, the absolute costs of formal qualification can be a barrier to entry. Thus we expect that individuals with medium level of education would be more likely to participate in formal AET. Though, since both Nordic and liberal countries have a less stratified educational system (OECD, 2007), the barriers to participate in AET in the form of previous diplomas play a minor role. Instead, central and southern European countries have a high stratified educational system, which probably makes it more difficult to take part in AET. Then, I expect that differences between lower and higher educated individuals in the likelihood to participate in formal AET should be smaller in Sweden and the UK and higher in Italy and France.

The third factor here taken into account is gender. Evidence from previous research shows a higher probability for women to participate in formal AET (Fouarge and Schils, 2009; Kilpi-Jakonen et al., 2012). A possible explanation is that women may feel more need to update their skills after family-related employment interruptions (childbearing), in order to remain competitive in the labor market (Stenberg et al., 2011). Dieckhoff and Steiber (2011) have shown that men have a higher probability of participating in non-formal AET. Under this view it is sensible for employers to invest in men, because males do not tend to interrupt their career for family reasons (Ibidem). Thus, I expect that women should be more likely than men to participate in formal AET, while men should have higher

probability to participate in non-formal AET. From a country point of view, I expect that in Sweden, where the welfare state emphasizes gender equality, the gender difference should be less marked. Even in the UK the gender difference should be not so high, because it is a liberal country, characterized, on one hand, by a high level of competition in the labour market and, on the other, by low state support. Thus, for women it is difficult to get a long interruption and employers should be less reluctant to invest for their training. Conversely, I expect Italy and France be more inclined to invest in men, because in these countries women interrupt their careers for childbearing more often and for a longer time (Dämmrich et al., 2014).

The Relationship between AET and Skills

Regarding the benefit of AET, there is a large international literature documenting empirical evidence that these learning activities improve labour market outcomes, such as employment and higher wages. Recent OECD analysis reveals a strong cross-country correlation at the aggregate level between labour force participation and employment on the one hand and both initial education and subsequent adult training on the other hand. At an individual level, there is a strong association between participation in adult training participation and employment probability: on average, looking at individuals aged 25-54 years, an increase of 10% in the time spent in training is associated both with an increase in the probability of being economically active by 0.4% and a fall in the probability of being unemployed of almost 0.2% (OECD, 2004). Nevertheless, most of the research about AET focus on their benefits in terms of wage *premia*. This literature provides strong evidence of wage effects of training, especially in the US and in the UK: an individual undertaking non-formal AET earns, on average, just above 5-10% higher real earnings than one who has not undertaken such learning courses (Blundell et al., 1999; Leuven, 2004). Tough, when we consider formal AET, Jenks et al. (2002) suggest that this type of lifelong learning has no measurable impact on individuals' wage. In other words, taking a qualification during early ages has a remarkable impact on the wage, while taking the same qualification later, for example after 30 age, has no actual consequence as regards the wage. A possible explanation of this pattern is that employers can assume that adult education is a signal of lower ability: a qualification achieved later in life proves less motivation or ability in people.

Another strand of literature shows a strong positive effect of training on firm productivity. The major study for the UK worked out an industry panel data between 1984 and 1996 containing training, wages, labour, capital and value-added. It found that training is associated with significantly higher productivity. In particular, raising the proportion of workers trained in an industry by 1% was associated with a 0.6% increase in productivity (value added per work) and a 0.3% increase in wages (Dearden et al., 2006). Similar positive effects have been found in other longitudinal surveys of firms in Mexico (Tan and Lopez-Acevedo, 2005) and Malaysia (Tan, 2000).

But what do we know about the impact of AET on learning outcomes? Most policy-makers believe that training translates into higher productivity, and therefore into higher incomes for individuals, because they assume that the participation in these type of activities increases people's skills. However, is this assumption consistent with the evidence?

Unfortunately, information on the effectiveness of both formal and non-formal AET is very scarce; the evaluation on whether learners acquire substantive skills is rather thin. In general, research from the UK and US try to measure the effectiveness of adult basic skills - literacy and numeracy provision - but they deal with small-scale studies conducted over a short span of time. Furthermore, few of the surveys are high enough quality to capture the complexities of the connections between interventions and outcomes.

Torgerson et al. (2003, 2004, and 2005) report the results of a systematic review about the experimental and quasi-experimental literature in the field of lifelong learning activities, published between 1980 and 2002. The aim of these studies was to investigate the effectiveness of adult learning programmes designed to increase literacy and numeracy skills. A total of 4,555 potentially relevant papers were identified by using electronic and hand searches. From this large database the authors identified: 12 papers reporting nine randomized controlled trials (RCTS) and 27 papers corresponding to 27 controlled trials (CTs). Of the nine RCTs included in the review, eight were undertaken in the US and one in the UK; five evaluated interventions in literacy, two programmes in numeracy and two in both numeracy and literacy. All of them were of highly quality in the sense they adopted an appropriate design for evaluating effectiveness. Focusing on five studies in all, the authors found statistically significant gains in three (when pooled), and non-significant gains in two. However almost all of them had methodological problems, such as small sample size, unclear method of random allocation and high attrition rate. Only one study, conducted in

California, was large enough to detect small, but important, improvements in literacy and numeracy among the participants. Regarding the CTs included in the review, 18 of them had no effect sizes (incomplete data) and only nine with full data. Of these nine trials, six evaluated interventions in literacy and three in both literacy and numeracy. Practically all they were undertaken in US, except one in New Zealand. Among the nine studies the results, three showed a statistically significant positive effect of the learning activities; five trials showed no difference; and one showed a positive effect for the control group.

The quality of the trials was variable, but many of them lacked methodological accuracy because of large attrition, no equivalence at baseline and lack of matching on pre-test scores. To sum up, the authors found some evidence that adult literacy and numeracy programmes are effective. Nevertheless, these findings are based on not completely reliable experiments owing to their scantiness, or heterogeneity, or low quality. Thus, any interpretation of the results must be considered with some caution.

In their literature review, Vorhaus et al. (2011) looked at 10 years of research related to adult literacy and numeracy. In particular, the authors reported the evidence of modest gains by learners in England from three studies. In 1998–99 Brooks et al. (2001) measured the progress of adult literacy students in dedicated mainstream basic skills (reading and writing skills) provision in England and Wales. About half the reading items were drawn from the least difficult tasks in the OECD survey (conducted in 1998), IALS (International Adult Literacy Survey). Of the 2,135 learners, from 71 colleges of further education and local education authorities, who took the reading pre-test, 1,224 (57%) took the reading post-test. Writing scripts were received from 1,724 students at pre-test and 937 (54%) at post-test. Background data was collected on the students and 177 adult literacy tutors completed a questionnaire. The average gain in reading was small but significant, from the 19th to the 22th percentile on the IALS scale. The average gain in writing was very tiny: an increase in the average number of words written from 19 to 21, with no significant change in sentence length, accuracy of grammar or spelling, or handwriting. In another study of 2008, Brooks et al. tracked the progress of 179 adult literacy students, and found their average gain was equivalent to about half of one IALS level. Finally, Brooks and Pilling (2009) report the progress in numeracy of adult numeracy learners and in reading/writing of adult literacy and ESOL learners after three-to-six months of instruction (typically one two-hour session a week) in 2004–06. Adult literacy

learners' gain in writing was non-significant; the other four gains were statistically significant, but all represented about one third of (the British equivalent of) one IALS level.

Benseman (2010) explores the effectiveness of workplace literacy and numeracy programmes ('Upskilling') based on an evaluation of 18 workplace courses, set up by 16 companies in New Zealand. The companies covered a range of industries, locations, company sizes and organizational structures, while the courses covered a range of programme formats, duration and types of learners. The courses tried to integrate literacy and numeracy into workplace training (embedding approach). The evaluation took place over three years, and quantitative and qualitative data were gathered to identify the outcomes for the course participants, their workplace practices, the companies they worked for and their lives outside work. Reading and writing skills were assessed using 'Go!', an assessment tool developed by NFER (National Foundation for Educational Research) for NRDC (National Research and Development Centre for adult literacy and numeracy) (Rhys Warner et al., 2008). A total of 491 course participants were interviewed and assessed pre-course and 343 (69.8%) of these participants were also interviewed and assessed post-course. Among the participants re-tested for reading at the end of their course, 86% showed an improvement in their reading scores, while the reading scores for 4% did not change while for 10% decreased. Average reading scaled scores increased by 10.1 points out of 100. Around two-thirds (66.1%) of participants made gains in their writing score. Regarding numeracy, only seven learners completed pre and post-course numeracy assessments, and they increased their average score from 12.1 to 15.3 points out of 46.

Wolf and Evans (2011) conducted a longitudinal study of the impact on learners and their organizations of government-funded workplace programmes designed to increase the literacy skills of employees, involving 567 learners and over 53 workplaces. The reading and writing skills of participants were tested at the start of their courses, and then a year and two years later. Information was collected on all three occasions about their jobs, learning experiences, education, attitudes to work, and aspirations. At the same time, managers, training managers and course tutors were interviewed. The courses offered 30 hours of tuition, after which learners had no further free workplace entitlement. Most of the learners were volunteers, whilst a small number were effectively forced to participate by their employers. The project examined whether this period had any impact on skills and whether it changed participants' learning trajectories. The short workplace courses did not,

in general, have any substantial immediate impact on participants' literacy skills. Among learners for whom English was their first language, there were no statistically significant improvements in literacy attainment. Amongst ESOL learners, there were small but statistically significant gains, but it is very likely that these resulted from continued exposure to an English speaking environment. Participants' average performance continued to improve over a two year's post-instruction period. Learners using their literacy skills actively, in and out of the workplace, were most likely to show consistent gains.

Wolf and Jenkins (2014) analysed the effect on reading comprehension skills of British adults who participated in government-funded literacy courses organized in workplace from 2003-2009. The study involved a relatively small sample of 500 learners in 53 different workplaces. After volunteering to participate in the study, they were followed from the enrollment until between 2 or three years later. The target learners were low-skilled employees, namely workers doing routine and repetitive jobs, such as people working in food processing companies, cleaners, car assistants, bus-drivers, etc. Since in almost all sites there was a 100% agreement to participate among workers approached, the main drawback in this study is the absence of a control group. Using different statistical method (OLS and Multilevel Model: linear growth model) the authors found two different groups with two different outcomes. Among learners mastering English as a second language, there was a statistically significant, though non large, improvement in the literacy skills, especially in the period not included in the course, whereas among the native English speakers there were not significant gains. These findings are consistent with those of Wolf and Evans (2011): the difference between the two groups of learners may refer to their linguistic difference in some ways, which explains why the former progressed differently and faster. Wolf and Jenkins stressed that "*however it is also probable, and we believe more probable, that their greater improvement simply reflect more time spent in an English-speaking country. For that reason, this group's gains cannot be confidently attributed to the effects of the course*" (Wolf and Jenkins, 2014, p. 604).

A particularly relevant paper for the current study is a cross-country comparison by Sgobbi (2014) who investigates how AET impact individual proficiency in individuals' cognitive skills in eleven EU countries, based on the PIAAC survey promoted by OECD. The aim is to point out the drivers of proficiency in literacy, numeracy and problem solving. A first set of OLS regressions examines the drivers of individual proficiency for the total adult population in selected countries, whereas a second set of regressions focuses on

employed individuals. Both sets of regressions include two binary variables concerning adult education and training experienced by respondents in the 12 months preceding the survey, plus a set of covariates (age, gender, educational attainment, employment status, family background). The empirical analysis shows that the relationship between adult education and cognitive skills is either negative or non-significant, whereas the relationship between training and skills displays a positive effects. In addition, the effect of training gets smaller and less significant when the analysis is restricted to employed individuals. The study tries also to control for the potential endogeneity of AET, drawing on a treatment effects model. Focusing only on individuals employed or self-employed, Sgobbi estimates selection equations to account for possible systematic differences between individuals employed and the remaining PIAAC population by means of a two-step Heckman. Nevertheless this study is open to criticism when dealing with the selection bias: it considers as selection equation (and as excluded variables, the number of member in the household, the number of children and the health condition) the probability of people to be employed and not the more congruent probability to be in training. In my study I do not address the selectivity bias because there are not good instruments available. Furthermore, unlike Sgobbi who just presented the results of her analysis for 11 European countries without doing any comparisons among them, I perform a series of Z-scores to examine the differences between regressions coefficients for the AET (formal and non-formal) among the four countries (Italy, Sweden, France and UK).

To make a short summary: previous research from within the UK and US seek to measure the effectiveness of literacy and numeracy provision in small-scale and over a short time-period, during which learner gains may not be apparent or are difficult to measure. Moreover, most of the investigated studies are of poor quality or insufficiently well-designed to capture the complexities of the connections between interventions and outcomes. Altogether, there is limited evidence of a significant association between participation in AET and proficiency (increased skills).

Based on the findings of previous research I anticipate the following findings:

i) I expect to find a positive association between participation in formal and non-formal AET, both in numeracy and in literacy.

ii) Literacy and numeracy are to a large extent acquired in school. Obtaining access to the instruction required to become a good reader, for example, is

difficult outside a formal school setting. So it might be expected to find a positive association between education attainment and literacy or numeracy.

iii) Turning to age, on one hand, older people benefit of more experience, but, on the other hand, young adults (25-35) have the advantage of more recent schooling and, as a group, a larger proportion of the younger population have received extended formal schooling compared to older adult groups. Thus, I expect a negative relationship between both literacy and numeracy and age.

iv) Regarding the relationship between skills and gender, recent studies (for example Nierderle and Vesterlund, 2010) have documented the existence of a gender gap for a series of math test scores (AP calculus, the mathematics SAT, and the quantitative portion of the Graduate Record Examination (GRE), I expect a negative association between numeracy and female individuals. In addition, since at the school level there is evidence that females outperform males in verbal tests (Goldin et al., 2006) I expect to find a similar pattern also with regard to adult population.

Data and Empirical Strategy

Data

I use data from the Programme for the International Assessment of Adult Competencies (PIAAC), a large-scale comparative survey conducted under the auspices of OECD. The survey directly assesses the skills of about 5,000 individuals per each country, aged 16-65 and representing the countries working age population. In this paper, I use data of the first round, carried out in 24 industrialised countries between 2011-2012. I analyse the public-use files as available on the OECD's PIAAC webpage. PIAAC builds on knowledge and experiences gained from previous international adult assessments - the International Adult Literacy Survey (IALS), conducted between 1994 and 1998, and the Adult Literacy and Lifeskills Survey (ALL), conducted between 2003 and 2008.

I rely on the PIAAC because it is the only data source providing detailed information on adult learning experiences together with background variables and test scores on general cognitive skills for a large number of countries. PIAAC reports an assessment of the key cognitive and workplace skills needed for individuals to participate in advanced

economies: literacy, numeracy and problem solving skills in technology-rich environments. Literacy and numeracy were assessed by administering either computer-delivered or paper-and-pencil delivered sets of tasks characterized by different degrees of difficulty. Problem solving capabilities in technology-rich environments were administered through interviewed individuals in 18 of the 22 countries involved in the first round of the Survey of Adult Skills (Cyprus, France, Italy, and Spain did not participate).

To reduce the time required by assessment tests while not compromising the coverage of the tested constructs, the Survey of Adult Skills resorts to a complex design strategy, assigning different assessment items to each respondent. This choice requires the implementation of specific procedures to produce comparable and reliable measures of individual performance. The PIACC survey based on the Item Response Theory (IRT) to calibrate item responses and obtain parameter estimates for the cognitive test items. These parameters were subsequently used in latent regression models to calculate multiple 10 plausible values for each interviewed individual and each proficiency measure. Reliable estimates of performance in literacy, numeracy and problem solving at population or subpopulation levels are obtained as the weighted average of multiple plausible values. In addition, a replication approach to estimate the sampling variability allows a correct variance estimate of the proficiency means for each country (OECD 2013).

The survey also contains a background questionnaire including basic demographic data along with information regarding the development and maintenance of skills, such as education, participation in various types of adult education and training programmes, the employment/labor market status and income (OECD, 2010). PIAAC data thus provide useful information to investigate either the determinants of the participation in AET, and the relationship between participation in AET on individual proficiency (while controlling for additional variables that may significantly affect this relationship).

The current analysis includes only 4 of the 24 countries: Italy, Sweden, UK, and France, and it considers for each of them the scores in literacy and numeracy. In order to capture lifelong learning activities taking place after the completion of initial education, I leave individuals aged 16-24 out of the analysis. Then, I focus on individuals aged 25-65, the normal age range to enter in the labour market. Overall, the final sample covers four countries and includes 21,157 individuals.

Methods

Since individual observations in the dataset are not independent because clustered within countries, multilevel regressions models, which combine individual and contextual factors, should be an appropriate technique, because they can account for the nested structure of the data. However, the application of multilevel models for an international survey-data-set, like PIAAC, is a bit troubling. Firstly, in these surveys the country selection is not a random sample, but a convenient sample of those countries where researchers are willing and have the financial means to participate in the study. Secondly, the analysis of this paper is restricted only to a sub-sample of four countries (and, in any case, the total number of countries included in PIAAC sample are less than 25), consequently the application of multilevel model would have a low number of degrees of freedom on the country level[2]. Then, as pointed out by Möhring (2012, p. 3), "*the advantages of multilevel models, as the introduction of random slopes and cross-level interaction effects, cannot be fully applied due to statistical reasons. If models are correctly specified paying regard to the small number country level, only low number of macro level indicators can be controlled for".*

Given the above, to address research question 1) I carry out separate logistic regressions for each country and each learning activity. The dependent variable is a dichotomous variable indicating whether a person participated AET in the 12 months prior the survey. As mentioned earlier, I distinguished between 2 types of AET, formal and non-formal. The "Logit" model is specified as the log odds of equation:

$$\text{Ln}\,[p_i/(1-p_i)] = \alpha + \beta_1 Age_i + \beta_2 Female_i + \beta_3 \text{Educ}_i + \beta_k x_i \qquad (1)$$

As independent variables, I consider three factors: age (in year bands), gender (a dummy variable which has value 1 for females, and 0 for males) and education level (from primary to tertiary level). In addition to these variables, I include a set of covariates (x_i), related to individual characteristics: subjective working condition (employed or self-employed, retired, unemployed, etc.), working sector (private sector, public sector), social

[2] Mass and Hox (2005), conclude that only samples with more than 50 macro units produce unbiased estimators.

classes (unskilled workers, skilled manuals, professionals, etc.), the number of individuals in the households, the number of children, the health condition, the language mastery (whether the respondent is a native speaker), the highest qualification of parents and the number of books at home at age 16.

This approach uses a method called 'Maximum Likelihood', which allows to find the value of the parameters *β* which maximises the likelihood of observing what I have actually observed in the data. So, if the model leads to a large improvement in the likelihood, compared to the null model, then it has some explanatory power and is better than the null model.

In order to address research questions 2) and 3) I use an OLS regression, which consider years of schooling, age, gender, a set of covariates to capture the observable individual heterogeneity and a variable called *Aetraining*. The resulting education production function is:

$$Y_i = \alpha + \pi S_i + \gamma Age_i + \tau Female_i + \delta Aetraining_i + \omega Z_i + \varepsilon \quad (2)$$

Where Y_i is a measure of cognitive skills (standardised test scores in literacy and numeracy), S_i is the years spent in the education system to achieve the highest educational; Age_i is the respondent's age (in bands); $Female_i$is a dummy variable indicating the individual gender; $Aetraining_i$ is a categorical variable assuming value 0 for individuals who did not participate in any type of AET activities in the 12 month before the survey, 1 for people who did participate in non-formal AET and 2 for individuals in formal AET; Z_i represents other variables assumed to affect cognitive skills (such as work condition, economic sector, type of contract, etc.). δ is the coefficient measuring the effect of $Aetraining$ on skills while ε is the error term.

In order to compare the countries selected in this study, I perform a series of Z-tests to examine the differences between regression coefficients for the $Aetraining_i$variable and for gender, education and age (to compare two-country samples). Significant Z-scores identify significant differences in the slope coefficients between the two samples. The *Z-test* is an appropriate technique to examine the equality of effects between samples from mutually exclusive populations. With the two coefficients from two samples represented as δ_1 and δ_2, and *SE* as the standard error, the Z-test can be performed using the following equation (Paternoster et al., 1998):

$$Z = \frac{\delta_1 + \delta_2}{\sqrt{SE\delta_1^2 + SE\delta_2^2}} \qquad (3)$$

Finally, to address question 4), I estimate equation (2) using quantile regression technique. OLS approach estimates average skills (numeracy or literacy) as a function of age, education and gender and other factors. It assumes that the average is a good representation of the overall distribution of skills. However, just as the average value can provide an incomplete picture of the skills distribution, so too can the regression results provide an incomplete picture of the relationships between the predictive variables and the outcome. One strategy for completing the picture is to use quantile regression (Koenker and Bassett, 1978; Angrist, J.D. and Pischke, 2006).

Quantile regression provides estimates for the relationships between variables and the outcome at different parts of the outcome distribution: it is useful both for exploring changes in the shape of the distribution of skills and for controlling for various factors. It helps in front of complex interactions - of which not all can be measured - and where limiting factors may apply as constraints (Cade and Noon, 2003).

In the following analysis, quantile regression is used to establish the relationship of the explanatory variables at the 5th, 10th, 25th, 50th , 75th, 90th and 95th percentiles of the skills distribution. The formal function is:

$$\min_{\beta \in R^k} \sum_{i= \; y_i \geq x_i\beta} \theta \, | \, Y_i - (\alpha_\theta + \pi_\theta S_i + \gamma_\theta Age_i + \tau_\theta Female_i + \delta_\theta Aetraining_i + \omega_\theta Z)_i \, | \; +$$

$$\sum_{i=h \; y_i \leq x_i\beta} (1-\theta) \, | \, Y_i - (\alpha_\theta + \pi_\theta S_i + \gamma_\theta Age_i + \tau_\theta Female_i + \delta_\theta Aetraining_i + \omega_\theta Z)_i \, | \quad (4)$$

The quantile regression has other advantages over OLS, which can be summarised as the following (Buchinsky, 1998):

i) It provides robust estimates of the coefficients; namely estimates are insensitive to the outliers of the dependent variables;

ii) When error terms is not randomly distributed, estimators provided by quantile regression can be more efficient than OLS estimators;

iii) If different estimates for several quantiles are observed, the influence change of the independent variables on the dependent variable along the whole conditional distribution can be easily understood.

All regressions (Logistic, OLS and quantile) were estimated with Stata 14.0 using the *repest* command elaborated by Pokropek and Jakubowski (2013) to calculate correct standard errors in presence of multiple plausible values of the dependent variables.

Limitations

Comparable cross-country longitudinal data for developed countries are currently unavailable. Therefore, in the current analysis, I have to rely on to the PIAAC cross-sectional data. This raises an issue: it is difficult to estimate the causal impact of AET on cognitive skills with cross-sectional data. The main problem is related to the potential *endogeneity* of AET, due to omitted variables. AET, indeed, is not randomly assigned to participants since individuals self-select themselves and/or are selected by firms. Indeed, on one side, for example, employers are likely to invest more in training of employees they perceive to be more skillful; on the other side, individuals with higher skills levels might be more likely to participate in AET because of unobserved characteristics (i.e., motivation, flexibility, commitment) that also affect their skills. As a result, the positive relationship between AET and skills could not due solely to the effects of the learning activity itself but rather to the characteristics of the participants - i.e., innate ability bias - (Bassanini et al., 2005; Albert et al., 2010). Since I did not find credible instruments variables (IV) and cannot rely on panel-data structure, it is impossible to make causal claims. Thus, I can only investigate whether AET participation are associated with high level of cognitive skills, conditional on a set of covariates.

Empirical Results

Dependent Variables

The outcomes for the first research question is measured by two binary variables, indicating entry into formal and non-formal AET in the 12 months prior the survey, where 1 = ‘participated in formal/non formal AET’ and 0 = ‘did not participate’.

The outcomes variable for the other three research questions are measured using the standardised test scores in literacy and numeracy. The Expert Group defines the PIAAC

literacy scale as follows: "*literacy is 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, chapter 17, p. 2). While numeracy is defined as "*the ability to access, use, apply, interpret, and communicate mathematical information and ideas in order to effectively manage and respond to the mathematical demands of diverse situations in the information age*" (OECD, chapter 17, p. 6). The proficiency showed by the respondents in the test is measured on a scale from 0 to 500 points, which is divided into skills levels (from below 1 to 5, where 1 is lowest level and 5 the highest).

Independent variables

The independent variable of interest for research question 1 is the level of education reached by an individual. This is measured by a categorical variable coded 1 = 'primary level', 2 = 'lower secondary level', 3 ='upper secondary level', 4 = 'post-secondary or tertiary level'. In the tertiary level are also included people who got a master's degree or a PhD. Gender is measured by a dummy variable for females. The age is considered by bands. The first group is composed by individuals aged between 25 and 35, followed by those who are 36-45, 46-55 and 56-65.

The independent variables for the other research questions are essentially the same, with the addition of one categorical variable, named *aetraining*, assuming value 0 for people who did not participate in any type of AET activities in the 12 month prior the survey (reference group), 1 for people who did participate in non-formal AET and 2 for those entering in formal AET. Furthermore, in the OLS and in the quantile regression analysis, instead of levels of education I consider a continuous variable measuring the number of years of education necessary to get the highest qualification.

Control variables

The control variables comprise work-related variables (working situation, type of contract, employment sector, social class) in addition to personal and background variables (general health, locus of control, motivation, number of people in the household, parental education, and the number of book at home at age 16 and finally whether the individual is a native speaker).

All work-related variables are included in all the analyses. Regarding the working situation, as a categorical variable I assume value 1 for people employed or self-employed (reference group), 2 for *retired*, 3 for *unemployed*, 4 for people only doing *housework* and 5 for the *other* category (it includes students and people involved in military services or disables). The working contract is measured by a categorical variable, where 1 = 'indefinite contract' (reference category); 2 = 'fixed-term or temporary contract (include apprenticeship)'; 3 = 'no contract'. The employment sector is a dummy indicating whether an individual works in the private sector (reference group) or whether is in the public sector or in a non-profit organization (value 1). Lastly, the categorical variable *social class* measures the type of job assuming value 1 for 'skilled occupations' (reference group), 2 for 'semi-skilled white-collar occupations', 3 'semi-skilled blue-collar occupations' and 4 'elementary occupations'.

Among the personal and background variables included in the logistic model, the *health* condition is measured by a variable with five categories, ranging from 'excellent' (reference group) to 'poor'. *Household* indicates the number of individuals in the household, comprising 7 categories: from 'one person' (reference group) to 'seven people or more'. *Book* is a categorical variable intending to capture the intensity of the cultural capital experienced in early youth. It reports the number of books at the respondent's household when he or she was 16, and taking values between 1 for 'less than 10 books' (reference group) and 6 'more than 500 books'. *Pared*, which assesses the highest level of education achieved by the respondent's mother or father, is a categorical variable where 0 = 'neither parent has attained upper secondary qualification' (reference group), 2 = 'at least one parent has attained upper secondary qualification', and 3 = 'at least one parent has attained tertiary qualification'. Then *nativespeaker* is a dummy taking value 0 for non-native speakers and 1 otherwise.

Beside *book*, *pared* and *nativespeaker*, in the OLS and quantile regression analysis, I consider 2 more control variables. The first one, called *locus of control*, assesses the effectiveness of one's political action and can be regarded as a proxy for perceived locus of control (Sgobbi, 2014). The second one, assessing whether individuals get to the bottom of difficult things in a scale from 1 'not at all' (the reference group) to 5 'to a very high extent', intends to capture the *motivation* of respondents in learning activities.

Descriptive analysis: Participation rates in formal and non-formal AET

I begin with a brief examination of the distribution of both types of AET across the four countries.

Table 1 – Participation rates in AET

	France		Italy		Sweden		UK	
	Formal AET	Non-formal AET	Formal AET	Non-formal AET	Formal AET	Non-formal AET	Formal AET	Non-formal AET
Gender								
Female	4.48	32.55	5.92	23.99	9.68	59.13	14.42	52.37
Male	4.56	32.51	4.91	18.92	15.80	61.56	16.53	48.94
Age								
25-35	9.63	37.47	14.62	27.26	28.58	65.85 |	21.51	53.01
36-45	4.98	39.16	4.16	24.11	11.90	64.20	18.88	56.02
46-55	2.33	34.64	1.84	22.59	8.24	63.06	13.00	53.35
56-65	0.62	15.92	0.15	9.31	2.06	46.29	4.60	36.17
Education(levels)								
Primary or less	0.16	8.01	0.36	3.22	8.25	24.65	3.66	20.44
Lower secondary	2.98	19.11	1.32	12.99	8.03	38.81	7.60	33.97
Upper Secondary and Post Sec.	3.37	30.03	7.51	26.33	9.07	59.95	14.51	49.36
Tertiary	8.56	52.27	17.04	51.24	20.66	75.33 |	22.10	65.50
Current work situation								
Employed or self-employed	4.18	41.10	5.07	31.15	10.24	68.83	16.55	60.80
Retired	0.11	11.09	0	5.49	0.92	23.39	3.76	20.94
Unemployed	9.6	19.35	6.22	10.40	15.80	32.28	13.66	37.32
Housework	0.94	7.04	0.76	2.83	9.85	32.65	9.57	14.80
Other	14.87	17.28	30.07	18.95	58.62	43.82	24.80	23.21
Type of contract								
Indefinite contract	3.47	44.16	3.79	33.28	9.35	72.36	17.73	66.12
Fixed-term/Temporary contract	10.72	34.47	11.94	24.76	30.77	62.62	24.36	67.16
No contract	7.79	36.95	5.76	6.88	27.92	37.65	13.52	42.68
Sector								
The private sector	3.15	36.07	4.78	26.88	8.44	63.25	14.56	52.80
The public sector and non-profit	7.05	54.73	7.79	43.42	15.67	77.17	22.84	79.44
Social class								
Skilled occupations	5.62	50.13	9.98	45.41	13.22	78.80	19.38	68.58
Semi-skilled white-collars	5.28	31.86	6.14	20.16	15.05	54.78	17.32	51.86
Semi-skilled blue-collars	2.96	23.45	1.17	16.68	7.32	46.60	9.96	44.33
Elementary occupations	3.51	13.30	4.48	7.28	14.29	25.57	9.12	21.05
Total	4.55	32.57	5.46	21.46	12.72	60.25	15.48	50.63

Table 1 shows that there is substantial cross-national variation in the proportion of persons undertaking the two types of lifelong learning activities. Formal AET and non-formal AET are not equally widespread, and the latter is prevalent in all countries.

Overall Sweden displays the larger figures for non-formal AET (60.25%), while it is smaller in Italy (21.46%). On the other hand, regarding formal AET the UK has the higher participation rate (15.48%), whereas in France there is the lower one (4.55%). As already suggested in the introduction, this cross-national variation seems to partially reflect institutional differences among the four countries. In particular the highest level of participation is found in a Nordic country, namely Sweden, while the lowest rates are found among the Central-Conservative and Southern Europeans countries, such as France and Italy. Within the two extremes, there is a Liberal country such as the UK. On average, higher is the age of individuals, smaller are the rates of participation in both types of AET in all countries. At the same time, as the level of education achieved by individuals increases so too does the participation rates in both formal and non-formal AET. Lastly, females in Italy have greater participation rates than men in formal AET. While in France, Sweden and in the UK the situation is exactly the opposite. Turning to non-formal AET, men have higher figures only in Sweden.

In order to investigate more in detail these relationships, I include them in a multivariate Logistic model, along with other explanatory variables.

Research Question 1: Does Participation in AET Vary by Age, Gender and Initial Educational Level between Countries?

In the following paragraph, the results of the logistic regressions regarding the influence of individual characteristics on participation in both formal and non-formal AET are set out (Tables 2 and 3). In particular, in order to address research question 1) I focus on discussing the effect of age, education and gender on participation in different types of lifelong learning activity.

Table 2 - The determinants of participation in formal AET, Logit estimates

	France		Italy		Sweden		UK		Pooled	
	OR	S.E.	OR	S.E.	OR	S.E.	OR	S.E.	OR	S.E.
Female	0.782***	0.17	0.967***	0 .224	1.422***	0.173	1.172***	0.172	1.043***	0.102
Age Bands										
(reference: 25-35)										
36-45	0.681***	0.152	0.490***	0.139	0.604***	0.103	0.812***	0.119	0.738***	0.079
46-55	0.295***	0.077	0.187**	0.073	0.412***	0.078	0.686***	0.107	0.555***	0.067
56-65	0.070	0.045	0.050	0.045	0.139***	0.041	0.246***	0.073	0.219***	0.053
Education levels										
(reference: Primary or less)										
Lower secondary	0.798***	0.253	2.468	2.517	3.922	2.904	1.285**	0.665	1.47**	0.623
Upper secondary and post secondary	0.503***	0.113	3.306	3.000	4.409	3.252	2.866**	1.228	2.384**	0.961
Tertiary	-	-	-	-	12.852	9.405	2.873**	1.228	3.387**	1.380
Constant	0.042**	0.024	.003	0.009	0.011	0.017	0.117*	0.063	0.020**	0.009
LL_0	-2,862,746		-2,972,890		-1,149,170		-6,417,471		-1.44E+07	
LL_1	-2,463,786		-2,345,294		-917,131.800		-5,955,877		-1.28E+07	
Chi2	131.237***		128.131***		297.658***		103.195***		376.082***	
N	2,583		1,845		2,369		3,547		10,498	

*$p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. *Controlling for: current work situation, type of contract, sector, social class, health, household, number of book at age 16, parental education and native speaker condition.*

Table 3 - The determinants of participation in non-formal AET, Logit estimates

	France		Italy		Sweden		UK		Pooled	
	OR	S.E.	OR	S.E.	OR	S.E.	OR	S.E.	OR	S.E.
Female	0.947***	0.071	0.883***	0.124	0.968***	0.133	0.938***	0.124	0.924***	0.055
Age Bands										
(reference: 25-35)										
36-45	1.141***	0.122	1.164***	0.209	0.839***	0.138	1.281***	0.213	1.207***	0.083
46-55	1.232***	0.126	1.105***	0.215	0.799***	0.132	1.323***	0.226	1.338***	0.105
56-65	0.738***	0.110	0.892***	0.271	0.520***	0.100	1.143***	0.232	1.116***	0.128
Education levels										
(reference: Primary or less)										
Lower secondary	1.718***	0.443	0.836*	0.481	2.422**	1.099	1.559***	0.453	1.089***	0.188
Upper secondary and post secondary	2.668***	0.620	1.154*	0.637	3.237**	1.398	1.830***	0.470	1.587***	0.248
Tertiary	4.183***	0.919	1.750*	1.028	3.032**	1.388	2.165***	0.582	2.321***	0.381
Constant	0.233***	0.074	0.302*	0.176	1.731	1.109	0.755***	0.303	0.353***	0.075
LL_0	-10,400,000		-8,858,951		-1,829,766		-8,502,565		-31,700,000	
LL_1	-9,292,254		-7,835,782		-1,622,649		-7,331,267		-27,600,000	
Chi2	308.575***		204.537***		246.087***		272.754***		889.647***	
N	2,718		1,864		2,382		3,556		10,528	

*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$. *Controlling for: current work situation, type of contract, sector, social class, health, household, number of book at age 16, parental education and native speaker condition.*

Age

As evident in Table 3, there is a significant relationship between all age bands and participation in non-formal AET in all countries selected. Contrary to my expectations, in Sweden the rate of decrease in the odds of AET participation for older groups of individuals is higher. Here, individuals aged 36-45 have an expected decrease in odds of participating in non-formal AET of 0.839 (p<0.01), with respect to the reference group (individuals aged 25-35). Afterwards, the odds tend to decrease with the age, till the older groups (56-65). Conversely, in the other three countries, the pattern is a bit different. The 36-45 age group experiences the highest odds of entering in non-formal AET, compared to the reference group (25-35). For example, in Italy individuals aged 36-45 have an odds of 1.164 (p<0.01) of being in non-formal AET. Afterwards the relative odds decrease with age. Instead, in the UK and in France, the odds of participating in non-formal AET increases until age 46-55 and then it drops.

Results for formal AET (Table 2) indicate that overall the relationship between the outcome and age is statistically significant, except for the oldest individuals (56-65) in Italy

and France. In all countries, the odds of taking part in formal AET diminish with the age at a rate steeper than the one observed for non-formal AET. This trend is particularly evident in Italy where being a person aged 36-45 lowers the odds of taking part in formal AET in the prior 12 months of about 0.490 ($p<0.01$), compared to the reference group (25-35). Then with age the odds drop to 0.187 ($p<0.05$) for people 46-55 and to 0.050 ($p>0.10$) for the oldest group. This trend is a bit less marked in the UK, where the odds decrease from 0.812 ($p<0.01$) for people aged 36-45, to 0.686 ($p< 0.01$) for individuals aged 46-55, and 0.246 ($p<0.01$) for people closer to retirement.

Summary: *as age increases the odds of the individual to participate in any type of AET increases. This result is in concordance with my expectation and with the human capital theory* (Becker, 1964), *which states that younger individuals have higher probability of participating in adult learning activities due to higher net returns over the remaining life* (see also Ben-Porath, 1967; Li et al., 2000; Fourage and Schils, 2009).

Education

The results for non-formal AET (Table 3) in Italy indicate that compared to people who have just finished primary school, those who with a post-secondary qualification or a university degree (or more) have the higher odds to enter formal AET (OR = 1.750, $p<0.10$); followed by those holding an upper secondary diploma (OR = 1.154, $p< 0.10$) and those who got a lower secondary qualification (OR = 0.836, $p<0.10$). There are a barely detectable statistically significant difference between all categories. In France and Sweden the association between education level and the odds of entering non formal AET is stronger; Italy depicts the weaker relationship.

With regard to formal AET, the overall results suggest an association of increasing strength between the education level and the odds of entering formal AET. Nevertheless, as I hypothesised in the literature review section, the differences between lower and higher educated individuals in the odds to participate in formal AET is found to be smaller in countries with less stratified school system, such as the UK and Sweden, compared to Central and Conservative countries, like Italy and France. In Italy, with respect to people holding only a primary diploma, those who reached a lower secondary level have an higher odds of being in formal AET (OR = 2.468, $p>0.10$), this is even higher (OR = 3.306, $p>0.10$) in those in upper secondary level. In the UK the differences between levels are less marked. The odds of entering formal AET there is 1.285 ($p<0.10$), 2.866 ($p<0.05$) and

2.873 ($p<0.05$), for individuals in lower secondary, upper secondary, and tertiary levels, respectively.

Summary: *the results in Table 2 and 3 strongly support my expectation for which better educated persons participate more often in non-formal adult learning courses than their lower counterparts. However, the same educational effect, with the exception of France, is also found for formal AET*. *In most countries education seems one of the most important influencing predictor for participation in both types of AET. This could be due to the already mentioned complementary relationships between initial and AET and/or because of higher skill requirements and higher learning capacity of better educated persons* (Brunello, 2001; Albert et. al. 2010).

Gender

In France women have lower odds to enter in formal AET (OR = 0.782, $p<0.01$). The association between both learning activities and gender turns out to be highly significant in all countries. Furthermore, my expectation about a less market gender difference in Sweden and in the UK, compared to Italy and France, is partially confirmed, since it is found only for non-formal AET, but not for formal AET. Indeed in Italy women have almost the same odds of men to enter in formal AET (OR = 0.967, $p<0.10$), while in Sweden is 1.422 ($p<0.01$).

Summary: *The results of the multivariate logistic model show that, in line with my expectations, men are more likely to participate in non-formal AET. While women are more likely to enter in formal AET only in the UK and in Sweden, but not in France and in Italy.*

Other control variables

With regard to other covariates relating to employment characteristics and the background, I briefly illustrate some common trends (see Appendix, Tables 8 and 9): individuals with fixed-term or temporary working contracts (including apprenticeship) have lower odds of entering non-formal AET, compared to people in indefinite contracts, whereas, in formal AET, the pattern is completely the opposite. Regarding the working subjective condition, compared to individuals employed or self-employed, people retired, unemployed or at home doing only housework experience lower odds of being in non-formal AET, except in the UK, where pensioner have higher odds (OR = 3.771, $p>0.10$). In all countries, individuals working in the public sector or in non-profit organizations have higher odds of being in both kinds of learning activities. Moreover, the odds of participating in non-formal AET tend to decrease with the level of social class. Among the other background

covariates, the results show that being a native speaker reduces the odds of being in non-formal AET; while it is associated with higher odds in the other type of AET. Lastly, the higher the education level of parents, the greater the odds of entering in formal and non-formal AET.

Research Question 2: Is Participation in AET Associated with an Improvement in Individual Cognitive Skills? Are There any Differences between Countries?

The main purpose of this paragraph is to assess whether AET (formal and non-formal) are related to adult skills and, if so, how returns to both types of AET vary across countries. To tackle these issues, I develop a two-stage strategy. First I estimate OLS regression models for each individual's countries and both types of skills, numeracy and literacy; then, in the second stage, I perform a series of *Z-tests* to examine the differences between the regression coefficients for the independent variable to check whether the differences between Italy, France, UK and Sweden are statistically significant.

The results of the OLS regression are summarised in Tables 4 and 5. More specifically, Table 3 reports the estimates determinants of proficiency in literacy; while Table 4 shows the drivers of proficiency in numeracy in the selected countries.

Table 4 – The drivers of literacy, OLS estimates

	France		Italy		Sweden		UK		Pooled	
	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
AET										
(reference: Did not partecipated in any AET)										
Particpated in non-formal AET	4.651***	1.570	6.544**	2.638	4.017	2.468	6.393**	2.705	8.550***	1.261
Particpated in formal AET	8.262**	3.608	4.243	5.725	-0.392	3.776	6.080*	3.207	9.534****	1.980
Female	-1.476	1.607	-1.599	2.637	-3.943*	2.027	-6.621***	2.211	-2.776**	1.235
Age Bands										
(reference: 25-35)										
36-45	-10.587***	1.738	-0.350	2.957	-1.584	2.419	-2.322	2.764	-4.087***	1.298
46-55	-13.933***	2.029	-0.289	3.504	-9.437***	2.135	-7.512**	3.329	-6.807***	1.594
56-65	-22.440***	2.669	-12.286	6.026	-16.191***	2.706	-7.890**	3.694	-13.114***	2.232
Years of education	4.248***	0.300	3.486***	0.406	4.754***	0.513	2.573***	0.450	3.271***	0.215
F	55.905***		23.672***		49.351***		51.707***		185.815***	
R-squared	0.414		0.298		0.411		0.344		0.377	
N	2,643		1,874		2,363		3,290		10,170	

*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$. *Controlling for: current work situation, type of contract, sector, social class, motivation, locus of control, number of book at age 16, parental education and native speaker condition.*

Table 5 – The drivers of numeracy, OLS estimates

	France		Italy		Sweden		UK		Pooled	
	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
AET										
(reference: Did not partecipated in any AET)										
Particpated in non-formal AET	7.160***	1.724	6.084**	2.889	4.178	2.567	7.615***	2.955	8.205***	1.429
Particpated in formal AET	5.805	4.335	-3.949	5.803	1.134	3.936	4.383	3.846	4.004	2.449
Female	-11.522***	1.795	-11.422***	2.562	-13.808***	2.104	-16.551***	2.531	-12.709	1.354
Age Bands										
(reference: 25-35)										
36-45	-6.004***	1.805	-1.765	3.323	-1.750	2.833	0.836	3.186	-2.538	1.625
46-55	-9.913***	2.217	-2.054	3.524	-7.055**	2.952	-4.858	3.469	-6.219***	1.547
56-65	-16.548***	3.087	-13.632**	6.016	-9.698***	3.091	-2.347	3.761	-11.497***	2.238
Years of education	5.524***	0.317	3.504***	0.436	5.448***	0.522	2.728***	0.573	3.807***	0.227
Constant	200.864***	7.973	236.602***	12.556	226.336***	11.818	243.639***	13.890	232.007***	6.790
F	73.573***		23.545***		46.358***		54.896***		189.644***	
R-sq	0.482		0.297		0.396		0.357		0.382	
N	2,643		1,874		2,363		3,290		10,170	

$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$. *Controlling for: current work situation, type of contract, sector, social class, motivation, locus of control, number of book at age 16, parental education and native speaker condition.*

The beta coefficients for *aetraining* represent the average differences in skills returns for individuals who attended various types of AET, compared to those without any AET (the omitted reference category).

There is substantial variability in the skills returns to formal and non-formal AET.

Summary: *overall my expectation about a positive association between both types of lifelong learning activities and literacy/numeracy is confirmed in almost all countries, with the exception of Sweden and Italy*. *In the former country, indeed the relationship between literacy and formal AET turns out to be negative and non-significant (-0,392, p<0.10); whereas in the latter the association between numeracy and formal AET is negative and non-significant (-3.949, p<0.10) as well*.

The relationship between literacy and AET

Focusing first on literacy, the results show that in France the association between literacy and both learning activities is significant at 5% level; while the same is not to be seen in Sweden where the association is not significant for both learning activities. In Italy, the coefficients equal to 6.544 (p<0.05) and 4.243 (p>0.10) for non-formal AET and formal AET respectively. The interpretation for non-formal AET is as follows: being equal the effects of the other variables, participating in non-formal AET in the 12 months, prior the survey, increases the proficiency in skills of about 6,54 points, compared to people who did not participate in any kind of learning activity. In France the coefficient for the formal AET is higher (8.262, p<0.05), while in Italy the magnitude of the relationship between non-formal AET and the outcome is the greatest.

Summary*: with the exception of France, non-formal AET has a higher effect on literacy compared to formal AET.*

The relationship between numeracy and AET

The association between the outcome and the *aetraining* variable is mixed: for the non-formal AET category in France, Italy and the UK, it is significant but not the same occurs in all countries for formal AET. Returns to non-formal activities are smaller in Sweden (4.178, p>0.10), and larger in the UK (7.615, p<0.05) whereas the returns to formal AET are moderately high in France (5.805, p>0.10), but negative in Italy (-3.949, p>0.10). In this case it means that entering formal AET decreases, *ceteris paribus*, the proficiency in numeracy of about 4 points, with respect to individuals without any type of AET.

Summary: *the overall pattern suggests that the formal AET has a smaller impact on skills compared to non-formal AET*.

Z-scores for the AET coefficients

I compare the beta coefficients for both categories of AET between Italy and each of the other three countries, separately for literacy and numeracy. For both types of skills, there is not significance difference between the coefficients of the *aetraining* variable in Italy and those of the other countries (see Appendix, Tables 18 and 19).

For example, regarding literacy, the Z-scores comparing the beta coefficients of non-formal AET category for Italy and the three countries are in every case negative, suggesting the effect of this learning activity are greater in France (Z-score = -0.617, p>0.10), Sweden (Z-score = -0.700, p>0.10) and the UK (Z-score = -0.040, p>0.10)[3]. In contrast to this, turning to numeracy the relative Z-scores are all positive (but not significant), thus suggesting a greater impact of formal AET on skills in Italy compared to France, Sweden and the UK.

Research Question 3: Do Cognitive Skills Vary by Age, Gender and Initial Education Level? Are there any differences between countries?

In this section I present the results from Table 4 and 5 related to the association between both types of skills and the other three variables - age, gender and education. Following the same strategy used for the AET, I also investigate how these associations vary across the four countries included in this research.

Age

The beta coefficients for age represent the average differences in skills returns for individuals in different age bands compared to those aged 25-25 (the omitted reference category). For literacy, the only country where the association with all age bands is highly significant is France, where, by the way, the relationship is found to be higher in magnitude. In this country, indeed, the results indicate that, compared to younger people,

[3] Since in my analysis I perform a multi-country comparison of statistical tests, some Z-test could have a *P* values less than 0.05 purely by chance, even if all null hypotheses are really true. To take into account this, I adjust the 5% significance level (α) with a Bonferroni correction = $\frac{\alpha}{Number\ of\ tests\ performed}$. Thus in this case the $\alpha_{Bonf} = \frac{\alpha}{4} = \frac{0.05}{4} = 0.01$.

individuals in the older groups (56-65) report the highest negative relationship with the outcome (-22.440, p<0.01); they are followed by those aged 46-55 (-13.933, p< 0.01) and 36-45 (-10.587, p<0.01). In UK the average difference between age categories is less marked. The coefficients for people close to retirement is -7.890 (p<0.05), while the one for people in the middle age groups are -7.512 (p<0.05) and -2.322 (p>0.01).

Regarding numeracy, the pattern does not change essentially: the effect of age keeps being negative for all countries. The association turns out to be significant for all age bands in France; conversely, in Italy and in the UK it is not significant. Even in this case France shows a higher magnitude as concerns the relationship between the outcome and the independent variable is. In the UK differences are lesser among the all categories. Interestingly, in Italy the negative effect of age on numeracy is particularly strong for the oldest group, but not so marked for the middle aged groups. Here, being between 56-65 reduces the proficiency in numeracy of almost 14 points with respect to the younger respondents - holding constant the effect of the other variables.

Summary: *the results for age show a decreasing negative effects of age to adults' skills: the higher the age the weaker the association with the dependents variables. Thus my expectation meets strong support.*

Education

The returns to formal education on literacy range between 2.573 in the UK and 4.754 in Sweden. Thus, an additional year of education, being constant the other variables, increases the scores of literacy of about 2.6 points in the UK, and almost 5 in Sweden. On the other hand, for numeracy the coefficients of years of education vary between 2.728 (p<0.01) in the UK and 5.448 (p<0.01) in Sweden.

Summary: *the skills returns to prior education are overall highly significant. My hypothesis about a positive association between education attainment and both literacy and numeracy is confirmed*.

Gender

The association between gender and the outcome is not significant in France and Italy for literacy, whereas a highly significant relationship is detected for all countries, with regard to numeracy. The size of the female coefficient for literacy is higher in the UK (-6.621, p<0.01) and smaller in France (-1.476, p>0.01). Very strong is the negative effect of the female dummy variable on numeracy: the beta coefficient ranges between -11.422 in Italy

(p<0.01) and -16.551 in the UK (p<0.01). Then, all in all being female in those countries decreases, *ceteris paribus*, the proficiency in numeracy of about 11 and 16 points.

Summary: *my expectations about a gender gap in both types of skills are partially confirmed. In both regressions, being female is negatively associated with the outcomes. Therefore, surprisingly, my hypothesis stating the existence of a gender gap playing in favor of female in the literacy is not supported by evidence*.

Other control variables

Among the other covariates, the *nativespeaker* dummy variable is the strongest predictor of proficiency for both type of skills. Results from Tables 10 and 11 (see Appendix) show that in line with previous studies (Wolf and Evans, 2011; Jenkins and Wolf, 2014), being a native speaker has a significant negative impact on literacy. The pattern for numeracy is even more marked. For instance, the condition of the native speaker reduces the numeracy skill level of about 30 points in the UK. Also the *book* variable has a great effect on skills. The relationship tends to increase with the number of book at home at age 16: for literacy the coefficients range between 5.035 (between 11 and 25 books, p>0.10) and 28.075 (more than 500 books, p<0.01) in Sweden; whereas for numeracy it varies between 0.699 (p>0.10) and 26.505 (p<0.01). Considering the work-related control variable, compared to those with indefinite contract, having a fixed-term or temporary contract negatively affects the scores in both type of skills. Furthermore, with the exception of France and only for numeracy, working in the public sector decreases skills proficiency. Lastly, apart from some category in Italy for literacy, the ability to get to the bottom of things (*motivation*) has an increasing positive effects on skills.

Z-scores for the age, education and gender coefficients

Finally, I compare the beta coefficients for age, education and gender between Italy and each of the other three countries, separately for literacy and numeracy (Appendix, Tables 18 and 19). .

Considering the results from the literacy regressions first, the Z-test produces significant results in the comparisons of the beta coefficients of individuals aged 36-45 and 46-55, between Italy and France. The Z-scores suggest the relationship between these two age groups, and the outcome was significantly smaller in Italy (Italy/France: Z-score = -2.984, p<0.01, for individuals 36-45; Z-score = -3.370, p<0.01, for individuals 46-55).

Regarding numeracy, the only significant Z-scores are found in the comparison of the coefficients of years of formal education between Italy and France (Z-score = 3.746, p<0.01) and between Italy and Sweden (Z-score = 2.858, p<0.01).

Research Question 4: Does the Relationship between Participation in Different types of AET and Skills Differ across Various Points of the Skill Distribution? Are There any Differences between Countries?

Tables 6 and 7 show the estimates of OLS for the *aetraining* variable as well as those for 7 representative quantiles: 0.05, 0.10, 0.25, 0.50, 0.75, 0.90 and 0.95. Differences between percentiles of the skills distribution computed for six different extremes taken by twos (θ_{95} - θ_{5}, θ_{90} - θ_{10} and θ_{75} - θ_{25}) are also reported. To be parsimonious the estimates related to other independent variables – age, gender, education - are reported in the Appendix (Tables 12, 13, 14, 15, 16, 17).

Table 6 – The relationship between AET and literacy, quantile regression estimates

	France		Italy		Sweden		UK	
	non_form AET	form AET	non_form AET	form AET	non_form AET	form AET	non_form AET	form AET
OLS	4.651***	8.262**	6.544**	4.243	4.017	-0.392	6.393**	6.080*
Q5th	6.826	5.910	5.985	-1.450	5.480	3.705	7.131	7.505
Q10th	5.452	4.914	6.053	-3.179	4.900	1.154	5.407	7.261
Q25th	5.168	3.809	5.450	-1.395	3.521	-1.786	3.994	6.774
Q50th	4.807	9.466	7.629	8.117	2.547	-1.494	5.729	4.221
Q75th	3.858	9.096	8.092*	9.030	2.343	-2.094	7.639	5.008
Q90th	3.525	12.859	6.296	10.190	4.338	1.489	7.275	5.622
Q95th	2.657	13.177	5.059	9.518	6.096	4.153	8.244	9.026
Q95th-Q5th	-4.169	7.267	-0.926	10.968	0.616	0.448	1.113	1.521
Q90th-Q10th	-1.927	7.945	0.243	13.369	-0.562	0.335	1.868	-1.639
Q75th-Q25th	-1.31	5.287	2.642	10.425	-1.178	-0.308	3.645	-1.766

*$p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. *Controlling for: gender, age, years of education, current work situation, type of contract, sector, social class, motivation, locus of control number of book at age 16, parental education and native speaker condition.*

Table 7 – The relationship between AET and numeracy, quantile regression estimates

	France		Italy		Sweden		UK	
	non_form AET	form AET	non_form AET	form AET	non_form AET	form AET	non_form AET	form AET
OLS	7.160***	5.805	6.084**	-3.949	4.178	1.134	7.615***	4.383
Q5th	13.228	7.285	6.982	-9.613	6.847	3.494	9.281	7.462
Q10th	10.908*	4.121	7.283	-9.134	6.879	3.081	7.134	5.082
Q25th	7.391*	1.834	6.548	-6.287	4.275	0.745	6.755	2.087
Q50th	6.158*	3.964	5.998	-5.906	1.350	-1.790	8.275	4.442
Q75th	6.038	8.404	4.496	1.262	1.927	-0.690	5.601	1.994
Q90th	6.847	10.531	3.59	3.154	3.753	0.948	6.789	5.745
Q95th	7.697	13.749	1.802	1.240	3.618	0.550	8.469	8.952
Q95th-Q5th	-5.531	6.464	-5.180	10.853	-3.229	-2.944	-0.812	1.490
Q90th-Q10th	-4.061	6.41	-3.693	12.288	-3.126	-2.133	-0.345	0.663
Q75th-Q25th	-1.353	6.57	-2.052	7.549	-2.348	-1.435	-1.154	-0.093

*$p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. *Controlling for: gender, age, years of education, current work situation, type of contract, sector, social class, motivation, locus of control, number of book at age 16, parental education and native speaker condition.*

Regarding literacy, the estimated coefficients for the *aetraning* variable are not significant for all quantiles selected in every country. At the bottom of the literacy distribution, Sweden shows the lower value for the non-formal AET category (5.480, p>0.10), while the UK displays the highest coefficient (7.131, p>0.10). On the other hand, at the 5th percentile Italy lays out a negative association (-1.450, p>0.10) between the formal AET category and the outcome, whereas the highest one is to be found in France (5.910, p>0.10). In terms of differences between percentiles computed at the six considered extremes, the four countries point out different patterns. For example, in France and Sweden, for both types of AET, the differences between percentiles are decreasing. In other words θ_{95} - θ_{5} are higher than θ_{90} - θ_{10}, which in turn are higher than θ_{75} - θ_{25}. Conversely, in Italy there is an increasing pattern for non-formal AET, but a

steady one for the other learning activity. The UK reports an increasing trend for non-formal AET and a decreasing one for formal AET. Among the four countries, France shows the highest difference between the 95th and the 5th percentile (-4.169); while in Italy all percentiles differences are particularly high, reaching the peak of 13.369 points for θ_{90} - θ_{10}. Confirming its reputation as an equalitarian country, Sweden presents the lowest differences between the percentiles across the literacy distribution.

Table 14 (see Appendix) shows that the effect of age on the literacy distribution takes different trajectories. France in general displays the highest differences between percentiles: the coefficients of all age bands are negative, but they tend to decrease. On the other hand, in the UK and Sweden differences between quintiles are the lowest. In Italy the association between the middle aged group (36-45) though fluctuating is surprisingly positive at the bottom of the skill distribution (0.446, p>0.10). In the same country the relationship between the oldest individuals and the outcome sharply decreases in size from -20.973 (p>0.1) at the 5th percentile to -5.461 (p>0.1) at the 95th percentile.

In almost all countries the effect of years of formal education on skills tends to decrease across the literacy distribution. The only exception is Sweden, where between the fifth percentile and the ninth decile the relative coefficient does not essentially change, afterwards increasing when at the top of distribution.

The gender gap shows a different path across countries from the bottom to the top of the literacy distribution. Surprisingly, in the UK the gap tends to steadily increase, moving from the θ_5 to the θ_{95} percentile. Instead, in Sweden the gender gap raises across percentiles, growing constantly up to the median, then decreasing till the top. France and Italy experience different paths: the former shows an increasing gender gap across the literacy distribution, while the opposite occurs in the latter.

Turning to numeracy, the beta coefficients of both types of AET are not significant across the percentiles selected in every country. The effect of these learning activities on skills is positive in all countries, with two exceptions: Italy, owing to a negative association between formal AET and numeracy below the median, and Sweden, where the negative association is between the median and the third quartile. Interestingly, France reports the highest value of the non-formal AET coefficient at the bottom of the skills distribution (13.23, p>0.01), but also the highest coefficient for the other learning activity (13.749, p>0.10) at the top of the distribution. Considering the differences between percentiles, it is difficult to identify common trends among the four countries, since a lot of variation occurs

in the path of both types of AET across the numeracy distribution. France shows a different pattern for the two types of AET: the differences between percentiles tend to decrease, moving from the bottom to the top of the distribution for non-formal AET, while remaining enough stable for formal AET. In Sweden the differences between percentiles are not so high and tend to diminish for every learning activity. In Italy, like in France, the differences decrease for non-formal AET, while increasing from 10.853 for θ_{95} - θ_{5} to 12.288 for θ_{90} - θ_{10}, and decreasing afterwards to 7.549 at θ_{75} - θ_{25}. The UK offers an opposite view: the differences between percentiles slightly increase across the distribution for non-formal AET and decrease for the other type of AET. Overall, Italy has the highest level of inequality between percentiles for both type of AET; whereas the differences are less marked in the UK.

Such as literacy, the effect of age on the numeracy distribution takes different trajectories in every country and for different age groups. In France the association between age and the outcome increases, moving from the 5th to the 95th percentile, for every age groups. Italy shows a common and interesting pattern for the two middle groups: the relative coefficients, indeed, are positive at the bottom of the distribution, then they decrease steadily until the median, where they present negative values. Afterwards they increase again until the ninth decile, where they display positive values and, lastly, reporting negative values at the 95th percentile. On the other hand, the coefficients for the oldest individuals are very negative, but they tend to decrease across the skills distribution. The UK and Sweden have the lowest differences between percentiles.

The effect of prior education tends to be statistically significant and stable across the numeracy distribution in every country. The differences between percentiles are very modest and range between -0.929 (θ_{90} - θ_{10}) in France to 0.228 (θ_{75} - θ_{25}) in the UK.

The coefficient of female dummy are really significant in most cases, moving from the median to the top of the distribution, but are not such in the lowest part of the distribution. The presence of a gender gap observed in the OLS estimates is confirmed also in the quantile regression, but with different paths across countries. Across the numeracy distribution the gender gap is stable in France, but fluctuating in Italy. Surprisingly, Sweden presents very high and stable values at the top of the distribution. Lastly, the UK records the highest negative coefficient at the median level (-18.096, $p<0.01$).

Conclusion

The first part of this study, investigated the factors influencing the participation of individuals aged 24-65 in formal and non-formal AET for four countries: Italy, UK, Sweden, and France. The following analysis especially focused on three variables: age, prior education and gender.

First, as hypothesised, the general pattern with regard to age profiles is for participation in all types of AET to be concentrated among young adults with the probability of enrolment to decrease with age. The exact functional form differs a bit among countries and learning activities. In some cases, the decrease over the age is monotonic, whereas in others the rate at which participation decreases change over the life course. More specifically, participation in formal AET tends to decrease in a linear way: whereas participation in non-formal learning activities tends to be enough stable among middle ages groups (36-45 and 46-55), afterwards reducing dramatically for the oldest individuals.

Secondly, as expected in the literature review section, the more-highly educated individuals are more likely to participate in non-formal learning activities in all countries. Regarding formal activities, I expected that medium-educated individuals would be more likely to participate in formal AET. Instead, with the exception of France, I found the same educational effect observed for non-formal AET. However, as hypothesised, the differences between lower and higher educated individuals in the odds to participate in formal AET is found to be smaller in countries with less stratified school systems, such as the UK and Sweden, compared to Central-Conservative and Southern Europeans countries, like Italy and France. Overall the results suggest an association of increasing strength between the education level and the odds of entering both types of AET.

Lastly, as the outset, I expected that men would be more likely to participate in non-formal AET. The results from the logistic regressions, confirm this hypothesis, though I also expected that women to be more likely to enter in formal AET. This hypothesis found evidence only in the UK and in Sweden, but not in France and in Italy. Furthermore, my expectation about a less market gender difference in Sweden and in the UK, compared to Italy and France, is partially confirmed, since it is found only for non-formal AET but not for formal AET.

In the second part of this study, I analysed the relationship between participation in AET (formal and non-formal) and adult skills (literacy and numeracy) and the variation

across the four counties selected. Furthermore, I investigated the effect of other variables, such as age, years of education and gender, on skills, and the way in which these associations vary across countries.

Based on OLS results, my expectation about a positive association between both types of lifelong learning activities and skills is confirmed in almost all countries, with the exception of Sweden and Italy. In the former country, indeed, the relationship between literacy and formal AET turns out to be negative and non-significant (-0,392, $p<0.10$); whereas in the latter the association between numeracy and formal AET is negative and non-significant (-3.949, $p<0.10$) as well. For both types of AET, the overall pattern suggests that the formal AET has a smaller impact on skills compared to non-formal AET. The only exception is literacy in France where, compared to people without any learning activity, the coefficient to formal AET is 8.262 ($p<0.05$), whereas the one of non-formal AET is 4.651 ($p<0.01$). The Z-test did not produce any statistically significance difference between the coefficients of both types of AET variable in Italy and those of the other countries.

The results for age show a decreasing negative effects of age to adults' skills: the higher is age, the weaker the association with both literacy and numeracy. Thus, my expectation meets strong support: compared to the youngest individuals, the effect of age on skills is negative for all countries and tend to increase in size, moving towards the older groups. The Z-test produced significant results only for literacy, in the comparisons of the b coefficients of individuals aged 36-45 and 46-55, between Italy and France.

As expected the skills returns to prior education are positive and highly significant in all countries. Just for numeracy, the only significant Z-scores were found in the comparison of the coefficients of years of formal education between Italy and France and between Italy and Sweden.

Regarding gender, my expectations about a gender gap in both type of skills are partially confirmed. In both regressions, being female is negatively associated with the outcomes. Surprisingly, my hypothesis stating the existence of a gender gap playing in favour of female in literacy is not supported by evidence. In this case the Z-scores turns out to be not significant.

It is clear that the OLS technique really misleads relevant information about cross-countries differences in the impact of the independent variables on within group inequality at different points of the skills distribution. The quantile regression estimates, even if in

most cases turn out to be non significant, provide a more complete pictures of the relationships between the predictive variables and the outcomes (literacy and numeracy test scores).

The effect of both learning activities takes different trajectories in every country. There is a clear evidence that in France, moving from the bottom to the top of the skills distribution, the impact of the two types of AET shows an opposite path: decreasing for non-formal AET and increasing for formal AET. In Italy the effect of formal AET is more unequal compared to the other learning activities because it displays higher coefficients at the top of both the skills distributions. On the other hand, in Sweden and in the UK the percentiles difference are less marked across all distributions, suggesting a fairer effect of both types of AET.

With the only exception of Sweden, the relationship between years of formal education on literacy decreases across the distribution, resulting more efficient at the 5th percentiles. On the other hand, the relative coefficient tends to be statistically significant and stable across the numeracy distribution in every country.

The effect of age shows different patterns across both countries and different individuals. In France the beta coefficients constantly increase, moving from the 5th to the 95th percentile, for every age groups, suggesting a high inequality within groups. In Italy, on the contrary, the association between the middle aged groups (36-45 and 45-55) is positive at the bottom of the skills distributions, then it decreases steadily till the median, where they present negative values. Afterwards it increases smoothly until the top. The UK and Sweden show more balanced paths with the lowest differences between percentiles.

The gender gap persists across all skills distributions, tough it is more marked for numeracy. Overall in Italy, France and the UK it tends to remain enough stable across the distributions; while, surprisingly, in Sweden it raises dramatically at the top of literacy distribution.

Recommendations

The combination of two factors - the demographic aging of societies and a shift in the age distribution of labour force - results in the need for policies to encourage people to upgrade skills in order to remain at work. Policies providing opportunities for adult individuals to participate in AET programmes are necessary to ensure economic security in retirement, a

competitive labour force and economic growth. The implementation of policies focusing on lower income groups and especially unemployed are crucial, as they are the most in need of skills upgrading and most at risk for economic insecurity.

Despite widespread recognition that the investment in human capital for people of all ages is very important, little research has empirically examined the effects of participation in AET programmes on adult's skills. Gaining a better understanding of how adult individuals benefit from participating in AET is a very important area of study, thus providing policy-makers with informed decisions.

The key question of interest to policy-makers is as follows: whether or not these programmes are actually effective, so sufficiently to justify the cost to the public (Lee, 2005). The evaluation of these programmes has been the aim of a large methodological literature in economics, with specific focus on the impact of AET on wages. However, this approach leaves open the question of whether AET is effective in raising of individuals' skills. For AET programmes, indeed, to be truly effective they need to increase human capital (skills) because only that can improve the productivity of individuals, which in turn can lead to a meaningful raise in their wages.

Despite the limitations of this research, the study contributes to existing research by examining how AET participation benefits adults' skills. I found that participation in both types of AET, on average, increases skills level. I also found that, for both literacy and numeracy, the overall pattern suggests that on average the formal AET has a smaller impact on skills compared to non-formal AET. Another important finding is the effect of learning activities: both of them take different trajectories across the skills distribution in every country selected. In Conservative and Southern Europeans countries, such as Italy and France, the impact of AET tend to be a bit unequal, being more efficient for groups of people at the top of the skill distributions, whereas, in Nordic and Liberal countries, such as Sweden and the UK, the percentiles difference are less marked across all distributions, suggesting a fairer effect of both types of AET.

The combination of these findings makes an important contribution to the existing research by demonstrating the benefits of AET in terms of improved skills for adult people (especially low skilled), which will be essential for allocation of funding for such programmes.

PIAAC is a rich cross sectional dataset useful because it provides notable opportunities, on one side, to investigate how individuals benefits from participation in

lifelong learning activities, on the other, to make comparison across countries. However future analysis in this field could provide further information on how participation in lifelong activities can change literacy and numeracy skills, thanks to longitudinal datasets, in order to deal with potential endogeneity of these learning programmes.

Furthermore, future research could make use of qualitative research to gain a better understanding of how and where adults participate in AET. Learning more about how individuals become aware of educational opportunities and difficulties to deal with would be useful in developing programmes and strategies to tackle social barriers. Lastly, future research could explore specific AET policies in the countries included in this study with the view to test the efficacy in a more timely way and develop a clear strategy using best practice in the cultural context.

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Appendix

Table 8 - The determinants of participation in formal AET, Logit estimates

	France		Italy		Sweden		UK		Pooled	
	OR	S.E.	OR	S.E.	OR	S.E.	OR	S.E.	OR	S.E.
Female	0.782***	0.172	0.967***	0 .224	1.422***	0.173	1.172***	0.172	1.043***	0.102
Age Bands										
(reference: 25-35)										
36-45	0.681***	0.152	0.490***	0.139	0.604***	0.103	0.812***	0.119	0.738***	0.079
46-55	0.295***	0.077	0.187**	0.073	0.412***	0.078	0.686***	0.107	0.555***	0.067
56-65	0.070	0.045	0.050	0.045	0.139***	0.041	0.246***	0.073	0.219***	0.053
Education levels										
(reference: Primary or less)										
Lower secondary	0.798***	0.253	2.468	2.517	3.922	2.904	1.285**	0.665	1.47**	0.623
Upper secondary and post secondary	0.503***	0.113	3.306	3.000	4.409	3.252	2.866**	1.228	2.384**	0.961
Tertiary	-	-	-	-	12.852	9.405	2.873**	1.228	3.387**	1.380
Current work situation										
(reference: Employed or self-employed)										
Retired										
Unemployed	-	-	4.141	5.923	0.703	0.494	0.121	0.133	1.540	1.139
Housework	-	-	-	-	0.469	0.333	0.155	0.144	0.354*	0.200
Other	4.000	2.572	1.600***	1.102	8.300***	3.233	4.917***	1.745	3.778***	0.757
Type of contract										
(refrence: Indefinite contract)										
Fixed-term/Temporary contract	2.222***	0.450	2.504***	0.787	3.027***	0.561	1.271***	0.213	1.832***	0.225
No contract	3.242	2.328	1.176	1.114	2.902**	1.188	0.882**	0.353	1.657***	0.459
Sector										
(reference: The private sector)										
The public sector and non-profit	2.301***	0.332	1.256***	0.323	1.769***	0.258	1.342***	0.208	1.531***	0.152
Social class										
(reference: Skilled occupations)										
Semi-skilled blue-collars	1.208***	0.268	0.730***	0.2247	1.162***	0.265	0.972***	0.160	1.117***	0.126
Semi-skilled blue-collars	0.493***	0.187	0.226*	0.127	0.761***	0.256	0.706***	0.192	0.504***	0.083
Elementary occupations	1.500***	0.498	0.786*	0.411	1.614**	0.750	0.373***	0.148	0.788***	0.164
Health										
(reference category: Excellent)										
Very good	0 .794***	0.191	1.166***	0.431	1.119***	0.206	0.900***	0.140	0.909***	0.092
Good	0.549***	0.131	1.829***	0.676	0.858***	0.169	1.112***	0.201	0.863***	0.107
Fair	0.689***	0.190	1.737	1.134	0.930***	0.316	1.088***	0.294	0.874***	0.137
Poor	1.692	1.203	1.269	1.071	0.432	0.333	0.535***	0.324	0.749***	0.280
Household										
(reference: one person in the household)										
Two persons in the household	1.036***	0.321	1.298***	0.499	0.653***	0.126	0.801***	0.133	0.975***	0.114
Three persons in the household	0.725***	0.241	0.932***	0.330	0.525***	0.116	0.698***	0.138	0.744***	0.104
Four persons in the household	0.604***	0.170	1.334***	0.499	0.731***	0.166	0.865***	0.179	0.892***	0.128
Five persons in the household	0.543**	0.213	1.210**	0.696	0.762***	0.247	1.007***	0.275	0.942***	0.189
Six persons in the household	0.301	0.295	-	-	0.882	0.590	1.017**	0.441	0.971***	0.340
Seven persons or more in the household	4.298	2.652	-	-	-	-	0.562	0.648	1.360***	0.747
Book										
(reference: 10 books or less)										
11 to 25 books	0.937**	0.417	2.062	1.284	0.695*	0.377	0.945***	0.258	1.085***	0.212
26 to 100 books	1.261**	0.466	2.398*	1.436	1.034**	0.492	0.887***	0.248	1.087***	0.203
101 to 200 books	0.905**	0.409	2.416*	1.453	1.301**	0.587	0.765***	0.180	0.998***	0.173
01 to 500 books	1.123**	0.417	2.485	1.642	1.200**	0.607	1.095***	0.339	1.326***	0.263
More than 500 books	1.336***	.520	2.942	2.479	0.953**	0.465	0.797***	0.286	1.119***	0.269
Parental education										
(reference: Neither parent has an upper sec. qualification)										
At least one parent has an upper sec. qualification	1.099***	0.262	1.657***	0.475	1.234***	0.269	1.070***	0.196	1.755***	0.213
At least one parent has a tertiary qualification	1.283***	0.331	2.892*	1.684	1.287***	0.238	1.027***	0.228	1.861***	0.295
Native speaker	2.276***	0.578	1.897***	0.667	1.421***	0.256	1.088***	0.209	1.555***	0.187
Constant	0.042**	0.024	.003	0.009	0.011	0.017	0.117*	0.063	0.020**	0.009
LL_0	-2,862,746		-2,972,890		-1,149,170		-6,417,471		-1.44E+07	
LL_1	-2,463,786		-2,345,294		-917,131.800		-5,955,877		-1.28E+07	
Chi2	131.237***		128.131***		297.658***		103.195***		376.082***	
N	2,583		1,845		2,369		3,547		10,498	

*$p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 9 - The determinants of participation in non-formal AET, Logit estimates

	France		Italy		Sweden		UK		Pooled	
	OR	S.E.	OR	S.E.	OR	S.E.	OR	S.E.	OR	S.E.
Female	0.782***	0.172	0.967***	0 .224	1.422***	0.173	1.172***	0.172	1.043***	0.102
Age Bands										
(reference: 25-35)										
36-45	0.681***	0.152	0.490***	0.139	0.604***	0.103	0.812***	0.119	0.738***	0.079
46-55	0.295***	0.077	0.187**	0.073	0.412***	0.078	0.686***	0.107	0.555***	0.067
56-65	0.070	0.045	0.050	0.045	0.139***	0.041	0.246***	0.073	0.219***	0.053
Education levels										
(reference: Primary or less)										
Lower secondary	0.798***	0.253	2.468	2.517	3.922	2.904	1.285**	0.665	1.47**	0.623
Upper secondary and post secondary	0.503***	0.113	3.306	3.000	4.409	3.252	2.866**	1.228	2.384**	0.961
Tertiary	-	-	-	-	12.852	9.405	2.873**	1.228	3.387**	1.380
Current work situation										
(reference: Employed or self-employed)										
Retired										
Unemployed	-	-	4.141	5.9229	0.703	0.494	0.121	0.133	1.540	1.139
Housework	-	-	-	-	0.469	0.333	0.155	0.144	0.354*	0.200
Other	4.000	2.572	1.600***	1.102	8.300***	3.233	4.917***	1.745	3.778***	0.757
Type of contract										
(refrence: Indefinite contract)										
Fixed-term/Temporary contract	2.222***	0.450	2.504***	0.787	3.027***	0.561	1.271***	0.213	1.832***	0.225
No contract	3.242	2.328	1.176	1.114	2.902**	1.188	0.882**	0.353	1.657***	0.459
Sector										
(reference: The private sector)										
The public sector and non-profit	2.301***	0.332	1.256***	0.323	1.769***	0.258	1.342***	0.208	1.531***	0.152
Social class										
(reference: Skilled occupations)										
Semi-skilled blue-collars	1.208***	0.268	0.730***	0.2247	1.162***	0.265	0.972***	0.160	1.117***	0.126
Semi-skilled blue-collars	0.493***	0.187	0.226*	0.127	0.761***	0.256	0.706***	0.192	0.504***	0.083
Elementary occupations	1.500***	0.498	0.786*	0.411	1.614**	0.750	0.373***	0.148	0.788***	0.164
Health										
(reference category: Excellent)										
Very good	0 .794***	0.191	1.166***	0.431	1.119***	0.206	0.900***	0.140	0.909***	0.092
Good	0.549***	0.131	1.829***	0.676	0.858***	0.169	1.112***	0.201	0.863***	0.107
Fair	0.689***	0.190	1.737	1.134	0.930***	0.316	1.088***	0.294	0.874***	0.137
Poor	1.692	1.203	1.269	1.071	0.432	0.333	0.535***	0.324	0.749***	0.280
Household										
(reference: one person in the household)										
Two persons in the household	1.036***	0.321	1.298***	0.499	0.653***	0.126	0.801***	0.133	0.975***	0.114
Three persons in the household	0.725***	0.241	0.932***	0.330	0.525***	0.116	0.698***	0.138	0.744***	0.104
Four persons in the household	0.604***	0.170	1.334***	0.499	0.731***	0.166	0.865***	0.179	0.892***	0.128
Five persons in the household	0.543**	0.213	1.210**	0.696	0.762***	0.247	1.007***	0.275	0.942***	0.189
Six persons in the household	0.301	0.295	-	-	0.882	0.590	1.017**	0.441	0.971***	0.340
Seven persons or more in the household	4.298	2.652	-	-	-	-	0.562	0.648	1.360***	0.747
Book										
(reference: 10 books or less)										
11 to 25 books	0.937**	0.417	2.062	1.284	0.695*	0.377	0.945***	0.258	1.085***	0.212
26 to 100 books	1.261**	0.466	2.398*	1.436	1.034**	0.492	0.887***	0.248	1.087***	0.203
101 to 200 books	0.905**	0.409	2.416*	1.453	1.301**	0.587	0.765***	0.180	0.998***	0.173
01 to 500 books	1.123**	0.417	2.485	1.642	1.200**	0.607	1.095***	0.339	1.326***	0.263
More than 500 books	1.336***	.520	2.942	2.479	0.953**	0.465	0.797***	0.286	1.119***	0.269
Parental education										
(reference: Neither parent has an upper sec. qualification)										
At least one parent has an upper sec. qualification	1.099***	0.262	1.657***	0.475	1.234***	0.269	1.070***	0.196	1.755***	0.213
At least one parent has a tertiary qualification	1.283***	0.331	2.892*	1.684	1.287***	0.238	1.027***	0.228	1.861***	0.295
Native speaker	2.276***	0.578	1.897***	0.667	1.421***	0.256	1.088***	0.209	1.555***	0.187
Constant	0.042**	0.024	.003	0.009	0.011	0.017	0.117*	0.063	0.020**	0.009
LL_0	-2,862,746		-2,972,890		-1,149,170		-6,417,471		-1.44E+07	
LL_1	-2,463,786		-2,345,294		-917,131.800		-5,955,877		-1.28E+07	
Chi2	131.237***		128.131***		297.658***		103.195***		376.082***	
N	2,583		1,845		2,369		3,547		10,498	

*$p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 10 - The drivers of literacy, OLS estimates

	France		Italy		Sweden		UK		Pooled	
	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
AET										
(reference: Did not partecipated in any AET)										
Particpated in non-formal AET	4.651***	1.570	6.544**	2.638	4.017	2.468	6.393**	2.705	8.550***	1.261
Particpated in formal AET	8.262**	3.608	4.243	5.725	-0.392	3.776	6.080*	3.207	9.534****	1.980
Female	-1.476	1.607	-1.599	2.637	-3.943*	2.027	-6.621***	2.211	-2.776**	1.235
Age Bands										
(reference: 25-35)										
36-45	-10.587***	1.73751	-0.350	2.957	-1.584	2.419	-2.322	2.764	-4.087***	1.298
46-55	-13.933***	2.02905	-0.289	3.504	-9.437***	2.135	-7.512**	3.329	-6.807***	1.594
56-65	-22.440***	2.66891	-12.286	6.026	-16.191***	2.706	-7.890**	3.694	-13.114***	2.232
Years of education	4.248***	0.300	3.486***	0.406	4.754***	0.513	2.573***	0.450	3.271***	0.215
Current work situation										
(reference: Employed or self-employed)										
Retired	16.529	12.863	-21.196	47.364	-1.093	11.326	0.178	10.509	3.853	7.441
Unemployed	20.129*	11.516	-6.334	10.314	8.927	10.613	-2.275	12.066	-4.835	8.479
Housework	-15.309	22.415	23.565**	10.523	-5.589	8.289	18.325**	9.319	15.169***	5.324
Other	-4.977	7.240	-14.776*	8.344	16.014***	5.977	8.981	9.456	-2.134	5.874
Type of contract										
(refrence: Indefinite contract)										
Fixed-term/Temporary contract	-3.489	2.692	-3.961	3.269	-7.746**	3.469	-6.752**	3.323	-5.747***	1.775
No contract	5.031	10.426	-11.521	8.319	-0.869	8.194	-6.048	5.454	-6.382	4.599
Sector										
(reference: The private sector)										
The public sector and non-profit	2.336	1.758	-6.375**	3.197	-7.310***	1.886	-0.504	2.740	-1.982	1.338
Social class										
(reference: Skilled occupations)										
Semi-skilled blue-collars	-5.036**	1.9859	-2.376	3.057	-7.143***	2.426	-12.022***	2.751	-6.357***	1.347
Semi-skilled blue-collars	-11.941***	2.79762	-9.415**	3.997	-16.827***	2.869	-14.781***	3.955	-13.110***	2.170
Elementary occupations	-15.684***	2.92599	-9.254**	4.471	-18.040***	5.929	-30.152***	4.725	-16.972***	2.255
Locus of control: no influence on the government										
(reference category: Strongly agree)										
Agree	-1.176	1.844	-1.980	2.757	-0.706	2.940	0.833	3.447	-0.314	1.337
Neither agree nor disagree	0.643	2.018	4.912	3.664	4.081	3.236	7.707**	3.361	5.555***	1.599
Disagree	2.632*	3.132	7.867**	3.628	8.914***	2.879	10.352***	3.110	10.550***	1.736
Strongly disagree	-7.622*	4.527	-1.527	4.729	3.310	3.431	-0.219	5.875	-1.288	2.859
Motivation: get to the bottom of difficult things										
(reference: not at all)										
Very little	19.792**	7.954	-10.145	7.751	10.774***	8.056	14.691	10.617	5.023	4.903
To some extent	27.069***	7.144	1.140	7.537	22.343***	7.626	19.147**	9.577	13.444***	4.647
To a high extent	27.540***	6.850	-4.820	7.594	22.658***	7.550	25.046**	9.905	12.822***	4.574
To a very high extent	27.894***	7.224	-5.205	7.264	22.785***	7.600	21.926**	9.894	13.046***	4.650
Book										
(reference: 10 books or less)										
11 to 25 books	5.659**	2.542	4.279	3.528	5.035	5.516	-0.183	4.877	3.090	1.931
26 to 100 books	11.928***	2.365	4.955	3.662	10.145**	4.913	14.543***	4.060	10.019***	1.860
101 to 200 books	14.532****	2.774	14.595***	4.006	21.623***	5.028	16.485***	4.511	15.154***	2.127
01 to 500 books	19.238***	2.998	14.820***	4.703	25.776***	4.904	23.461***	4.145	20.170***	2.155
More than 500 books	14.705***	3.332	17.017*	8.759	28.075***	5.035	23.272***	4.558	19.164***	2.537
Parental education										
(reference: Neither parent has an upper sec. qualification)										
At least one parent has an upper sec. qualification	0.473	1.911	2.863	2.902	5.663**	2.374	7.228**	3.141	6.380***	1.302
At least one parent has a tertiary qualification	6.552***	2.178	1.254	6.571	5.322**	2.219	12.570***	3.377	13.103***	1.731
Native speaker	-18.447***	2.661	-23.880***	4.327	-29.405***	2.643	-28.043***	3.865	-23.728***	2.072
Constant	213.886***	7.418	244.689***	10.983	229.624***	10.808	249.180***	12.612	237.440***	6.253
F	55.905***		23.672***		49.351***		51.707***		185.815***	
R-squared	0.414		0.298		0.411		0.344		0.377	
N	2,643		1,874		2,363		3,290		10,170	

$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table 11 - The drivers of numeracy, OLS estimates

	France		Italy		Sweden		UK		Pooled	
	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
AET										
(reference: Did not partecipated in any AET)										
Particpated in non-formal AET	7.160***	1.724	6.084**	2.889	4.178	2.567	7.615***	2.955	8.205***	1.429
Particpated in formal AET	5.805	4.335	-3.949	5.803	1.134	3.936	4.383	3.846	4.004	2.449
Female	-11.522***	1.795	-11.422***	2.562	-13.808***	2.104	-16.551***	2.531	-12.709***	1.354
Age Bands										
(reference: 25-35)										
36-45	-6.004***	1.805	-1.765	3.323	-1.750	2.833	0.836	3.186	-2.538	1.625
46-55	-9.913***	2.217	-2.054	3.524	-7.055**	2.952	-4.858	3.469	-6.219***	1.547
56-65	-16.548***	3.087	-13.632**	6.016	-9.698***	3.091	-2.347	3.761	-11.497***	2.238
Years of education	5.524***	0.317	3.504***	0.436	5.448***	0.522	2.728***	0.573	3.807***	0.227
Current work situation										
(reference: Employed or self-employed)										
Retired	21.550**	9.062	-22.542	46.448	5.161	13.464	16.362	10.020	12.047	8.729
Unemployed	10.140	16.194	-0.925	11.519	14.225	9.931	-20.907	12.820	-0.950	8.817
Housework	-45.414**	21.533	29.743***	11.124	-8.919	9.761	20.354*	10.646	15.674**	7.334
Other	-14.368*	8.662	-17.696*	10.139	11.727*	6.383	10.655	12.012	-3.855	7.094
Type of contract										
(refrence: Indefinite contract)										
Fixed-term/Temporary contract	-4.407	2.706	-2.103	3.284	-7.399*	3.940	-12.603***	3.858	-6.099***	1.742
No contract	5.206	10.545	-17.906**	8.454	7.528	7.906	-9.170	6.681	-9.4504**	4.785
Sector										
(reference: The private sector)										
The public sector and non-profit	1.273	1.863	-8.493**	3.513	-9.948***	2.261	-0.909	2.443	-3.872***	1.294
Social class										
(reference: Skilled occupations)										
Semi-skilled blue-collars	-11.396***	2.286	-2.547	3.248	-12.220***	3.023	-15.781***	2.730	-10.391***	1.419
Semi-skilled blue-collars	-17.950***	2.720	-12.385***	4.083	-17.066***	3.245	-15.874***	4.294	-16.314***	2.169
Elementary occupations	-24.159***	2.771	-12.818***	4.752	-24.268***	5.859	-32.551***	5.691	-22.863***	2.389
Locus of control: no influence on the government										
(reference category: Strongly agree)										
Agree	0.142	1.918	1.505	3.231	-0.593	3.430	4.913	3.368	1.237	1.506
Neither agree nor disagree	-0.479	2.172	5.495	4.156	3.893	3.457	10.256***	3.547	4.282**	1.828
Disagree	-0.008	3.174	10.388**	4.806	5.870*	3.136	10.398***	3.595	7.809***	2.143
Strongly disagree	-12.303***	4.747	-8.295*	4.815	-1.123	3.703	1.722	5.770	-5.507*	2.912
Motivation: get to the bottom of difficult things										
(reference: not at all)										
Very little	18.313**	7.763	-6.464	8.173	11.102	8.223	8.792	13.334	4.597	5.352
To some extent	30.202***	6.461	4.544	7.887	29.030***	7.822	16.877	11.278	16.115***	4.949
To a high extent	31.303***	6.824	2.181	7.510	26.836***	7.826	25.324**	11.705	17.6778***	4.990
To a very high extent	30.384***	7.028	2.326	7.802	27.370***	7.695	23.378**	11.495	17.297***	5.149
Book										
(reference: 10 books or less)										
11 to 25 books	5.306***	2.626	5.341	3.525	0.699	6.262	0.922	4.572	4.067**	2.020
26 to 100 books	13.175***	2.563	11.280***	3.698	10.667**	5.083	13.550**	4.450	13.057***	2.089
101 to 200 books	13.681***	3.025	16.771***	4.659	19.079***	5.491	17.927***	4.829	17.203***	2.446
01 to 500 books	20.245***	3.246	25.643***	5.451	26.756***	5.124	26.411***	4.784	25.978***	2.502
More than 500 books	15.473***	3.384	25.677***	7.489	26.505***	5.453	26.432***	5.560	23.987***	2.731
Parental education										
(reference: Neither parent has an upper sec. qualification)										
At least one parent has an upper sec. qualification	1.876	1.937	4.589	3.003	6.218***	2.406	6.116**	2.868	3.922***	1.416
At least one parent has a tertiary qualification	7.532***	2.629	-2.133	5.383	3.693	2.578	13.380***	3.417	9.747***	1.807
Native speaker	-23.625***	3.007	-18.149***	4.852	-30.986***	2.715	-30.495***	3.750	-25.062***	2.419
Constant	200.864***	7.973	236.602***	12.556	226.336***	11.818	243.639***	13.890	232.007***	6.790
F	73.573***		23.545***		46.358***		54.896***		189.644***	
R-sq	0.482		0.297		0.396		0.357		0.382	
N	2,643		1,874		2,363		3,290		10,170	

*p < 0.10, ** p < 0.05, *** p < 0.01.

Table 12 – The relationship between gender (female) and literacy, quantile regression estimates

	France	Italy	Sweden	UK
OLS	-1.47582	-1.59949	-3.943*	-6.621***
Q5th	0.236	-5.329	-0.860	-3.479
Q10th	-0.529	-2.392	-2.049	-4.431
Q25th	-1.632	-1.394	-4.252	-6.253
Q50th	-2.492	-0.919	-5.612	-7.654*
Q75th	-2.837	-1.994	-4.687	-8.272*
Q90th	-2.559	-2.997	-3.706	-8.578
Q95th	-2.797	-1.959	-1.818	-10.097
Q95th-Q5th	-3.033	3.370	-0.958	-6.618
Q90th-Q10th	-2.030	-0.605	-1.657	-4.147
Q75th-Q25th	-1.205	-0.600	-0.435	-2.019

*p < 0.10, ** p < 0.05, *** p < 0.01. *Controlling for: AET, age, years of education, current work situation, type of contract, sector, social class, motivation, locus of control, number of book at age 16, parental education and native speaker condition.*

Table 13 – The relationship between gender (female) and numeracy, quantile regression estimates

	France	Italy	Sweden	UK
OLS	-11.522***	-11.422***	-13.808***	-16.551***
Q5th	-12.378	-10.411	-10.796	-15.178
Q10th	-11.510*	-10.704	-13.122*	-15.746**
Q25th	-12.199***	-13.556**	-14.252***	-16.778***
Q50th	-11.855***	-12.164**	-15.750***	-18.096***
Q75th	-11.973***	-10.518**	-14.177***	-17.060***
Q90th	-11.986***	-8.519	-14.683**	-15.692**
Q95th	-12.211**	-9.444	-14.510**	-16.242**
Q95th-Q5th	0.167	0.967	-3.714	-1.064
Q90th-Q10th	-0.476	2.185	-1.561	0.054
Q75th-Q25th	0.226	3.038	0.075	-0.282

**p < 0.10, ** p < 0.05, *** p < 0.01. Controlling for: AET, age, years of education, current work situation, type of contract, sector, social class, motivation, locus of control number of book at age 16, parental education and native speaker condition.*

Table 14 – The relationship between age and literacy, quantile regression estimates

	France			Italy			Sweden			UK		
	36-45	46-55	56-65	36-45	46-55	56-65	36-45	46-55	56-65	36-45	46-55	56-65
OLS	-10.587***	-13.933***	-22.440***	-0.350	-0.289	-12.286	-1.584	-9.437***	-16.191***	-2.322	-7.512**	-7.890**
Q5th	-17.614*	-21.944**	-29.531**	4.558	2.522	-20.973	6.730	-6.142	-14.540	-1.079	-8.698	-5.259
Q10th	-16.057*	-20.826***	-30.023***	1.745	0.005	-21.552	2.005	-8.913	-16.384	-1.043	-10.761	-5.821
Q25th	-13.162***	-18.011***	-26.466***	-0.638	0.513	-15.237	-3.087	-11.072**	-19.239***	-2.989	-8.292	-6.857
Q50th	-10.131***	-15.199***	-20.410***	-0.769	-0.965	-10.143	-4.456	-12.116**	-19.386***	-3.242	-7.187	-8.302
Q75th	-7.118*	-9.202**	-17.697***	-0.382	-0.750	-8.192	-2.227	-8.661*	-14.956	-2.020	-6.526	-9.372
Q90th	-5.021	-6.271	-16.859**	-0.774	-1.903	-4.074	-2.891	-7.777	-14.741*	0.417	-4.589	-7.753
Q95th	-2.745	-5.199	-17.772*	0.446	-3.263	-5.461	-2.203	-8.898	-13.341	-1.071	-7.817	-8.997
Q95th-Q5th	14.869	16.745	11.759	-4.112	-5.785	15.512	-8.933	-2.756	1.199	0.008	0.881	-3.738
Q90th-Q10th	11.036	14.555	13.164	-2.519	-1.908	17.478	-4.896	1.136	1.643	1.46	6.172	-1.932
Q75th-Q25th	6.044	8.809	8.769	0.256	-1.263	7.045	0.86	2.411	4.283	0.969	1.766	-2.515

**p < 0.10, ** p < 0.05, *** p < 0.01. Controlling for: AET, gender, years of education, current work situation, type of contract, sector, social class, motivation, locus of control, number of book at age 16, parental education and native speaker condition.*

Table 15 – The relationship between age and numeracy, quantile regression estimates

	France			Italy			Sweden			UK		
	36-45	46-55	56-65	36-45	46-55	56-65	36-45	46-55	56-65	36-45	46-55	56-65
OLS	-6.004***	-9.913***	-16.548***	-1.765	-2.054	-13.632**	-1.750	-7.055**	-9.698***	0.836	-4.858	-2.347
Q5th	-13.554	-18.401**	-21.629	4.423	5.135	-23.145	-1.638	-9.93	-13.849	3.834	-7.464	0.278
Q10th	-11.109*	-13.873*	-20.413**	1.844	2.406	-25.027	0.809	-7.925	-10.244	1.989	-7.633	0.721
Q25th	-8.435**	-13.876***	-20.156***	-1.261	-1.452	-14.816	-3.193	-8.744	-10.570	0.077	-6.407	-1.532
Q50th	-5.119	-10.937**	-16.218***	-4.753	-4.87	-9.402	-2.939	-6.842	-12.513	-1.098	-4.518	-4.942
Q75th	-1.709	-6.194	-11.871**	-1.613	-3.030	-5.935	-2.636	-6.136	-11.017**	1.502	-2.972	-4.503
Q90th	-1.733	-3.519	-12.552	0.208	0.238	-9.199	-2.666	-6.006	-7.718	4.194	-1.515	1.073
Q95th	-0.610	-1.668	-11.929	-0.046	-1.069	-11.025	-2.006	-4.274	-5.399	3.735	-1.352	2.822
Q95th-Q5th	12.944	16.733	9.700	-4.469	-6.204	12.120	-0.368	5.656	8.450	-0.099	6.112	2.544
Q90th-Q10th	9.376	10.354	7.861	-1.636	-2.168	15.828	-3.475	1.919	2.526	2.205	6.118	0.352
Q75th-Q25th	6.726	7.682	8.285	-0.352	-1.578	8.881	0.557	2.608	-0.447	1.425	3.435	-2.971

$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$. *Controlling for: AET, gender, years of education, current work situation, type of contract, sector, social class, motivation, locus of control, number of book at age 16, parental education and native speaker condition.*

Table 16 – The relationship between years of education and literacy, quantile regression estimates

	France	Italy	Sweden	UK
OLS	4.248***	3.486***	4.754***	2.573***
Q5th	4.879***	3.579**	4.957**	2.597
Q10th	4.576***	3.690***	5.183***	2.781*
Q25th	4.448***	3.724***	5.197***	2.875**
Q50th	4.514***	3.386***	4.887***	2.668**
Q75th	4.262***	3.024***	4.515***	2.358**
Q90th	3.683***	3.140**	4.336***	2.098*
Q95th	3.439***	2.867*	7.734***	1.699
Q95th-Q5th	-1.440	-0.712	2.770	-0.898
Q90th-Q10th	-0.893	-0.550	-0.847	-0.683
Q75th-Q25th	-0.186	-0.700	-0.682	-0.517

*$p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. *Controlling for: AET, gender, age, current work situation, type of contract, sector, social class, motivation, locus of control, number of book at age 16, parental education and native speaker condition.*

Table 17 – The relationship between years of education and numeracy, quantile regression estimates

	France	Italy	Sweden	UK
OLS	5.524***	3.504***	5.448***	2.728***
Q5th	6.026***	3.736	5.637**	2.523
Q10th	6.038***	3.276**	6.073***	2.582
Q25th	5.809***	3.538***	5.904***	2.782
Q50th	5.661***	3.610***	5.340***	3.046***
Q75th	5.447***	3.380***	5.506***	3.010**
Q90th	5.109***	3.295***	5.658***	2.667
Q95th	5.187***	3.512**	5.722***	2.327
Q95th-Q5th	-0.839*	-0.224	0.085	-0.196
Q90th-Q10th	-0.929	0.019	-0.415	0.085
Q75th-Q25th	-0.362	-0.158	-0.398	0.228

*p < 0.10, ** p < 0.05, *** p < 0.01. *Controlling for: AET, gender, age, current work situation, type of contract, sector, social class, motivation, locus of control, number of book at age 16, parental education and native speaker condition.*

Table 18 – Country comparisons in the relationship between literacy and AET, age, gender, education. Z-test estimates between Italy and the other three countries

	France		Sweden		UK	
	T-statistic	P-value	T-statistic	P-value	T-statistic	P-value
AET (reference: Did not partecipated in any AET)						
Particpated in non-formal AET	-0.617	0.540	-0.700	0.487	-0.040	0.336
Particpated in formal AET	0.594	0.554	-0.676	0.502	0.280	0.780
Female	0.040	0.968	-0.705	0.484	-1.459	0.149
Age Bands (reference: 25-35)						
36-45	-2.984*	0.004	-0.323	0.748	-0.487	0.628
46-55	-3.370*	0.001	-2.229	0.029	-1.494	0.139
56-65	-1.541	0.128	-0.591	0.556	0.622	0.536
Years of education	1.510	0.135	1.937	0.056	-1.508	0.136

*p < 0.01 (Bonferroni correction applied)

Table 19 – Country comparisons in the relationship between numeracy and AET, age, gender, education. Z-test estimates between Italy and the other three countries

	France		Sweden		UK	
	T-statistic	P-value	T-statistic	P-value	T-statistic	P-value
AET (reference: Did not partecipated in any AET)						
Particpated in non-formal AET	0.320	0.750	-0.493	0.623	0.370	0.712
Particpated in formal AET	1.347	0.182	0.725	0.471	1.197	0.235
Female	-0.032	0.975	-0.720	0.474	-1.424	0.158
Age Bands (reference: 25-35)						
36-45	-1.121	0.266	0.004	0.997	0.565	0.574
46-55	-1.888	0.063	-1.088	0.280	-0.567	0.572
56-65	-0.431	0.668	0.582	0.562	1.591	0.116
Years of education	3.746*	0.000	2.858*	0.005	-1.077	0.285

*$p < 0.01$ (Bonferroni correction applied)