Investing in skills pays off: the economic and social cost of low-skilled adults in the EU

CEDEFOP

Investing in skills pays off

The economic and social cost of low-skilled adults in the EU

Luxembourg: Publications Office of the European Union, 2017

Please cite this publication as:
Cedefop (2017). *Investing in skills pays off: the economic and social cost of low-skilled adults in the EU*. Luxembourg: Publications Office. Cedefop research paper; No 60.
http://dx.doi.org/10.2801/23250

Luxembourg: Publications Office of the European Union, 2017

PDF	ISBN 978-92-896-2412-1	doi:10.2801/23250	TI-BC-17-002-EN-N
EPUB	ISBN 978-92-896-2412-1	doi: 10.2801/086601	TI-BC-17-002-EN-E

The **European Centre for the Development of Vocational Training** (Cedefop) is the European Union's reference centre for vocational education and training. We provide information on and analyses of vocational education and training systems, policies, research and practice. Cedefop was established in 1975 by Council Regulation (EEC) No 337/75.

Europe 123, 570 01 Thessaloniki (Pylea), GREECE
PO Box 22427, 551 02 Thessaloniki, GREECE
Tel. +30 2310490111, Fax +30 2310490020
E-mail: info@cedefop.europa.eu
www.cedefop.europa.eu

Foreword

In recent years, the continuous process of labour market change has been dramatically accelerated by a long-lasting economic crisis. The consequences still affect most European countries.

Labour market change involves costs for individuals and the economy as whole. The role of policy and labour market institutions is crucial to avoiding negative consequences and ensuring that the costs and benefits of adjustments are, as far as possible, equally distributed across workers and firms.

In this context, the growing number of low-educated and low-skilled adults out of work in most European countries will require increasing attention in the years to come.

Long-term projections show that, on average, labour demand for the low-skilled is expected to decrease while labour demand for medium and high qualification levels will increase. Unemployment, social exclusion and disengagement from the labour market by the low-skilled can permanently lower potential growth and harm social cohesion. The (re)integration of low-skilled workers into labour markets and their upskilling is a key policy challenge for European economies.

The European Commission initiative *New skills agenda for Europe* and the recommendation *Upskilling pathways: new opportunities for adults* recognise the urgency of the low-skills issue and the importance of ensuring that every European acquires the skills and competences to realise fully his/her talent and potential.

For policy-makers to design and implement policies tailored to this particular group there is a need to develop a comprehensive and robust evidence base in relation to low-skilled adults in the EU, their volume and characteristics as well as their economic and social costs.

This Cedefop study seeks to provide such evidence. Providing a thorough evidence-based assessment of the consequences associated with being low-skilled, the benefits of updating the skills of individuals through adult and lifelong learning can be identified and appreciated, supporting the rationale for public intervention in this area.

Acknowledgements

This publication was produced by Cedefop, Department for learning and employability, under the supervision of Antonio Ranieri. Lidia Salvatore, Cedefop expert, was responsible for the publication and research conducted under the *Economic and social cost of low-skilled* project.

This publication is based on research undertaken by a consortium led by the Institute for Employment Studies (IES) with Istituto per la Ricerca Sociale (IRS). The publication was peer-reviewed by Pedro Moreno Da Fonseca, Cedefop expert.

Cedefop is grateful to those who actively participated in the validation workshop organised by Cedefop in October 2015 to discuss preliminary findings ([1]).

The work was carried out under Cedefop's contract
2014-0126/AO/ECVL/ARANI-LSALVA/LowSkilled/005/14

([1]) A detailed list of workshop participants is available on request.

Table of contents

List of tables, figures and boxes

Tables

Figures

Boxes

Executive summary

European economies have recovered to varying degrees from the economic and financial crisis of 2008 but the effects on labour market dynamics in many EU Member States have proved profound and lasting. Persistent lack of employment opportunities, especially among the young and low-skilled, may lead to serious long-term consequences. Growing social exclusion, disengagement from the labour market and underuse of human resources can lead to permanently lower potential growth. More generally, improving and maintaining high-level skills and workforce competences is essential to ensure that Europe remains competitive and innovative against increasing global competition, fast-changing labour market needs and demographic challenges.

Policy-makers have long recognised the importance of skilled human capital for economic and social development and there is broad consensus on the vulnerability of the low-skilled. However, the low-skilled are now clearly at the top of the European policy agenda: the *New skills agenda for Europe* includes a specific action (*Upskilling pathways: new opportunities for adults*) aimed at supporting Member States in ensuring that every European acquires a minimum level of skills necessary to realise talent and potential fully.

Cedefop's *Investing in skills pays off: the economic and social cost of low-skilled adults in the EU* seeks to provide comprehensive and robust evidence on low-skilled adults in the EU, their volume and characteristics, and their economic and social costs. Fully appreciating the benefits of updating the skills of individuals through adult and lifelong learning is essential support to the rationale for public intervention in this area and to designing and implementing effective policies tailored to this particular group.

Low skills: conceptual and measurement challenge

Analysis of low-skilled status in the labour market to date has been primarily conducted using the level of educational attainment of the population ([2]). However, this definition is widely recognised as oversimplifying the concept of

([2]) Low-skilled are typically defined as individuals whose schooling is below any level of secondary education corresponding to levels 0-2 of the ISCED classification.

being low-skilled, as it does not take into account different types of skills, abilities and factors which can result in low-skilled status:

(a) long-term unemployment and/or disengagement from the labour market;
(b) skill obsolescence due to ageing, technological change, changes in production processes and/or work organisation;
(c) gaps between individual job skills and changing skills demands of the labour market;
(d) socioeconomic factors such as migrant background and gender.

A narrow conceptualisation of being low-skilled also fails to capture the role of skills and competences gained outside formal education environments, such as those acquired through training, informal learning and work experience.

Low-skilled status must, therefore, be conceptualised as a multidimensional and dynamic phenomenon which goes beyond educational attainment and considers both its determinants and effects. It should also include a wider typology of people with low skills, such as those with obsolete skills and mismatched workers.

Understanding low skills and EU trends

Educational attainment has increased substantially in recent decades, especially among younger generations. In 2015, low-qualified adults in the EU decreased to 23.5% and Cedefop forecasts this will fall substantially to 14.7% by 2025. When it comes to the labour force, low-qualified adults are expected to fall by 33% between 2015 and 2025, despite a total adult labour force basically stable over the same period.

Despite this long-term trend, in 2015 one in four European adults aged 25 to 64 (about 64 million adults) still held only low qualifications. PIAAC data also shows that the share of the adult population with low cognitive skills in literacy and numeracy is 18% and 20% respectively ([3]), with low achievement in these areas more prevalent among those with low qualifications than those with medium or high qualifications. However, data also show that educational attainment does not fully explain adults' skills. On average, 33% of individuals ([4])

([3]) PIAAC covers 17 Member States: Belgium (the Flemish Community), Czech Republic, Denmark, Germany, Estonia, Ireland, Spain, France, Italy, Cyprus, Netherlands, Austria, Poland, Slovakia, Finland, Sweden and the UK (Cyprus not available for our analysis).

([4]) People aged 16 to 64 years old.

without upper secondary education are low-skilled in literacy and 38% in numeracy. Even among those with higher educational attainment, 5% are low-skilled in literacy and 6% in numeracy (European Commission, 2014a).

There is widespread agreement in literature on the positive effect of education on labour market outcomes. People with at least upper secondary education are generally more likely to participate in the labour force, less likely to be unemployed, and more likely to receive higher earnings compared to those with only lower educational attainment.

In 2015, only 63.6% of adults with low qualifications actively participated in the labour market, compared to 79.9% with a medium educational level and 88.8% of those with tertiary education. Eurostat data suggest that low-educated adults are more likely to be discouraged ([5]) on the labour market than their more educated peers, resulting in disengagement and social exclusion.

Besides enhancing labour market participation, education also seems to provide a shield from unemployment. Rates are substantially higher among those with lower educational attainment in all the EU-28: on average, 16.3% among those holding low qualifications are unemployed compared to 5.2% of those holding higher tertiary qualifications.

The recent economic crisis exacerbated the already vulnerable labour market position of workers with low qualifications. Between 2007 and 2015 the employment rate of adults with low qualifications decreased in the EU-28 from 57.1% to 53.2%, compared to a decline of only 1.1 percentage points for highly educated individuals (from 85.2% to 84.1%). While unemployment rates increased across all education levels during the crisis, the economic downturn has negatively affected especially those with low qualifications whose unemployment rate increased on average from 9.2% in 2007 to 16.3% in 2015.

Once in employment, low-skilled adults are also more likely to be employed in low-skilled occupations. PIAAC data shows that among workers employed in low-skilled occupations, 35% possess low skills in literacy and 40% in numeracy. Low proficiency in literacy and numeracy is also high in semi-skilled manual occupations, particularly in Italy, Spain and France where more than 30% of workers have low scores on cognitive skills. Analysis of EU-SILC 2011 data suggests that adults with a low level of education are more likely to get trapped in low-skilled occupations: adults with low qualifications generally have a higher

([5]) Discouraged workers are those who desire to work but who are not in the labour force, believing that there is no work available for various reasons.OECD: *Employment database:* http://www.oecd.org/els/emp/onlineoecdemploymentdatabase.htm [accessed 3.3.2017].

probability of remaining in low-skilled jobs at any age and job mobility tends to decrease with age.

Low-skilled workers and those employed in low-skilled occupations also tend to experience more precarious employment than their higher skilled peers. They are more likely to be self-employed than those with medium or high levels of education and are also more likely to be employed under a temporary contract. Workers in low-skilled jobs usually experience poorer working conditions ([6]) compared to people in intermediate and highly skilled ones. They are reportedly less satisfied with their pay and career prospects, receive fewer benefits from extra payments, fringe benefits and performance-related schemes, and are also more likely to be employed in dangerous occupations and report higher accident rates.

Although the low-skilled are most in need of education, training and upskilling, empirical evidence tells us they are less likely to participate in learning activities. Both the adult education survey and PIAAC provide evidence on the unequal participation in learning activities and reveal strong disparities in the participation rates of different categories of adults in lifelong learning.

Trends in low skills among adults vary substantially across Member States. This is why consensus has emerged in literature on the importance of institutional settings and policies in explaining differences across countries. Two sets of policy approaches are consistently found in the empirical literature aimed at exploring ways to improve the labour market conditions of the low-skilled:

(a) remedial measures targeted at the current stock of low-skilled adults;
(b) preventive measures targeted at young school dropouts, NEETs and disadvantaged groups (Cedefop, 2016; OECD, 2014).

A cluster analysis allowed grouping of European countries according to the policy approach addressing low-skilled/qualified adults. Five country clusters were identified:

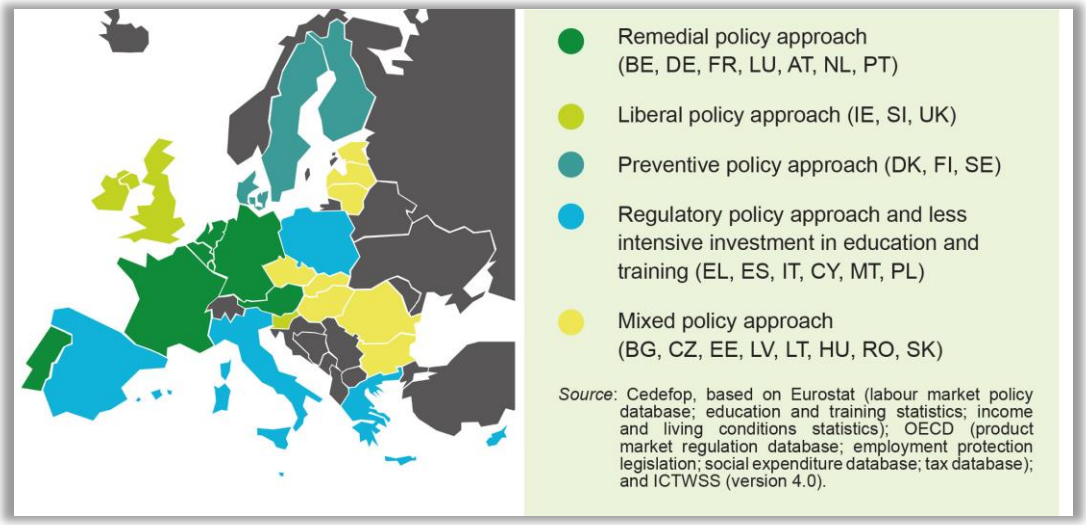
(a) remedial policy approach: countries with high labour market policies (LMP) expenditure, particularly in training, direct job creation and income support. This cluster is also characterised by high levels of product and labour market regulation. Work-life balance policies are also substantial and increasing;

([6]) Eurofound: *Fifth European working conditions survey* – 2010. http://www.eurofound.europa.eu/surveys/european-working-conditions-surveys/fifth-european-working-conditions-survey-2010 [accessed 3.3.2017].

(b) liberal policy approach: countries with the lowest of market regulation, and a high adult participation in lifelong learning. Despite growth in recent years, LMP expenditure remains low except for direct job creation;
(c) preventive policy approach: countries with high support for education and work-life balance, and expenditure on LMP also above the EU average. Market regulation indicators are in line with the EU average, while the degree of union coverage and density is the highest in Europe;
(d) regulatory policy approach and less intensive investment in education and training: countries with the highest levels of market and employment regulation. Expenditure on LMP and on education and training are lower than the EU average (particularly for training), as are adult participation in lifelong learning and work-life balance policies;
(e) mixed policy approach: countries with the lowest level of expenditure on ALMP, education, formal childcare and income support. Levels of market and employment regulation are in line with the European average, while union coverage and density are the lowest in Europe.

The cluster analysis suggests that the preventive policy approach helps not only preventing a high share of low-skilled adults, but also supporting labour market participation and living conditions of low-skilled adults. Countries in the mixed policy and regulatory policy clusters display similar negative patterns in the labour market and living conditions of the low-skilled adult population, although the incidence of the low-skilled population across these clusters is very different: in both groups skills gaps in employment rates are high, employment rates for

Figure 1. **European countries by cluster**

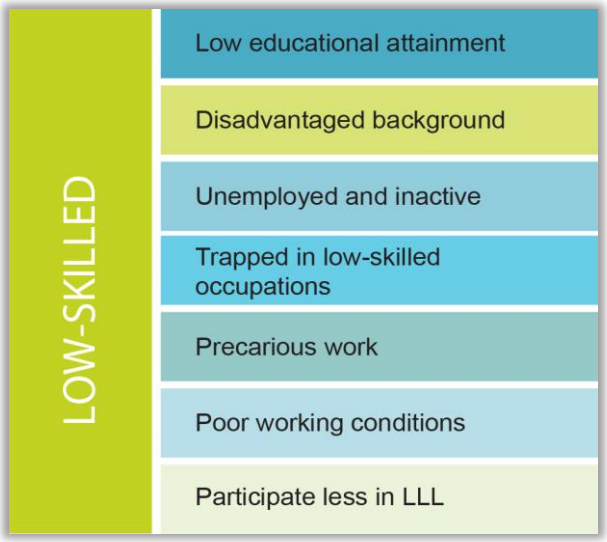


low-qualified adults are the lowest, and low-skilled adults are at a high (and increasing) risk of poverty. Cluster analysis also suggests that high levels of LMP expenditure observed in the remedial policy approach cluster may counteract the negative effects of being low-skilled. Countries in the liberal policy cluster, with their high level of adult participation in lifelong learning but lower than EU average LMP expenditure, generally display low rates of adults with low qualifications, but substantial share of adults who are low-skilled in numeracy.

EU low-skilled adults: characteristics, determinants and risks

While future trends in low skills suggest that shares of low-skilled adults will continue to decrease, current trends also indicate how low-skilled people are particularly disadvantaged and vulnerable on the labour market. Effective policy interventions tackling low skills require a clear understanding of who are the low-skilled and what are the risk factors of becoming low-skilled.

Figure 2. **Characteristics, determinants and risk of being low-skilled**



Source: Cedefop.

Characteristics of low skills

Findings from a pooled regression analysis of PIAAC data suggest low levels of cognitive skills are associated with lower levels of educational attainment, lack of work experience and spells of unemployment and inactivity.

Low cognitive skills are also associated with disadvantaged background, particularly migrant background, although the strength of the association varies widely across and within countries, between different age groups. The educational level of parents is also associated with cognitive skills proficiency (intergenerational persistence).

Determinants of low skills

Results from a variance decomposition analysis suggest that most of the observed difference in cognitive skills is explained by the level of formal education attained and frequency of use of information processing skills in everyday life (reading, writing, and numeracy). Personal characteristics (gender, age, migrant status and language spoken) and, especially, family background (migrant status, parental education level) are also responsible for a large portion of this difference. To a lesser extent, variance in cognitive skills is also explained by labour market attachment and having participated in training.

Along with these personal and human capital variables, job characteristics may play a role in determining low cognitive skills among employed adults. Results from an OLS regression on employed adults confirm a strong relationship between level of cognitive skills and type of occupation. The positive relationship between work experience and the level of proficiency in numeracy skills is also true for employed adults ([7]). The effect of work experience on cognitive skills is more pronounced for older workers, probably because of a self-selection effect.

Risks of being low-skilled

A probit regression analysis ([8]) on numeracy ([9]) skills shows results consistent with the analysis of the characteristics and determinants of low skills. The probability of being low-skilled is strongly related to level of education attained and parental background. Having a migrant background seems to play an important role in determining the probability of having low proficiency in cognitive skills.

A strong relationship also exists between work experience and the probability of being low-skilled in numeracy: this is higher among individuals who never worked and among individuals experiencing unemployment or inactivity spells.

([7]) Similar results are found for literacy.

([8]) Analysis uses average adjusted predictions and adjusted predictions at representative values.

([9]) This part of the analysis concentrates and presents results on numeracy skills, since literacy and numeracy proficiency scores are highly correlated (coefficient is 0.86) and produce similar results.

Consequences of being low-skilled

The idea that education and higher skills levels are associated with a wider range of benefits for individuals (and their families), employers, society, and the economy as a whole, is largely agreed in the literature. Alongside increased employability and higher earnings for individuals, as well as higher productivity and economic growth for the economy as a whole, a more recent strand of analysis focuses on the social and non-market benefits of education and skills: improved health, social and civic engagement, and lower involvement in criminal activities.

Figure 3 shows the different dimensions impacted by higher levels of skills. While, at individual level, education can define major labour market outcomes, it also contributes to improving individual satisfaction, well-being and health status. Higher skills are also positively related to lower involvement in criminal activities and may promote trust, civic engagement, active citizenship and social inclusion. Investment in human capital also affects what could be called Schumpeterian growth: investment in education leads to a more skilled and competent population, which is able to generate and adopt new ideas that stimulate innovation and technological progress.

All these benefits are interlinked and spill into all four dimensions. For example, higher employability and higher returns also lead to higher revenues for governments in increased returns from taxes, as well as reduced spending on

Figure 3. **Benefits of higher levels of skills**

Source: Cedefop.

benefits, such as income support. Education is not only associated with private benefits, but also with large gains to economies and societies.

Costs and benefits of low-skilled adults

The ultimate aim of this study is to estimate the individual and social value in monetary terms of a faster increase in the level of skills in Member States, compared to the current trend. It uses empirical data for all EU-28 Member States and – where data are not available – builds on findings from literature research on the impact of skills on main socioeconomic variables. Applying robust methodological approaches, estimates are provided on both microeconomic approaches (costs and benefits for individual agents such as families, firms and the public sector), and macroeconomic approaches, considering the implications for the economy as a whole. Both approaches offer advantages and limitations.

Following standard principles, microeconomic analysis assumes that wages correspond to marginal productivity and so include returns on education/training. It implies that non-individual costs and benefits, such as externalities and spillover effects, are not captured by aggregation of microeconomic outcomes of education/training without further assumptions. At the same time, the implicit assumption of constant returns on skills is unrealistic as it does not take into account deadweight losses, substitution and displacement effects.

Box 1. **Scenarios used to derive the net benefit from upskilling**

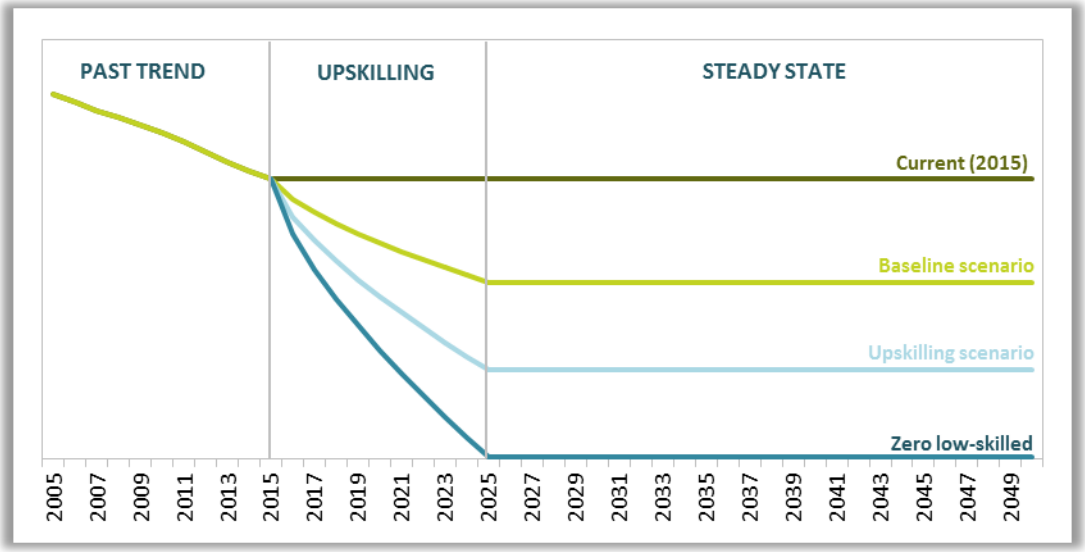
A baseline scenario (business as usual), which assumes that population 15 to 54 observed in 2015 would age to the key adults cohorts in 2025 (25 to 64 year-olds) and would be affected by the past trend of decreasing levels of low skills, gradually reaching a proportion of low-skilled adults of 14.7% by 2025. This target was chosen in line with Cedefop's forecast scenarios.

An upskilling scenario, which assumes a further decreasing trend in the proportion of low-skilled adults to reach 7.4% by 2025 (about half of the baseline target). A further assumption is that the increased reduction is higher for younger people and gradually lower for older cohorts. This scenario is challenging as it assumes that is possible to double the current trend in the reduction in the proportion of low-skilled population, but not impossible when considering that a share of low-skilled around 10% is already a reality in several Member States.

A high hypothetical zero low-skilled scenario, which assumes that, by 2025, the proportion of low-skilled in the adult population would completely disappear. This scenario is largely unrealistic because of the extensive (and difficult to sustain) investment in adult learning facilities and policies it would require. However, it was included because it represents an interesting reference point for the analysis.

However, macroeconomic approaches also suffer from limitations, initially because of the lack of consideration of non-market values and distributional effects which estimates based on national accounts cannot include. Further, data available for the estimate in this exercise, which includes an unprecedented period of economic downturn, reduces the ability of the models to evaluate fully the role of spillovers and externalities arising from public investments in human capital.

Figure 4. **Scenarios used to derive the net benefit from upskilling**



Source: Cedefop.

Microeconomic approach: aggregated economic net benefit of reducing the share of low-skilled adults by 2025

The first step in the microeconomic approach is to provide a series of estimates of costs and benefits of reducing the share of low-skilled/qualified to the individual agents:

(a) individuals/families (individual wage return, cost of upskilling, higher probability to be employed, improved health, reduced crime tendency);

(b) employers/firms (productivity gains and higher returns on investment, saving of downtime due to lack of skilled staff, and saving of recruitment costs);

(c) public sector/tax revenue (higher activity rate and lower unemployment, reduction of unemployment and out-of-work social benefits, reduction of ALMP public expenditure, public costs of upskilling, effects on tax revenues, healthcare spending, legal and social assistance systems).

Aggregation of individual agent costs and benefits resulting from upskilling the low-skilled population of different ages is presented in Table 1. The main components of costs and benefits are considered comparing the upskilling and the zero low-skilled scenarios against the baseline, assuming that the lower share of low-skilled/qualified adults can be achieved within a 10-year span (2015-25).

Results from the microeconomic analysis show substantial gross earnings increases, including tax revenues, as well as substantial positive effects for individuals in terms of health and crime benefits. The estimate of the aggregated economic net benefit of reducing the size of the low-skilled adult population account for a total present value over the 10 years of EUR 2 013 billion (yearly average value of about EUR 200 billion) in the upskilling scenario, and of EUR 3 529 billion in the zero low-skilled scenario (yearly average value of about EUR 350 billion).

Table 1. **Aggregated costs and benefits for individual agents: scenarios 2015-25 (million EUR)**

	Main components	Upskilling scenario (7.4%)	Zero low-skilled scenario (0%)
(+)	Aggregate net income	903 618	1 614 877
(-)	Opportunity costs (foregone earnings)	287 936	453 946
Net benefit (~GVA)		**615 682**	**1 160 932**
(+)	Surplus/compensation	523 330	986 792
Net benefit including surplus		**1 139 012**	**2 147 724**
(-)	Net public spending	156 267	345 010
(+)	Health and crime economic benefits	1 030 044	1 725 841
Total net benefit (+/-)		**2 012 789**	**3 528 554**

NB: All figures are expressed in net present value. Aggregate GVA is computed as the difference between aggregate income increase and the opportunity costs (foregone earnings).

Aggregated gross earnings: returns of acquiring ISCED 3 as opposed to ISCED 0-2 qualifications, including higher earnings and employment rate (microeconomic estimates applied to evaluate gains in lifetime income resulting from upskilling of low-skilled adults).

Opportunity cost of education/training investment: cumulative foregone earnings for the education/training spell required to acquire ISCED 3 qualification (based on empirically observed duration of acquiring ISCED 3 qualifications in EU-28).

Surplus/compensation ratio: value-added created during the production process which remunerates capital and employers' work more generally (based on Eurostat data on GDP income components).

Health and crime benefits: benefits for individuals of better quality of health and crime reduction effects of education (estimates based on: QALY differentials between low-skilled/qualified adults and those with upper secondary education; evidence from literature as for crime-related benefits).

Aggregated public spending/savings: effects on public budget (further to tax revenues due to higher earnings and employment) related to education/training public spending and out-of-work benefits savings.

Source: Cedefop estimations, based on EU-SILC.

Macroeconomic approach: long-term impact on the steady-state growth of GDP in 2025-50

To estimate the possible long-term impact of reducing the share of low-skilled adults, a valuation exercise was conducted using a macroeconomic approach. This provides alternative estimates of the costs of low skills to the European economy, making use of skill levels and macroeconomic output measures rather than aggregating individual returns.

The impact of skills can be best estimated by quantifying the output growth foregone due to low skills, in models which explain GDP growth per capita based on factors of production and further variables relevant to macroeconomic output (savings, depreciation of capital, population growth and labour market participation). While cross-country comparisons have the advantage of capturing externalities otherwise omitted in the micro approach, GDP per capita cannot represent the full value of skills for society, as this includes additional aspects such as unpriced values, externalities, distributional considerations and other important determinants of social well-being.

The model's empirical specification combines Eurostat data on the qualifications of the population aged 25 to 65 years with further macroeconomic aggregates from the AMECO database and the total economy database of the Conference Board for all 28 EU Member States.

Results from the panel data regression show that a 10 percentage point reduction in the long-term proportion of low-skilled adults (with ISCED 0-2 qualification) would increase long-term GDP per capita growth rate by 0.1 percentage point. We apply our scenarios (Box 1), assumed as the long-term proportion of low-skilled adults in steady-state that is no longer changing as of 2025, and the impact of the steady state growth rate of the GDP per capita is based on the model ([10]).

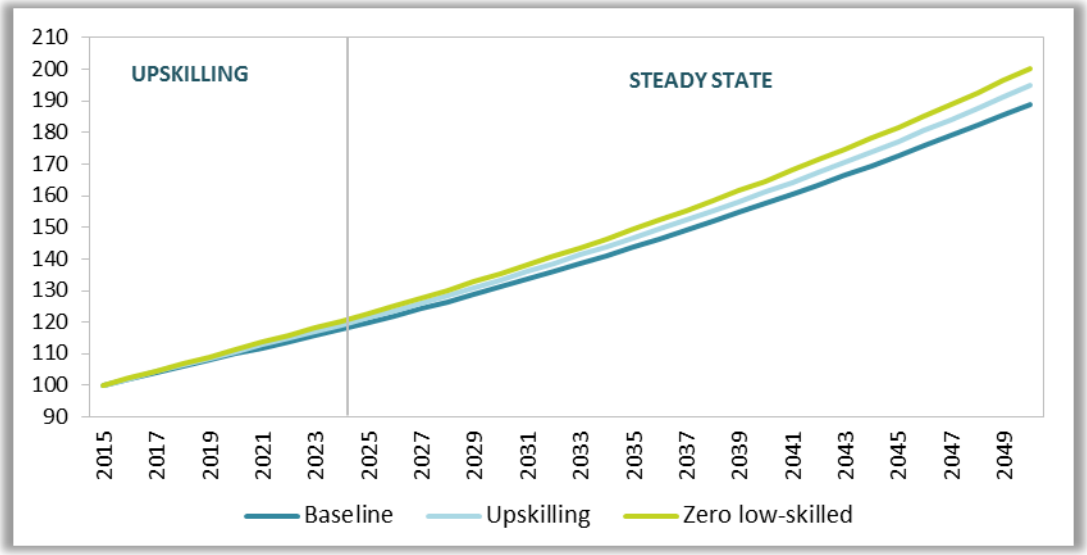
Applying the steady-state growth rate to the 2015 GDP per capita, we obtain the expected GDP per capita in 2025 in both upskilling and zero low-skilled scenarios. In the upskilling scenario, after 25 years the GDP per capita would be EUR 52 909, compared to EUR 52 007 for the baseline. With an expected population in the EU-28 increasing by about 15 million by 2050, the long-term annual GDP for the EU-28 would be about EUR 480 billion larger in the upskilling scenario than in the baseline. Following the same approach, in the hypothetical

([10]) In both scenarios it is assumed that the reduction in the proportion of low-skilled adults translates into a similar increase in proportion of adults with ISCED 3-4 (no impact on ISCED 5-8).

zero low-skilled scenario the long-term annual GDP differential would be about EUR 965 billion in 2050.

In the 25 years taken as reference period (2025-50) the increase in annual GDP due to the reduction in the share of low-skilled adults set in the 'upskilling' and the zero low-skilled scenarios would be over EUR 200 billion and EUR 410 billion respectively.

Figure 5. **GDP growth under different scenarios, macroeconomic approach, 2025-50**



Source: Cedefop estimation on data from Eurostat (labour force survey custom aggregation); annual macroeconomic database (AMECO); and total economy database (Conference Board).

Introduction
Low-skilled adults in the EU: why skills matter

Skills are a driving force of economic and social development. When citizens are engaged in the labour market and in society, countries prosper not only in terms of growth but also in terms of well-being and social cohesion.

The economic and financial crisis has profoundly affected labour market dynamics in the Member States. Soaring unemployment rates, especially among certain groups of the population, (the young and the low-skilled) may have negative consequences and lead to social exclusion and disengagement. Having such a pool of talent out of the labour market is even more concerning, in light of future demographic challenges, increasing global competition and fast-changing labour-market needs resulting from innovation processes.

Despite the magnitude and persistence of the low-skill phenomenon among adults in the EU, policy-makers have generally not paid as much attention to low-skilled adults as to other groups at risk of social and labour-market exclusion (such as young people). However, in view of the future labour-market and skills forecasts, low skills started to attract growing interest at policy level. Initiatives such as the *New skills agenda for Europe* (European Commission, 2016a) and the *Upskilling pathways: new opportunities for adults* (Council of the EU, 2016) have been developed at EU level to support Member States in ensuring that every European acquires the skills to realise fully his/her talent and potential.

For policy-makers to design and implement policies tailored to this particular group there is a need to develop a comprehensive and robust evidence base on low-skilled adults in the EU, their volume and characteristics, as well as economic and social costs. There is the need first to identify clearly this target group, in terms of size, characteristics, causes and trends and, then, measure the economic and social costs and benefits both for individuals and society, in order to build a robust evidence base on the phenomenon. From this it is possible to identify and appreciate the benefits of updating the skills of individuals through adult and lifelong learning, which will support the rationale for public intervention. The Cedefop study *Investing in skills pays off: the economic and social cost of low-skilled adults in the EU* seeks to provide this evidence.

To be able to design and implement effective policies targeted at the low-skilled requires accurately defining and measuring this population. Yet, to date, the low-skilled phenomenon has been analysed rather narrowly and primarily using the level of educational attainment of the population (typically with, at most,

lower secondary education: ISCED 0-2). This is mainly because available data are scarce and mostly confined to Eurostat databases, such as the adult education survey and the European Union labour force survey (EU-LFS). Although these provide reliable, updated and comparable data across the EU, their scope is narrow and fails to capture other dimensions that are highly relevant to defining and conceptualising the low-skilled. As a result, analysis based on these datasets tends to oversimplify the low-skill concept. Chapter 1 of this report aims at articulating a 'holistic' and broader definition of low-skilled status for adults, which will move beyond relying only on the level of educational attainment and embrace the different dimensions which comprise the overall skills and competences of workers. This is expected to help with understanding the characteristics which define low-skilled people and investigating mechanisms through which low skills and competences affect the labour market outcomes of workers in low-skilled jobs.

Chapter 2 provides a comprehensive and up-to-date comparative overview of current labour market conditions and recent and future trends in low-skilled adults in the 28 Member States; it is based on a wide range of existing European and international data sources and on the quantitative and qualitative evidence within existing literature. In this chapter we also explore the impact of different institutional settings and policies in explaining differences in low-skilled trends across Member States.

Against a background of current and future trends in low skills, effective policy interventions require clear understanding of who are the low-skilled and what are the risk factors of becoming low-skilled. Chapter 3 investigates the characteristics of the low-skilled adult population in the EU, aiming to identify what are the determinants of low-skilled status as well as the factors increasing the likelihood of becoming low-skilled.

Chapter 4 provides an overview of the consequences of low skills. The idea that education and higher levels of skills are associated with a wider range of benefits for individuals (and their families), employers, society and the economy as a whole, is largely shared in literature. In this chapter we explore the benefits associated with higher levels of skills in these four dimensions.

Finally, Chapter 5 provides an estimation of the costs of low skills to individuals, businesses, the economy and society at large, with a robust methodological approach using empirical data for all EU-28 Member States and – where data are not available – summarising the findings from existing literature on the impact of skills on a number of variables. Estimating such costs is part of the required evidence that will contribute to raising the low-skill issue higher on the political agenda and mobilising policy-makers and decision-makers at all levels to take immediate action and develop effective policies.

Chapter 1.
Low-skilled in the EU: conceptual and measurement challenge

To date, analysis of low-skilled status in the labour market has been narrow and primarily based on the educational attainment of the population. It has used a definition of lower secondary education – ISCED 0-2 – applied to main Eurostat data sources, such as the EU-LFS, which are the only ones providing reliable, updated and comparable data across all EU Member States.

However, conceptualising low-skilled status based only on educational attainments fails to capture other dimensions that are no less relevant for labour market analysis and for vocational education and training policy development. First, educational attainment does not take into account different types of skills and abilities, and factors that can result in low-skilled status, especially among adults: long-term unemployment and/or disengagement from the labour market, skill obsolescence due to ageing, rapid technological change, product/process innovation, changes in production processes and/or work organisation, and socioeconomic factors such as migrant background and gender. Second, this narrow conceptualisation fails to capture the role of other knowledge, skills and competences gained outside formal education environments, such as those acquired through training, informal learning and work experience.

Also, there is little consensus among scholars on the meaning of the concept of skills which, in many cases, is blurred with other terms such as competences and abilities. Recent theoretical work has argued that skills are a reflection of 'value', which may be personal, economic or social (Green, 2012). According to this definition skill involves the following dimensions:

(a) using skill produces value for an individual or organisation, signalled through price of goods produced or income earned by an individual;
(b) skills are expandable and can be enhanced by training and development, so personal attributes such as physical characteristics, which are not amenable to change, do not meet the definition;
(c) skills are socially determined.

Within this context, this report sought to articulate a broader definition of low-skilled status for adults, moving beyond educational attainment to embrace the different dimensions which comprise the overall skills and competences of adults. This is expected to help with understanding the characteristics which define low-skilled people and investigating mechanisms through which low skills and

competences affect the labour market outcomes of adults and workers in low-skilled jobs.

1.1. Conceptualisation and measurement of the low-skilled

1.1.1. Main definitions in use

Most literature identifies low-skilled adults as those with a low level of formal education. This is typically defined as individuals whose schooling is below any level of secondary education – ISCED 0-1 – extended ([11]) at most to lower secondary education (ISCED 0-2) ([12]).

Alternative definitions use job characteristics to identify the low-skilled population, those working in elementary occupations (ISCO-88 major group 9) ([13]). However, this can be controversial for some subgroups of the population such as immigrant workers ([14]). Some studies (Eurofound, 2008) use job characteristics to identify the low-skilled but in addition to ISCO-88 major group 9, elementary occupations, they also includes major groups 5 to 8. Other studies (Dieckhoff, 2008) consider low-skilled workers as those working only in ISCO-88 submajor groups 81 to 93 ([15]).

([11]) E.g. Steedman and McIntosh (2001) who present an analysis of the international adult literacy survey (IALS) test data concluding that ISCED 0-2 is a valid working definition (and measure) of the low-skilled in the Member States considered.

([12]) ISCED 1997 (international standard classification of education): 0 – Pre-primary education; 1 – Primary education or first stage of basic education; 2 – Lower secondary education or second stage of basic education; 3 – Upper secondary education (3C – programme not designed to lead ISCED 5A/B); 4 – Post-secondary non-tertiary education; 5 – First stage of tertiary education; 6 – Second stage of tertiary education

ISCED 2011: 0 – Early childhood education; 1 – Primary education; 2 – Lower secondary education; 3 – Upper secondary education; 4 – Post-secondary non-tertiary education; 5 – Short-cycle tertiary education; 6 – Bachelor or equivalent; 7 – Master or equivalent; 8 – Doctoral or equivalent.

([13]) This definition is used by manuals and research practices of international organisations, such as ILO or OECD which equate ISCO-88 major group 9 with the low-skilled level.

([14]) The position of immigrants in the EU labour markets raises the issue of whether low-skilled should be defined through the skills they possess, or the jobs they perform: some lower-skilled jobs are occupied by highly educated immigrants, whose qualifications are not recognised in the host country.

([15]) ISCO-08, 2008 (international standard classification of occupations): 0 – Armed forces occupations; 1 – Managers; 2 – Professionals; 3 – Technicians and associate

Finally, in some economics literature, such as in Manning (2004), low-skilled people are also defined by wage changes associated with specific jobs previously performed by low-skilled workers. Some scholars refer to the changes associated with the 'usual' attribution of some routine jobs to low-skilled people. In 'a model of changing task specialisation in which 'routine' clerical and production tasks are displaced by automation' (Autor and Dorn, 2009, abstract), less-educated workers tend to lose out: technological change and/or automation produce displacement of routine labour input. This should, in turn, lead to shifts in job specialisation because 'computer adoption […] implies greater demand for computer capital' (Autor and Dorn, 2009, p. 26). 'Computer capital substitutes for workers in carrying out a limited and well needed set of cognitive and manual activities, those that can be accomplished by following explicit rules (what we term 'routine tasks'); and that computer capital complements workers in carrying out problem-solving and complex communication activities ('non-routine' tasks)' (Autor et al., 2003, p. 1280).

1.1.2. Wider conceptualisation: low-skilled status as a multidimensional phenomenon

A broader look at the causes of becoming low-skilled leads to identifying various 'typologies' of vulnerable people likely to be classified as low-skilled: people with obsolete skills (even if they possess upper secondary education) and/or people who do not possess enough non-cognitive skills. The term 'non-cognitive skills' usually refers to a set of attitudes, behaviours, and strategies that are thought to underpin success in school and at work, such as motivation, perseverance, and self-control. They are sometimes described using terms such as character skills, competences, personality traits, soft skills and life skills. Despite growing interest in this topic (Morrison et al., 2013; Nelson, 2010; Kureková et al., 2013b), while the relationship between cognitive skills and later outcomes in life has been extensively studied, evidence on the causal relationship between non-cognitive skills and later outcomes is not well established. Dickerson and Green (2004), Smits and Zwick (2004), and Heckman et al. (2006) find that transversal competences (or non-cognitive generic skills), such as communication skills and/or language skills, attract positive wage premia and increase employability. It

professionals; 4 – Clerical support workers; 5 – Service and sales workers; 6 – skilled agricultural, forestry and fishery workers; 7 – Craft and related trades workers; 8 – Plant and machine operators and assemblers; 9 – Elementary occupations.

The texts we are quoting refer to ISCO-88. However, in March 2008, the ISCO-08 was adopted. See ILO website for the correspondence between ISCO-88 and ISCO-08: http://www.ilo.org/public/english/bureau/stat/isco/isco08/ [accessed 1.3.2017].

is worth highlighting that the possession of transversal non-cognitive skills ([16]) is not always linked to the formal qualification(s) acquired and/or level of education attained.

In addition to the innate characteristics and qualifications held by individuals, skills requirements are dynamic and may evolve over time, leading to changes in the types of characteristics which define the low-skilled.

Innovation, including increased use of ICTs and changes in production processes and/or work organisation, requires higher and/or new skills. Due to what is commonly referred as skill-biased technological change (SBTC) the average job is getting more demanding in terms of skills requirements (Kureková et al., 2013a). Job complexity is increasing across all sectors and occupations and inflation in relative skills demand, for instance requiring more demanding non-routine tasks, even for low-skilled jobs in some service sectors (European Commission, 2008).

Changes in skills demand are more likely to affect older workers negatively than other groups (Desjardins and Warnke, 2012). As the younger age cohorts have much lower shares of low-educated people (ISCED 0-2) than older cohorts, the thresholds at which qualifications are defined as 'low' in the labour market differ across the age cohorts. This is likely to have implications for how the same level of education is valued over time and between people of different ages.

In addition to older people, workers employed in sectors experiencing rapid technological and organisational change and those working in low-skilled jobs are at higher risk of experiencing skills obsolescence. Workers experiencing unemployment and inactivity spells may also face obsolescence of their human capital (Arthur et al., 1998), as may those working in jobs for which they are overqualified. (Kureková et al., 2013a; De Grip et al., 2008). Over recent years, due to fierce competition in the labour market resulting from fewer suitable work opportunities, a growing number of highly and medium-qualified workers have been willing to accept jobs at a lower skills level. Females, young people and third country nationals are the most represented among overqualified workers (Goldring and Yamina, 2013).

Beyond the immediate private and public fiscal costs, skills underutilisation can have longer-term consequences: people who do not use their skills fully are likely to lose them over time, which can result in adverse consequences for future

([16]) In the PIAAC adult survey (programme for the international assessment of adult competencies), non-cognitive skills are explored through non-cognitive modules referring to behavioural performance competencies, subjective well-being and health, career interest and intentionality, and work/training history and skills transfer.

employment and well-being, as well as lower participation in further training, with further consequences in terms of lower future earnings and productivity. This can be particularly detrimental for young people who have a longer working life ahead.

In recent years, the increased focus on lifelong learning has led to growing attention to the fact that individuals not only acquire skills over their lifetime, but are also confronted with skill loss and a general decline in the ability to acquire and retain new knowledge and skills. This is true both when dealing with skills defined as basic cognitive skills (such as reasoning, episodic memory, vocabulary or processing speed) and those defined as cognitive foundation skills such as literacy, numeracy and problem solving (Willms and Murray, 2007).

The conceptualisation of low-skilled status as a multidimensional phenomenon goes beyond educational attainment and qualification levels to capture the different dimensions of low skills (Table 2).

Table 2. **Additional categories (to that of low-educated) of low-skilled people**

Additional categories of low-skilled people	Main characteristics
People with obsolete skills	People with higher education than ISCED 0-2 but experiencing skills obsolescence. This group may include: • workers who have obtained an obsolete education which no longer holds currency in the face of structural and labour market changes. This is in particular the case with older workers who have not refreshed their initial educational attainment with more recent training; • workers who have not sufficiently applied in real work settings their specialised skills acquired in education. This is particularly the case for individuals with long spells out of the labour market, including females experiencing career interruptions (e.g. because of child rearing) and those suffering from long-term sickness absence; • unemployed and inactive people who may be facing barriers in their labour market entry or re-entry, many might be unmotivated or lacking the interest and/or foundation skills to undertake training which would develop new skills required by a changed labour market and by the new (knowledge) economy.
Mismatched, overqualified workers	People who have worked in a sector and/or in a job that did not make use of their educational attainment and associated skills/qualifications. This group may include: • immigrants working in roles which do not make use of the qualifications gained in their country of origin (such as high-skilled immigrants whose qualifications are not recognised in the host country); • young people with higher level qualifications but working in entry level positions because of their lack of experience and difficulty in gaining work experience, resulting, in some countries, from the continuing effects of the economic crisis; • females, because of labour market segregation and over-representation in precarious employment.

Source: Adapted from Kureková et al., 2013a.

Developments in literature along the broader classification summarised in Table 2, call for a different approach to measuring low-skilled status which:

(a) considers other dimensions as additional to the acquired and certified level of education (educational attainment);
(b) stresses the importance of demographic factors such as age, ethnicity, gender and occupational status during one's lifespan.

An holistic definition of low skills may include:

(a) low-skilled people: with educational attainment ISCED 0-2 and ISCED 3 who have experienced skills obsolescence and/or skills mismatch by age, sex and nationality;
(b) low-skilled jobs: people working in elementary occupations (ISCO major group 9) and in some cases also semi-skilled non-manual occupation (ISCO major groups 4-5) and in semi-skilled manual occupations (major groups 6-8).

However, limitations in data availability imply that a wider definition of low-skilled population can be applied only to those dimensions which can be measured at EU level (for all Member States). This is why, throughout the report, different operational definitions (based on existing data) have been adopted depending on the context of use.

Chapter 2.
Understanding low skills: trends in low-skilled adults in the EU

A comprehensive and up-to-date overview of recent and future trends of low-skilled adults in the EU is possible from a wide range of European and international data sources (EU-LFS, EU-SILC, EWCS, PIAAC, Cedefop skills forecasts) and the quantitative and qualitative evidence from existing literature. Available data allow us to consider three main dimensions of low-skilled status for individuals:

(a) the level of formal education and qualifications: ISCED 0-2;
(b) the level of cognitive skills: people who have obtained a low score on measures of literacy, numeracy or problem solving in technology-rich environments as assessed by the OECD survey of adult skills, PIAAC (Box 2);
(c) the level of skill required for different occupations: low-skilled jobs are those in elementary occupations (ISCO-08 major group 9), which require a low-skill level corresponding to a primary level of education.

Box 2. **Adopted OECD/PIAAC definition of low skills in literacy, numeracy and problem solving in technology-rich environments**

The definitions of low skills in literacy, numeracy and problem solving in technology-rich environments used in this report are based on proficiency score used by the OECD (2016):

- low literacy or numeracy skills are defined as scores less than 226 points at or below proficiency 1;
- low skills in problem solving are defined as scoring less than 241 points at proficiency level below 1.

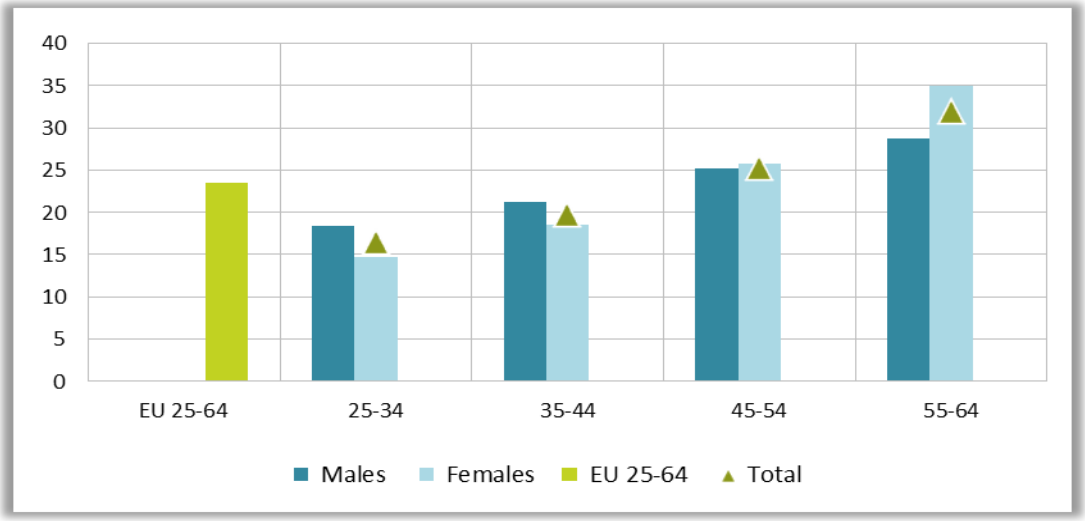
2.1. Low-skilled adults and jobs in the Member States

2.1.1. Recent trends in educational attainment and cognitive skills

Educational attainment has increased substantially in recent years, especially among younger generations, but in 2015 one in four European adults aged 25 to 64 years (equal to 64 million adults) still held only low qualifications (Eurostat, LFS). The incidence is higher in older cohorts, especially for females. As shown in Figure 6, while females are more educated than men in the younger cohorts, the opposite is true in the older group. Given that low-skill incidence in the older

cohorts is higher among females, they represent, on average, a slightly higher share of low-educated people than men.

Figure 6. **Incidence of low-educated adults by gender and age in EU-28, 2015**



Source: Eurostat, EU-LFS, [edat_lfse_03].

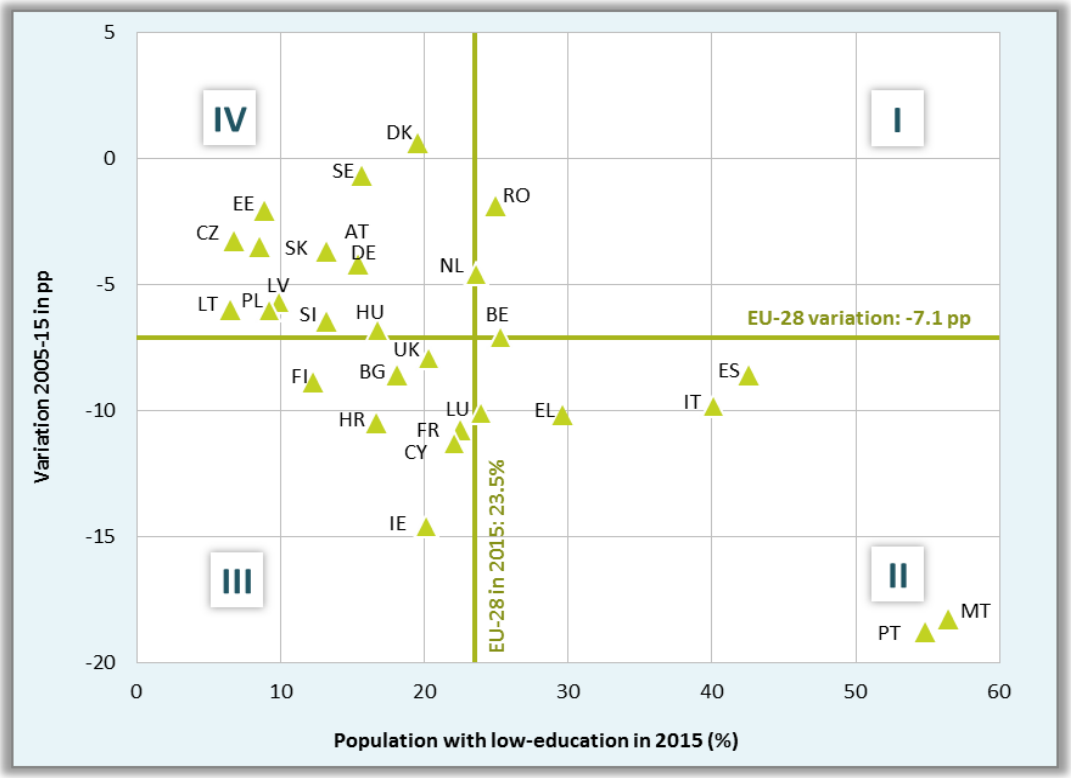
Despite a declining trend in the share of the adult population with low qualifications in all Member States (except for Denmark, due to a break in the series), at country level the situation is diverse: the incidence is particularly dramatic in Mediterranean countries, while it is less than 10% in east European countries.

Large country variations also exist in cognitive skills, both in average proficiency scores and the incidence of low proficiency in cognitive skills among the adult population (Figure 8). Italy and Spain are the weakest performers in both literacy and numeracy, while Finland, the Netherlands and Sweden are the top EU performers. On average, the share of the adult population with low cognitive skills in literacy and numeracy is 18% and 20% respectively ([17]). When the incidence of adults with low cognitive skills is plotted against the incidence of adults with low educational attainment, both aspects seem to follow the same trends. However, while the share of adults with low cognitive skills varies little across Member States, the same is not true for shares of adults with low qualifications. In countries such as Belgium, Spain, Italy and the Netherlands, educational attainment rates are substantially higher than the share of the adult population with low cognitive skills, while the

([17]) PIAAC covers 17 Member States: Belgium (Flanders), Czech Republic, Denmark, Germany, Estonia, Ireland, Spain, France, Italy, Cyprus, Netherlands, Austria, Poland, Slovak Republic, Finland, Sweden, the UK (England and Northern Ireland). However, data for Cyprus were not available for our analysis.

opposite is observed in the east European countries. East European countries are, however, characterised by lower than average rates of adults with low qualifications.

Figure 7. **Level and percentage change of adult population with low educational attainment level* in EU-28, 2005-15**

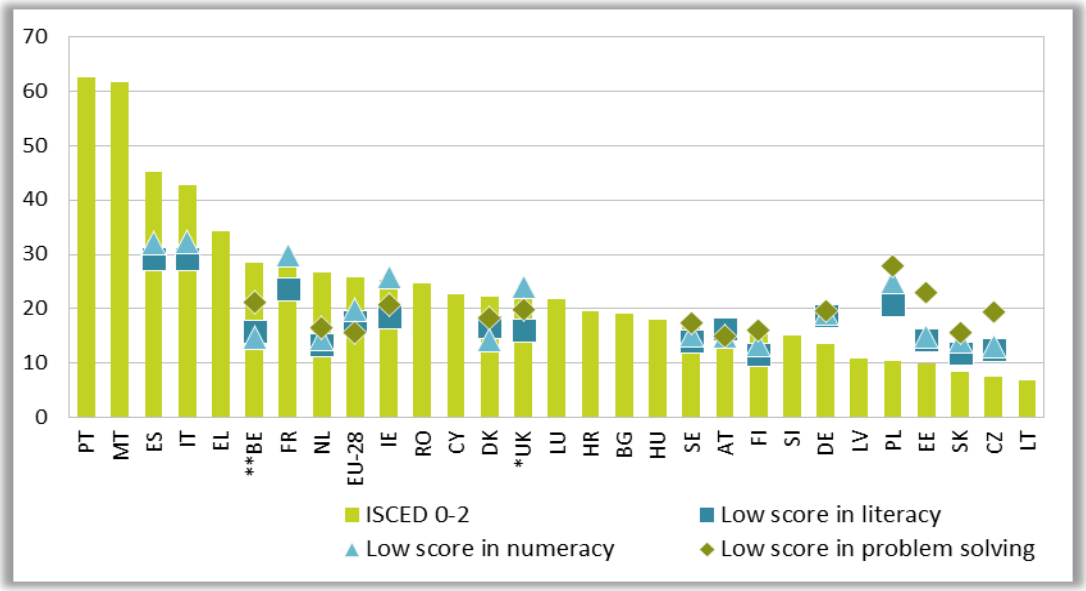


NB: Population in the age class 25 to 64. Low educational attainment: Pre-primary, primary and lower secondary education (ISCED 0-2).

Source: Eurostat, [edat_lfs_9903].

PIAAC data also show a close positive relationship between educational attainment and proficiency in information-processing skills. As shown in Figure 8, adults with low educational attainment, on average, score lower than adults who have attained secondary or tertiary education, especially in problem solving. However, accounting for the effects of other socio-demographic characteristics, such as age, reduces the strength of the relationship between educational attainment and proficiency in all countries (OECD, 2013a). Differences in skills proficiency related to educational attainment vary considerably among countries. Possible reasons for this include differences in the quality of schooling, the nature of adult-learning systems, and differences in patterns of participation in education (OECD, 2013a). The impact of different institutional settings and policies on the incidence of the low-skill population is explored in more detail in Section 2.2.

Figure 8. **Incidence of adults (25 to 64) with low proficiency scores in literacy, numeracy and problem solving, by country*, 2012, and educational attainment in 2012**



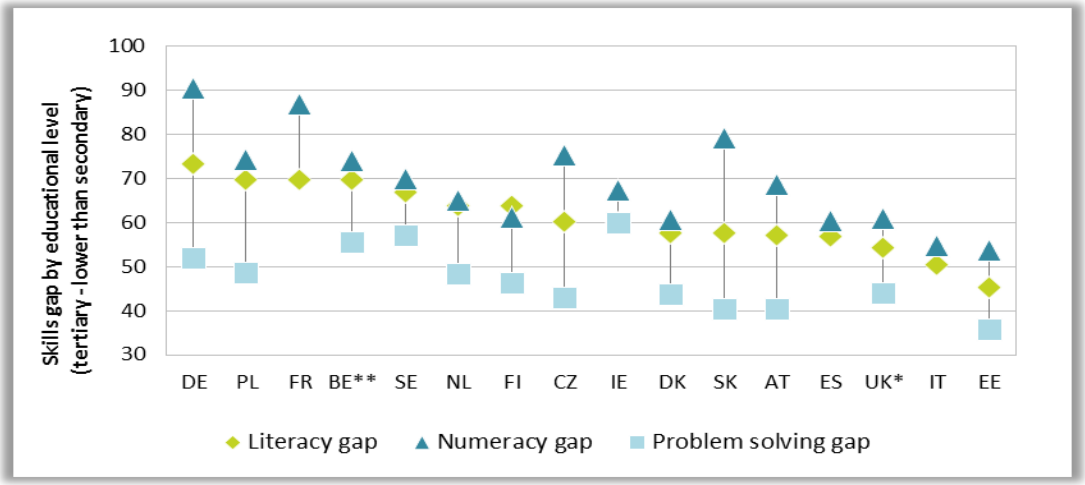
* UK (England and Northern Ireland); ** Belgium (Flanders).

NB: Percentages are calculated not accounting for missing values. For Spain, France and Italy proficiency scores on problem solving in technology-rich environments are not available.

▲ and ■ Proficiency score up to level 1 (below 226 points); ◆ Proficiency score below level 1 (below 241 points).

Source: Cedefop calculation on PIAAC 2012, Eurostat LFS [edat_lfse_03].

Figure 9. **Gap in average proficiency scores between adults (25 to 65) with high education and those with low education by country*, 2012**



* UK (England and Northern Ireland).

** Belgium (Flanders). High education: tertiary education (ISCED 5-8); low education: below upper secondary education (ISCED 0-2).

NB: Percentages are calculated not accounting for missing values. For Spain, France and Italy proficiency scores on problem solving in technology-rich environments are not available.

Source: Cedefop calculation on PIAAC 2012.

2.1.2. Labour market status of low-skilled adults and the financial crisis

There is widespread agreement in literature on the positive effect of education on labour market outcomes. People with at least upper secondary education are generally more likely to participate in the labour force, less likely to be unemployed and more likely to receive higher earnings compared to those with only lower educational attainment.

Education seems to be an important driver for labour market participation. In 2015, only 63.6% of adults with low qualifications actively participated in the labour market, compared with 79.9% for adults with a medium educational level and 88.8% for highly educated adults. While there are no significant differences among EU countries in the participation rate of highly educated adults, there is a higher level of country variation for those with low qualifications (Figure 10). Analysis by gender reveals that while activity rates do not vary much at higher educational levels, females with low education are particularly disadvantaged: at EU level only 51.8% of females with low education participate in the labour market against 75.7% of men.

Figure 10. **Activity rate by educational attainment levels (25 to 64), 2015**

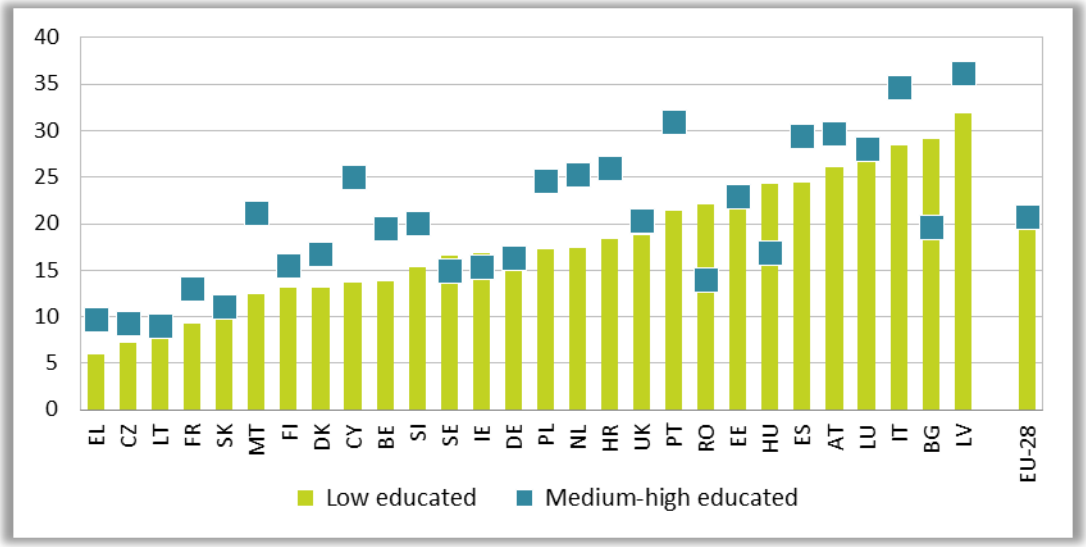
Source: Eurostat, EU-LFS, [lfsa_argaed].

Low activity rates among adults with low qualifications are also of concern; they may conceal discouragement and possibly result in disengagement and social exclusion. Low-educated adults seem more likely to be discouraged ([18]) on

([18]) Discouraged workers are persons who desire to work, but who are not in the labour force, believing that there is no work available for various reasons. OECD: *Employment*

the labour market than their more educated peers. As shown in Figure 11, the share of inactive adults wanting to work is lower among those with low qualifications than among the medium and highly educated in most EU Member States, except for Bulgaria, Hungary and Romania.

Figure 11. **Share of inactive adults wanting to work by educational attainment, 2013**



Source: Cedefop analysis of Eurostat EU-LFS, microdata 2013 (latest year available for microdata).

Besides enhancing labour market participation, education also seems to provide a shield from unemployment. Figure 12 shows that unemployment is substantially higher among those with lower educational attainment in all the EU-28.

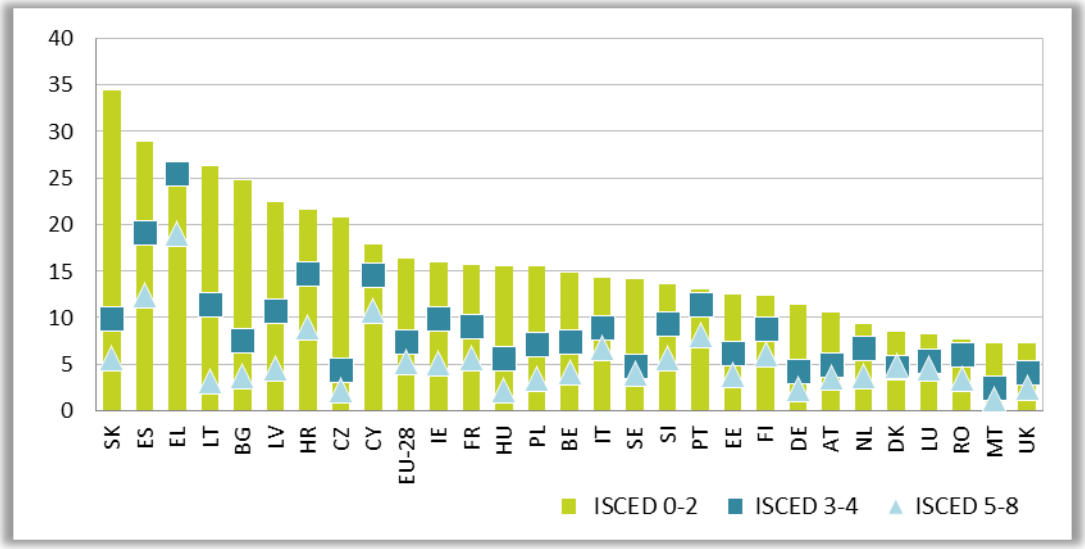
The economic crisis has negatively affected those with low qualifications, their unemployment rate increasing on average from 9.2% in 2007 to 16.3% in 2015. Only Germany, Hungary and Slovakia registered a decline in unemployment among those with a low level of education.

The financial crisis exacerbated the already vulnerable labour market position of workers with low qualifications (Kyndt et al., 2013; Kaufman, 1995; Rocco and Thijssen, 2006). Between 2007 and 2015 the employment rate of adults with low qualifications decreased in the EU-28 by 3.9 percentage points from 57.1% to 53.2%, compared to a decline of only 1.1 percentage points for highly educated individuals (from 85.2% to 84.1%); this widened the employment gap in level of education over the financial crisis years.

---

database. http://www.oecd.org/els/emp/onlineoecdemploymentdatabase.htm [accessed 3.3.2017].

Figure 12. **Unemployment rate by education level (25 to 64), 2015**



Source: Eurostat, EU-LFS [lfsa_urgaed].

The EU average conceals large country differences. Employment rates for low-qualified adults have been decreasing in most Members States, with the sharpest declines of about 10 percentage points in Bulgaria, Denmark, Ireland, Greece, Spain, Cyprus, Hungary and Portugal. In contrast, employment rates have increased by about five percentage points in Germany, Malta and Slovakia, although the last still has the lowest employment rate for low-qualified adults (Figure 13).

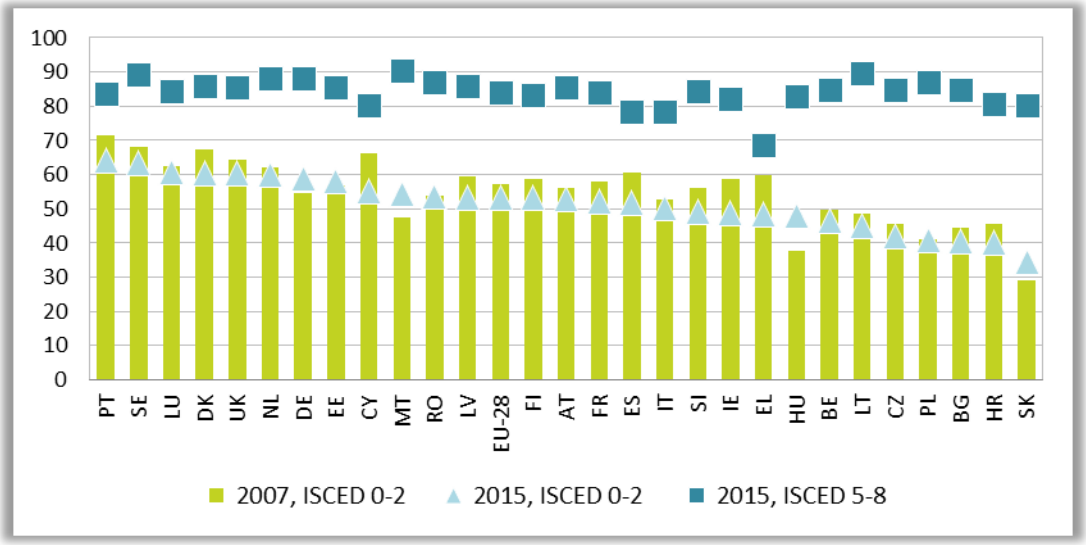
During the crisis employment rates of tertiary educated adults also fell considerably in some Member States, including Ireland, Greece, Spain and Cyprus. In contrast employment rates for this group increased by about three percentage points in Germany, Hungary, Malta and Poland.

Analysis by gender confirms the importance of education in influencing the labour market attachment of females (Goldin and Olivetti, 2013). Highly educated females tend to remain in employment even after childbirth (Goldin, 2006), so the gap in employment rate by education is much larger among women than among men. The gap in employment rates between those with low qualifications and the highly educated is higher for females than males in all Member states except for Slovenia. Female gaps by education range from 57.3 percentage points (Malta) to 25.3 percentage points (Portugal); for men the differences range from 48.4 percentage points (Slovakia) to 12.9 percentage points (Greece).

The impact of education on employment outcomes is much greater for older adults (Figure 14), though the low-educated young are particularly disadvantaged compared to low-educated adults aged 30 to 49. Low participation in employment

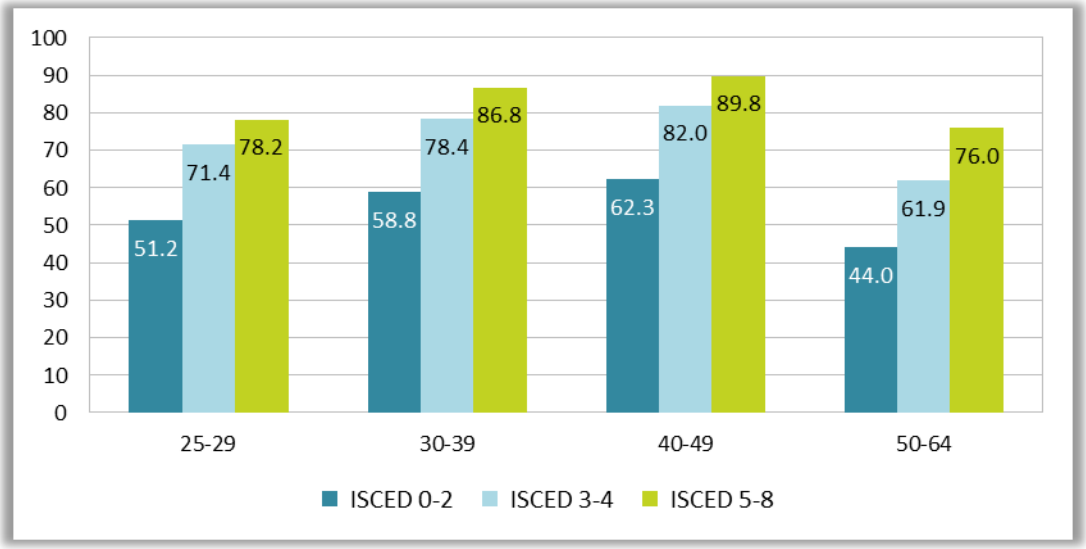
is a particular concern for low-educated females: only 38.4% of females with low qualifications aged 25 to 29 are employed, compared to 76.4% of females with tertiary qualifications.

Figure 13. **Employment rate of adults with low qualifications (25 to 64 years old), 2007-15 versus employment rate of adults with high qualifications in 2015**



Source: Eurostat, EU-LFS, lfsa_ergaed (employment rates by sex, age and highest level of education attained).

Figure 14. **Employment rate by educational attainment and age (25 to 64), 2013**



Source: Cedefop elaboration on Eurostat EU-LFS, microdata 2013 (latest year available for microdata).

2.1.3. Low-skilled jobs and associated working conditions

According to economic theory, there is a bidirectional association between human capital and occupation held. On the one hand, the worker's skill and education levels influence their probability of being employed in a high or low-skilled occupation. On the other hand, the job's characteristics, in particular work experience and on-the-job training, may provide opportunities for maintaining and developing cognitive skills in the case of high-skilled occupations, or contribute to their obsolescence in the case of low-skilled occupations.

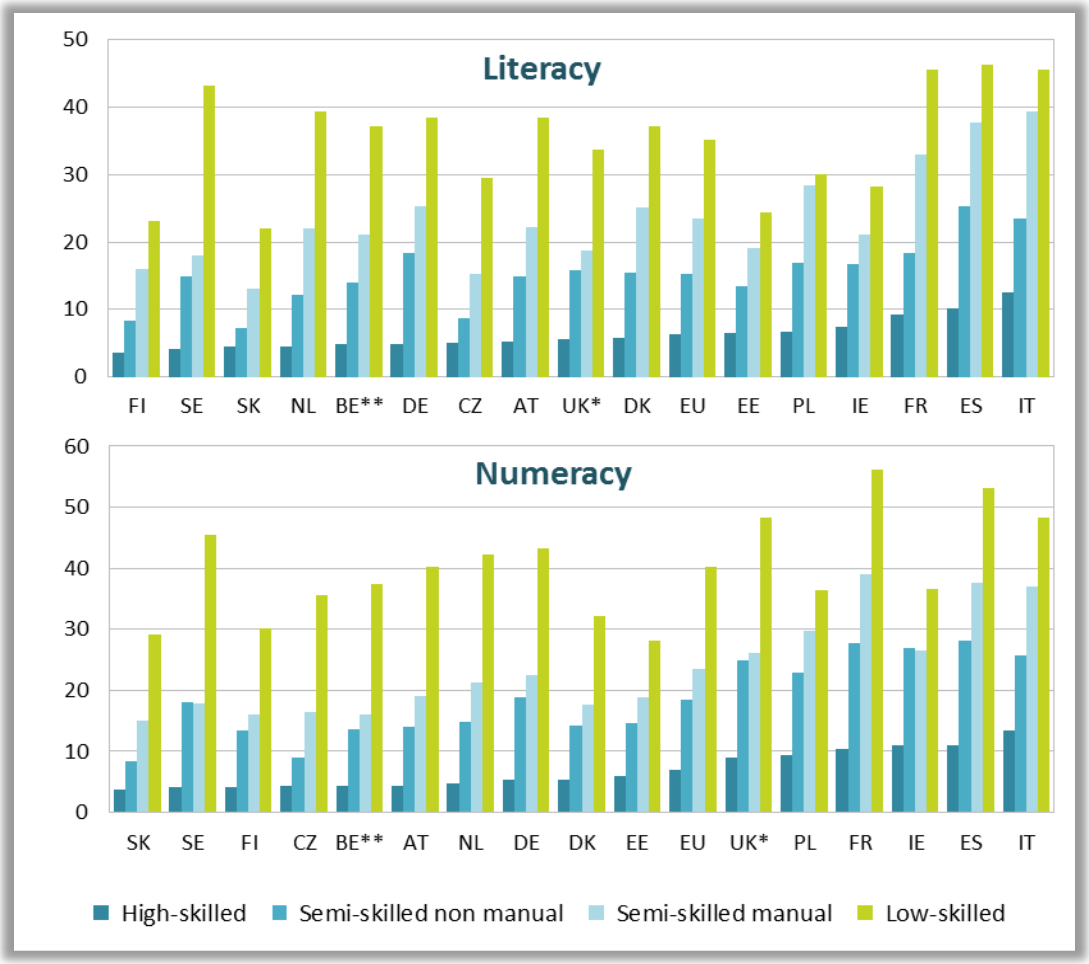
Looking at the distribution of workers by education and sector of employment ([19]) it is not surprising to observe a higher share of workers with low levels of education in agricultural activities (10% compared to 3.3% for those with intermediate to high levels of education) and industrial economic activities (29.4% compared to 23.8%), especially for men and the youngest adults. Also PIAAC data confirm that proficiency in literacy, numeracy and problem solving is strongly associated with the occupation held (OECD, 2013a). As shown in Figure 15, the incidence of low scores for both literacy and numeracy among workers employed in low-skilled occupations is very high in many Member States surveyed. On average, 35% of workers in low-skilled occupations possess low skills in literacy and 40% in numeracy. Low proficiency in literacy and numeracy is also high in semi-skilled manual occupations, particularly in Spain, France and Italy, where more than 30% of workers have low scores on cognitive skills.

Low-skilled workers and workers employed in low-skilled occupations tend to experience more precarious employment relations and poorer working conditions than their higher skilled peers. As shown in Figure 16, workers with low levels of education are more likely to be self-employed than those with medium or high levels of education. Self-employment, which can be seen as a measure of potential entrepreneurships, is not necessarily a good indicator when associated with low-educated men and older workers. Adults with low educational attainment are also more likely to be employed under a temporary contract (11.5% versus 8.4% of

([19]) We have grouped the Nace Rev.2 one-digit sections in four major categories. The breakdown by economic activity is based on the classification in NACE Rev.2 with the following interpretations: NACE section A, agriculture; sections B to F, industry (including construction); sections G to N, market services; and sections O to U, non-market services (including public administration, education, healthcare, arts and entertainment and others). For details see Eurostat, *Ramon, reference and management of nomenclatura: metadata: Statistical classification of economic activities in the European Community, Rev. 2 (2008):* http://ec.europa.eu/eurostat/ramon/nomenclatures/index.cfm?TargetUrl=LST_NOM_DTL&StrNom=NACE_REV2&StrLanguageCode=EN&IntPcKey=&StrLayoutCode=HIERARCHIC&IntCurrentPage=1 [accessed 3.3.2017].

those with intermediate and high levels of education). This is of particular concern for the younger segment of the adult population: 15.9% of those aged 25 to 44 years old with only low education hold a temporary contract compared to only 8.4% of those aged 45 to 64 years. Analysis of European working conditions surveys (EWCS) data also shows that workers in low-skilled occupations face more job instability and more uncertainty about the possibility of finding another job if dismissed than workers in high-skilled occupations, and they experienced fewer change in wages and hours worked between 2009 and 2010.

Figure 15. **Share of adult workers (25 to 65) with low skills in literacy and numeracy by occupational category***, 2012**



* UK (England and Northern Ireland).

** Belgium (Flanders).

*** Low skills in literacy: below level 2 (i.e. scores to less than 226 points). Highly skilled: managers; professionals, technicians and associate professionals (ISCO-08 groups 1-3); semi-skilled non-manual: clerical support workers; service and sales workers (ISCO-08 groups 4-5); semi-skilled manual: skilled agricultural, forestry and fishery workers; craft and related trades workers; plant and machine operators, and assemblers (ISCO-08 groups 6-8); low-skilled: elementary occupations (ISCO-08 group 9).

Source: Cedefop calculations on PIAAC (2012).

Semi-skilled manual occupations concentrated in the manufacturing and construction sectors were the most negatively affected by the financial crisis, with a higher percentage experiencing wage reduction relative to hours worked. Occupations with different skills intensity illustrate clear differences in the composition of earnings: workers in low-skilled jobs are less likely to benefit from extra payments, fringe benefits and performance-related schemes, while workers in semi-skilled manual occupations receive several types of extra payment: overtime (48%); extra pay for working on Sundays (18%); extra compensation for dangerous working conditions (14%); and piece-rate pay or productivity payment (19%). Consequently, low-skilled workers are the least satisfied with their pay and career prospects.

2.1.4. Low-skilled adult participation in formal and informal training

Adult learning is a key component of the European lifelong learning policy. One of the *Education and training 2020* (ET 2020) strategy's key benchmarks is that by 2020, 15% of adults (25 to 64) should participate in lifelong learning across the EU ([20]).

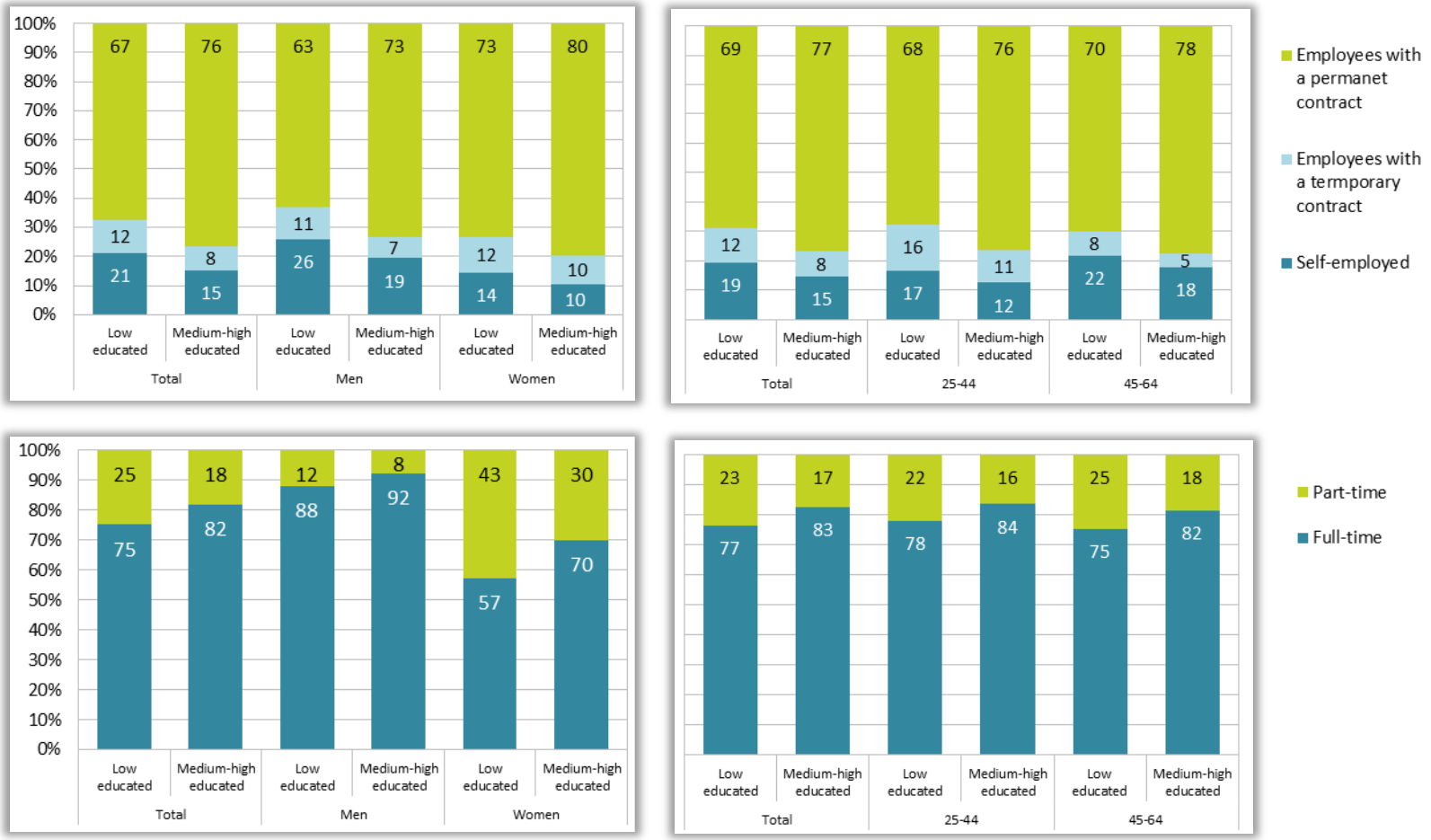
However, empirical evidence on participation in lifelong learning in European countries shows that in 2014 only six Member States had reached the ET 2020 target ([21]) and that people most in need of education, training and upskilling, are less likely to participate in learning activities. Older people participate less frequently than young people; the unemployed receive less training than the employed; and low-skilled individuals participate less frequently than their highly skilled counterparts (Roosma and Saar, 2012). Eurostat's adult education survey provides evidence about unequal participation in learning activities and reveals strong disparities in the participation rates of different categories of adults in lifelong learning.

According to socioeconomic literature various factors affect participation in education and training, including educational attainment, employment status, occupational category and age. Education level is widely acknowledged as an important predictor for participation in learning activities (e.g. Boeren et al., 2010; Gvaramadze, 2010; Fritsche, 2012; Jones et al., 2008) with participation three times higher for adults with tertiary attainment compared to those with only lower-secondary education.

([20]) European Commission: Education and training: *Strategic framework – Education and training 2020.* http://ec.europa.eu/education/policy/strategic-framework/index_en.htm [accessed 3.3.2017].

([21]) The EU-LFS is the data source for the EU benchmark indicator on adult participation in lifelong learning.

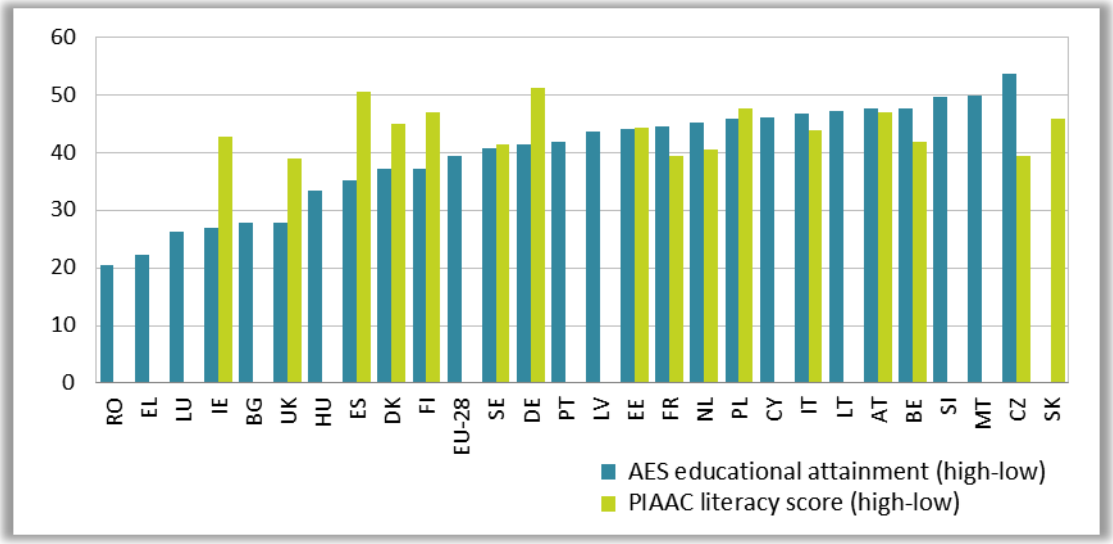
Figure 16. **Share of low-educated adult workers by type of employment in EU-28, 2013**



Source: Cedefop elaboration on Eurostat EU-LFS, microdata 2013 (latest year available for microdata).

Figure 17 shows the difference in lifelong learning participation rates for highly educated/highly skilled adults and poorly educated/low-skilled adults in Member States, according to Eurostat's adult education survey and OECD PIAAC data. Adults with low education and/or low basic skills are less likely to take part in education and training compared to those who have higher education and/or skill levels. For Member States for which PIAAC data are available, gaps in participation by skill are similar to those registered by education level. There are, however, wide differences across Member States in lifelong learning participation rates between low-skilled/educated and highly skilled/educated adults.

Figure 17. **Gap in participation rates of adults in lifelong learning by educational attainment (2011), literacy score (2012), and country**



NB: Difference in percentage points between participation rates in formal or non-formal education and training in the past 12 months of adults (25-64) with tertiary education (ISCED 5-8) compared to those with lower than secondary education (ISCED 0-2,).

Difference in percentage points between participation rates in formal or non-formal education and training in the past 12 months of adults (25-65) with high proficiency scores in literacy (levels 4 and 5) compared to those with low proficiency scores in literacy (below level 1 and level 1).

Source: Cedefop analysis of Eurostat metadata, adult education survey (2011) and PIAAC (2012).

The lower participation of low-qualified employees in training and education can be explained by a combination of worker attitudes toward training and the few training opportunities offered by employers to low-qualified employees (Kyndt et al., 2013). Although adults with low levels of educational attainment are usually employed in occupations which do not require special skills to perform their jobs (Calero and Escardíbul, 2014), lack of self-confidence and negative attitudes of low-qualified workers towards training and education might be a major barrier to

participating in educational activities (e.g. Hillage et al., 2000; Illeris, 2006; cited in Kyndt et al., 2013). According to Kyndt et al. (2013) there is evidence, albeit not conclusive ([22]), that low-qualified employees differ significantly in learning intentions by sex and age, with female workers having higher learning intentions than male workers and middle-aged workers (aged 36 to 45) having a much higher intention to participate in educational activities than other age groups ([23])

2.2. Institutions and policies addressing the low-skilled

Trends in low skills among adults vary substantially across Member States. Recently, consensus has emerged in literature on the importance of different institutional settings and policies in explaining these national differences (e.g. Gesthuizen et al., 2011; OECD, 2014; Rovny, 2014; Oesch, 2010).

Two sets of policy approaches consistently emerge from empirical literature aimed at exploring ways to improve the labour market conditions of the low-skilled:

(a) remedial measures targeted at the current stock of low-skilled adults;
(b) preventive measures targeted at young school dropouts, NEETs and disadvantaged groups (Cedefop, 2016; OECD, 2014).

Remedial measures/policies include specific training and lifelong learning measures to improve low-educated workers' skill acquisition and maintenance. There are also those active labour market policies (ALMPs) targeted at low-skilled adults, especially job search services and hiring subsidies aimed at reducing the duration of unemployment or inactivity spells to avoid skill obsolescence.

Preventive policies include programmes aimed at skills upgrading, career counselling, information, advice and guidance (IAG), sustained investment in education and childcare ([24]) and specific measures targeted at potential early

([22]) Hazelzet et al. (2009, cited in Kyndt et al., 2013), using a different sample of low-qualified employees, did not find a significant correlation between any variables and learning intention in their sample of low-qualified employees.

([23]) These results are, however, not confirmed by Hazelzet et al. (2009, cited in Kyndt et al., 2013). Hazelzet et al. used for their analysis a different sample of low-qualified employees.

([24]) The European Commission (2013a) launched the social investment package (SIP), aiming to redirect Member states' policies toward social investments (through country-specific recommendations). With the support of European Social Funds, the SIP provides guidance to improve skills formation, development and use, with particular attention to children and young people. (See also European Commission, 2013b).

school leavers (e.g. Cedefop, 2016). Measures supporting work-life balance, such as the provision of affordable care services, flexible working time arrangements and parental leave, as well as tax regimes ([25]) which do not discourage labour market participation among second earners in households are also important in supporting labour market participation and continuity of employment among females, favouring skill acquisition and preservation (Jaumotte, 2003).To shed light on the relationships between institutional settings and the incidence of adults with low levels of education and skills, we performed a cluster analysis (Table 3) to:

(a) identify similar groups of Member States according to the policy mix adopted in areas we expect to affect the volume and trends in volumes of low-qualified adults;
(b) analyse how each cluster performs in terms of differences in employment rates and risk of poverty by skill level comparing the low and high-skilled.

Box 3. **Cluster analysis: aims and methodological approach**

The analysis is based on an original dataset of policy indicators for 27 Member States over the 2003-13 period (*).

To cluster EU Member States we considered the 2003-07 pre-crisis period average for the following policy indicators:

- labour market policies (LMP) expenditure, distinguishing between active and passive measures as a % of GDP;
- education system in terms of (i) public expenditure in education as a % of GDP and (ii) adult lifelong learning measured as the participation rate of 25 to 64 year-old people in formal and non-formal education and training in the last four weeks;
- market regulation of both product and labour markets, including through union activity – as representation may be higher for low-skilled adults - and minimum wages;
- taxation on second earners in households, since empirical literature has shown that this is a key factor in deciding whether to participate in the labour market;
- work-life balance policies in terms of (i) public expenditure in maternity and paternity leave as a % of GDP, and (ii) formal childcare availability rate for children aged up to two years.

We used a hierarchical cluster technique, with the method of complete linkage, also known as 'farthest neighbour clustering', which tends to find compact clusters of approximately equal diameters.

(*) The main sources of data are Eurostat and OECD. See Table A3 in Annex 2 for further details. As data for Croatia are not available for most of the policy indicators considered, Croatia was not included in this analysis.

([25]) Especially fiscal policies for secondary earners (European Commission, 2015).

Table 3. **Policy approaches by clusters of countries, unweighted average values of the indicators for each cluster, 2003-07 and 2012-13**

	Remedial policy approach		Liberal policy approach		Preventive policy approach		Regulatory policy approach and less intensive investment in education and training		Mixed policy approach		Unweighted 27 Member States average	
	BE DE FR LU NL AT PT		IE SI UK		DK FI SE		EL ES CY IT MT PL		BG CZ EE LV LT HU RO SK			
	2003-07	2012-13	2003-07	2012-13	2003-07	2012-13	2003-07	2012-13	2003-07	2012-13	2003-07	2012-13
LMP Expenditure (% GDP)												
Training	0.23	0.23	0.10	0.15	0.35	0.35	0.09	0.08	0.04	0.04	0.14	0.14
Employment incentives	0.13	0.12	0.03	0.04	0.29	0.40	0.11	0.15	0.04	0.05	0.11	0.13
Supported employment/rehabilitation	0.12	0.11	0.01	0.01	0.28	0.33	0.04	0.05	0.02	0.04	0.08	0.09
Direct job creation	0.15	0.08	0.09	0.11	0.04	0.04	0.02	0.02	0.06	0.09	0.08	0.07
Start-up incentives	0.02	0.02	0.00	0.02	0.02	0.02	0.03	0.04	0.01	0.01	0.02	0.02
Income maintenance support	1.54	1.43	0.47	1.26	1.73	1.27	0.70	1.09	0.26	0.33	0.88	0.99
Education system												
Expenditure on education	5.13	5.43	5.19	5.94	7.11	7.44	5.10	5.66	4.56	4.43	5.18	5.47
Lifelong learning	8.75	11.63	15.96	12.08	22.68	27.87	5.63	6.54	4.45	5.53	9.13	10.55
Markets regulation												
Product market regulation	1.72	1.35	1.39	1.45	1.49	1.39	1.89	1.39	1.62	1.11	1.67	1.30
Employment protection legislation (regular)	2.69	2.55	1.50	1.63	2.30	2.32	2.63	2.24	2.24	2.16	2.37	2.24
Employment protection legislation (temporary)	2.13	2.13	0.70	0.89	1.46	1.25	2.68	2.19	1.05	1.38	1.70	1.69
Unions density	28.28	25.68	33.03	29.19	72.54	68.83	34.91	31.31	19.81	17.04	32.69	29.56
Unions coverage	83.56	82.90	58.17	55.13	88.66	88.50	61.89	59.84	34.46	25.55	61.94	58.32
Minimum wage	0.50	0.52	0.49	0.52	0.47	0.49	0.45	0.47	0.43	0.46	0.46	0.49
Taxation on second earner												
	0.36	0.36	0.26	0.25	0.34	0.30	0.21	0.20	0.25	0.28	0.28	0.28
Work life balance policies												
Parental leave (% GDP)	0.26	0.26	0.26	0.43	0.62	0.67	0.17	0.20	0.59	0.80	0.38	0.47
Formal childcare (0-2 years)	27.43	36.43	27.00	32.17	48.56	49.17	17.67	20.42	9.50	10.88	22.25	26.24

Source: Cedefop analysis on Eurostat, OECD and ICTWSS data. Full details on methodological approach and data used can be found in Annex 2 Table A3.

As shown in Figure 18, five country clusters were identified ([26]) by policy mix, consistent with those of the traditional welfare system classification:

(a) countries characterised by a remedial policy approach (Belgium, Germany, France, Luxembourg, the Netherlands, Austria and Portugal), with high levels of LMP expenditure, particularly in training, direct job creation and income maintenance support relative to the EU average. This cluster is also characterised by high levels of product and labour market regulation. Work-life balance policies are also substantial and increasing;

(b) countries characterised by a liberal policy approach (Ireland, Slovenia and the UK) with the lowest level for all market regulation indicators, and a high level of adult participation in lifelong learning (16% compared to 9.1% of European average), while expenditure on education is in line with the EU average. LMP expenditure is lower than the EU average except for direct job creation despite growth in the period from 2012-13, especially for training, direct job creation and income maintenance;

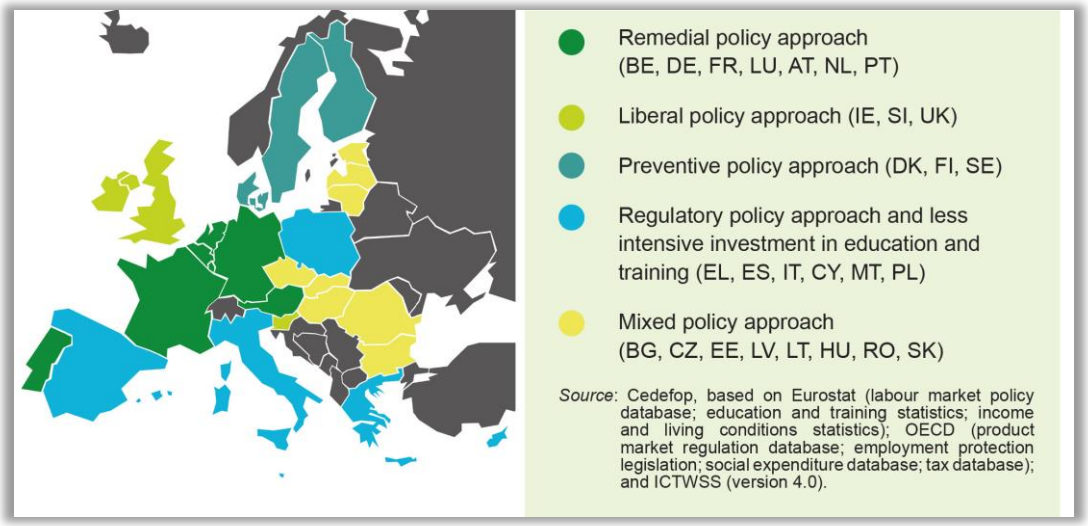
(c) countries characterised by a preventive policy approach (Denmark, Finland and Sweden), with high support for education and work-life balance: all these indicators show the highest values relative to other clusters. Expenditure on LMP, both active and passive, is also above the EU average. Market regulation indicators are consistent with the EU average, while the degree of union coverage and density is the highest in Europe;

(d) countries characterised by a regulatory policy approach and less intensive investment in education and training (Greece, Spain, Italy, Cyprus, Malta and Poland), with the highest levels of product market and employment regulation. Expenditure on labour market policies, both active and passive, and on education and training are lower than the EU average (particularly for training), as are use of work-life balance policies and adult participation in lifelong learning. High increases in unemployment have pushed up expenditure in income support during the recent financial crisis;

(e) countries characterised by a mixed policy approach (Bulgaria, Czech Republic, Estonia, Hungary, Lithuania, Latvia, Romania and Slovakia), with the lowest level of expenditure on ALMP, education, formal childcare and income support, even though this increased in the 2012-13 period due to the high rise in unemployment. Levels of market and employment regulation are consistent with the EU average, while union coverage and density are the lowest in the EU.

([26]) A range of solutions were processed and analysed (from 3 to 8 clusters).

Figure 18. **European Member States by cluster**

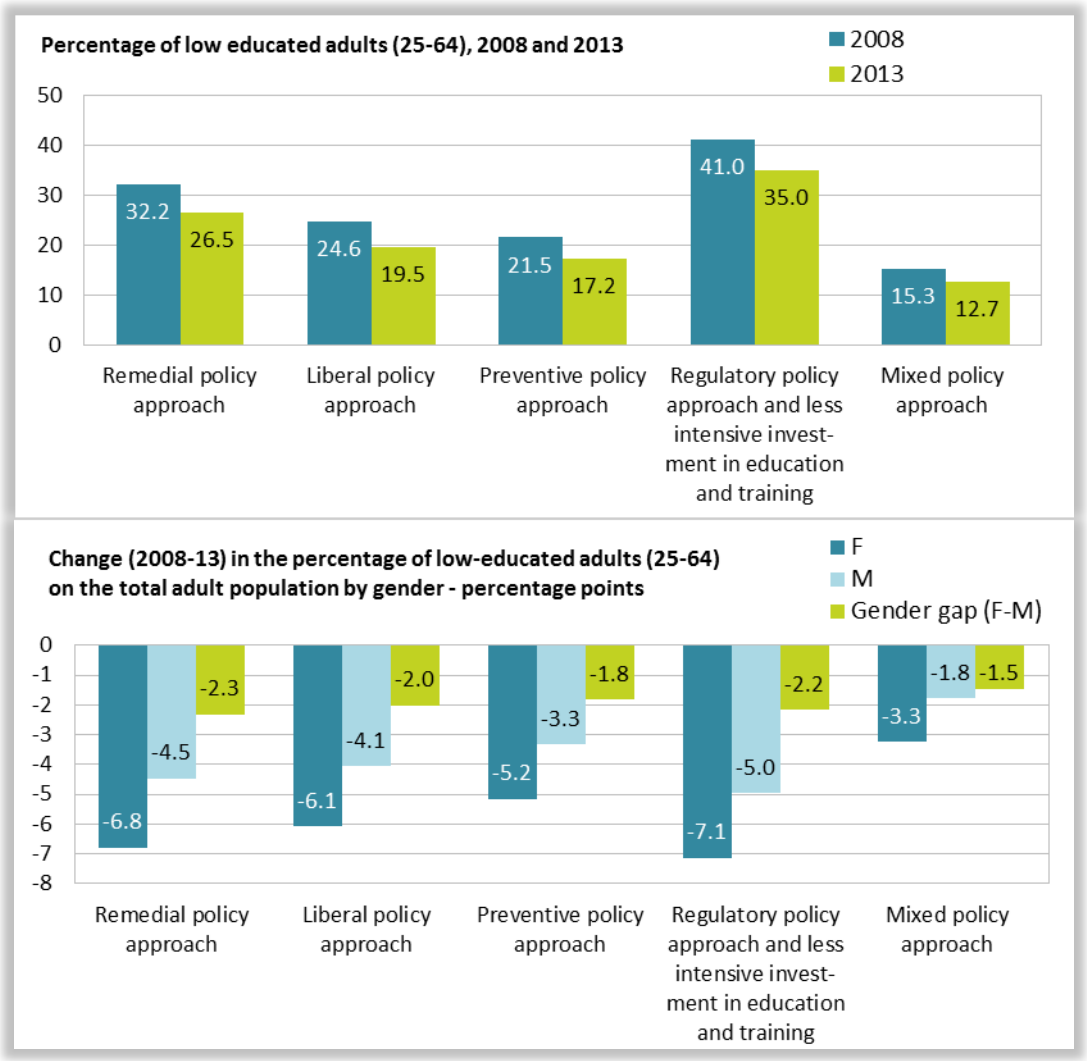


Available data do not show significant changes in the clusters' policy mix between the pre-financial crisis period of 2003-07 and post-financial crisis period of 2012-13; the exception is the increase in passive labour market measures, especially in the liberal policy approach cluster, due to the sharp increase in unemployment. The policy indicators also register a significant increase in formal childcare expenditure in all the clusters identified.

Results from the cluster analysis (Figure 19) show that in 2013 the highest incidence of low-educated adults (35%) was found in the cluster characterised by a regulatory policy approach and lower levels of investment in education and training. Conversely, the lowest rates are reported in the preventive policy approach cluster (17.2%) and in the mixed policy approach cluster (12.7%) ([27]). The volume of people with low levels of education has been decreasing since 2008 in all clusters for both males and females; however, there is a higher reduction in the incidence of low-education in the total adult female population, especially in the regulatory (-7.1 percentage points) and the remedial (-6.8 percentage points) policy approach clusters. These clusters are, nonetheless, characterised by a particularly high proportion of low-educated females.

([27]) This is probably due to the strong investment in education before the transition to market economy. Until 1970, expenditures on education in transition economies were much larger than in OECD countries and the rest of the world; real public education expenditure for students in secondary school was increasing until 1980 when it started to fall and did not recover. In transition economies the rates of grade repetition and school dropout both in primary and secondary education are small (Beirne and Campos, 2006).

Figure 19. **Proportion of adults with low levels of education by cluster and percentage change by gender, 2008-13 (%)**

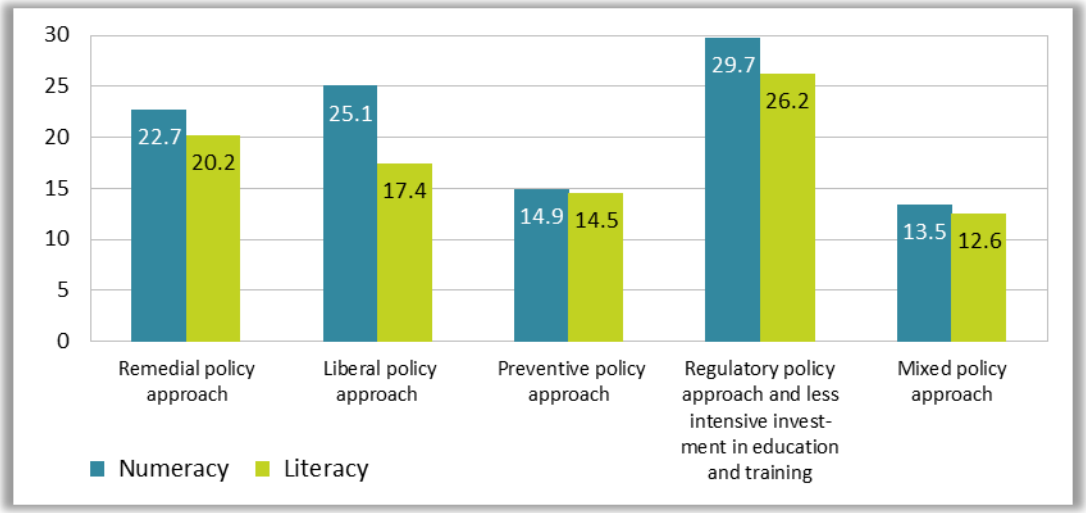


NB: Remedial policy approach: BE, DE, FR, LU, NL, AT and PT; liberal policy approach: IE, SI and the UK ; preventive policy approach: DK, SE, FI; regulatory policy approach and less intensive investment in education and training: EL, ES, IT, CY, MT, PL; mixed policy approach: BG, CZ, EE, LV, LT, HU, RO, SK.

Source: Cedefop analysis of LFS data.

Similar trends result from analysis of cognitive skill data (Figure 20). Preventive and mixed policy approach clusters report the lowest incidence of adults with low numeracy and literacy skills. Conversely the highest share of adults with low cognitive skills is reported in the regulatory policy approach and less intensive investment in education and training cluster. In all five clusters there are more low-skilled in numeracy than in literacy. This gap is particularly high in the liberal policy approach cluster (7.7 percentage points).

Figure 20. **Low-skilled adults (25 to 65) among the total adult population by type of cognitive skill and cluster (%)**



NB: Remedial policy approach: BE, DE, FR, LU, NL, AT and PT; liberal policy approach: IE, SI and the UK Preventive policy approach: DK, SE, FI; regulatory policy approach and less intensive investment in education and training: EL, ES, IT, CY, MT, PL; mixed policy approach: BG, CZ, EE, LV, LT, HU, RO, SK.

Source: Cedefop analysis of PIAAC data.

Figure 21 presents the employment indicator associated with each cluster. Adults with low levels of education have lower employment rates in all clusters compared to those who are highly educated but there are differences across clusters.

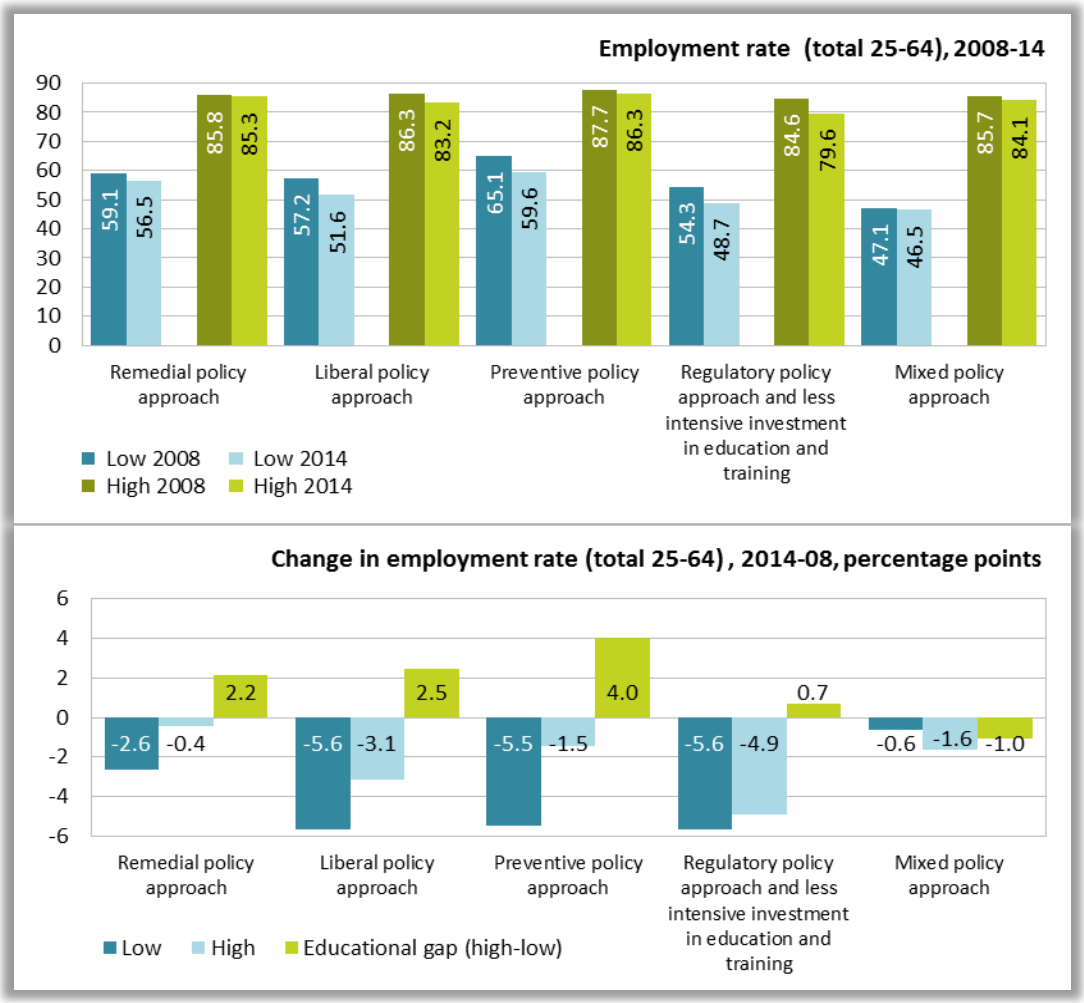
Countries adopting a preventive policy approach generally perform better than the others: employment rates are high across all qualifications. In contrast, the lowest employment rate for adults with low levels of education are reported in the mixed policy approach cluster (the gap with tertiary educated adults stands at over 38 percentage points) and in countries adopting a regulatory policy approach and less intensive investment in education and training (employment gap between adults with low levels of education and those who are highly educated of around 30 percentage points).

Education affects employment rates more strongly for females than males in all clusters. The employment gap between males with high and low levels of education is under 20 percentage points in all clusters except for countries in transition; for females, employment gaps between those with low and high levels of education are over 30 percentage points in all clusters, except in the preventive policy approach cluster. Skill gaps are particularly marked in the regulatory and the mixed policy approach cluster.

During the recession, employment for people with low qualifications dropped in all but the mixed policy approach cluster. However, in the regulatory approach

and less investment in education and training cluster the highly educated have also been considerably affected. Further, during the crisis no significant gender differences in employment rates were observed; one exception was the regulatory and mixed policy approach clusters, where the employment rate of highly educated females declined more than that of the low-educated ones.

Figure 21. **Employment rates for adults with low and high levels of education and change in percentage points by cluster, 2008-14**



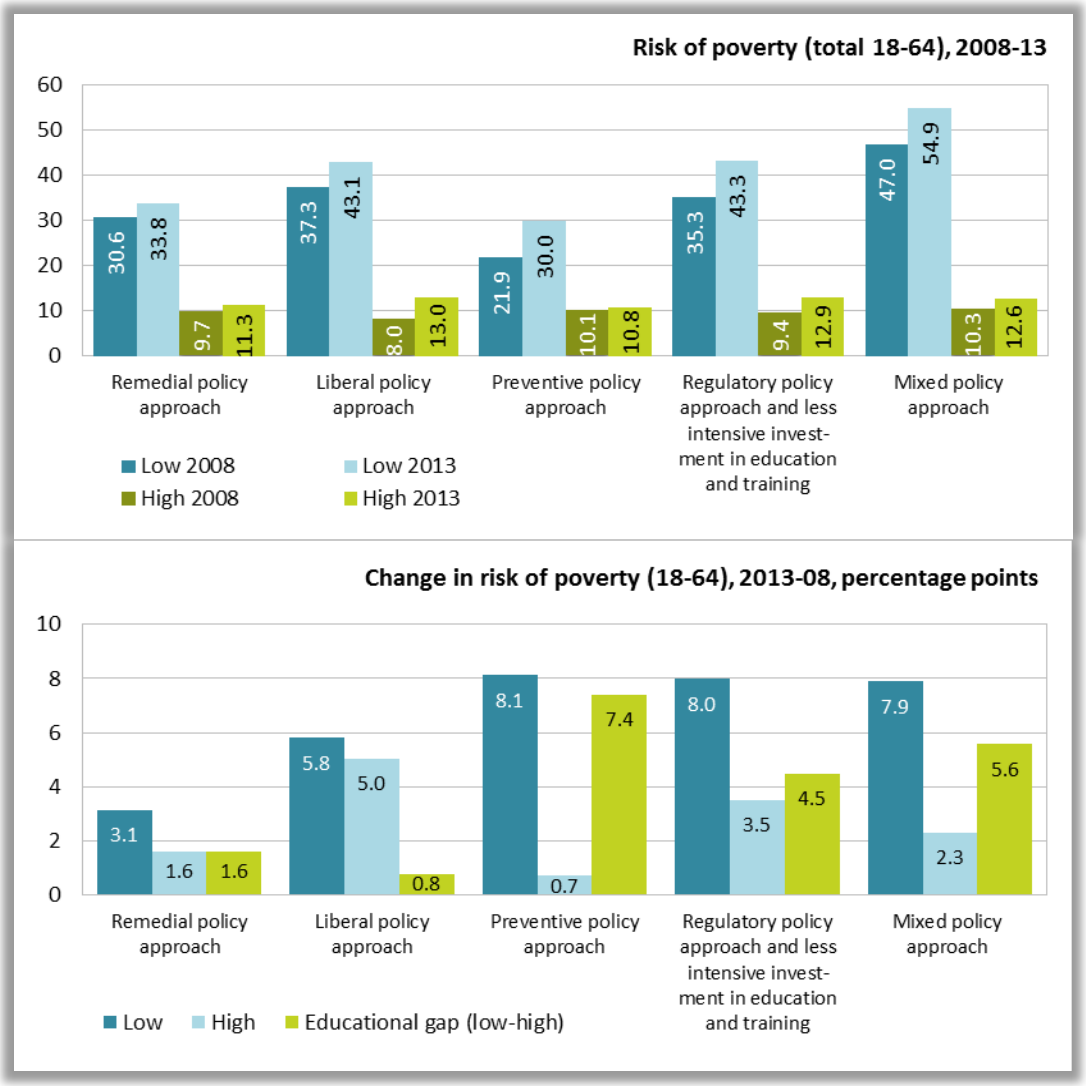
NB: Remedial policy approach: BE, DE, FR, LU, NL, AT and PT; liberal policy approach: IE, SI and the UK
Preventive policy approach: DK, SE, FI; regulatory policy approach and less intensive investment in education and training: EL, ES, IT, CY, MT, PL; mixed policy approach: BG, CZ, EE, LV, LT, HU, RO, SK.

Source: Cedefop analysis of LFS data.

The adverse labour market conditions have also affected the risk of poverty, with a growing share of adults at risk of poverty compared to levels before the financial crisis, across all educational attainment levels (Figure 22). While policy mix does not affect the risk of poverty for the highly educated (around 10% in all

clusters), the poverty risk for adults with low levels of education is particularly high in countries with a liberal or mixed policy approach, and comparatively low in the preventive policy approach cluster. In all clusters the risk of poverty increased more for people with low levels of education than the highly educated, with a worsening of the gap by education level more evident in the preventive, and regulatory, and mixed policy approach clusters. Also, in the liberal policy approach cluster the change in the risk of poverty increased considerably for both the low- and the highly educated.

Figure 22. **Risk of poverty for adults with low and high levels of education and change in percentage points by cluster, 2008-14**



NB: Remedial policy approach: BE, DE, FR, LU, NL, AT and PT; liberal policy approach: IE, SI and the UK; preventive policy approach: DK, SE, FI; regulatory policy approach and less intensive investment in education and training: EL, ES, IT, CY, MT, PL; mixed policy approach: BG, CZ, EE, LV, LT, HU, RO, SK.

Source: Cedefop analysis of EUSILC data.

Cluster analysis may suggest that the preventive policy mix helps not only preventing a high share of low-skilled adults, but also supporting labour market participation and living conditions of low-skilled adults. However, while this cluster reports the lowest share of those low-educated at risk of poverty (30%), the dramatic increase observed during the crisis (+9%), is of particular concern.

Countries in the regulatory and mixed policy approach clusters display similar negative patterns in the labour market and living conditions of the low-skilled adult population, although the incidence of the low-skilled population across these clusters is very different. In both clusters, which display low levels of expenditure in ALMP, the low-skilled population represent a vulnerable segment of the adult population: on the one hand, skills gaps in employment rates are high and employment rates for adults with low qualifications are the lowest; on the other hand, low-skilled adults are also at a high risk of poverty with increasing rates since the onset of the crisis.

Analysis also suggests that high levels of LMP expenditure observed in the remedial policy approach cluster may counteract the negative effects of being low-skilled. Despite a higher than EU average incidence of low-educated adults (26.5%), this cluster displays the second highest employment rate for low-educated adults and the lowest poverty rate (33.8%). These rates have increased relatively little with the crisis (+3%). Countries in the liberal policy approach cluster, with their high level of adult participation in lifelong learning but lower than EU average LMP expenditure, generally display low rates of adults with low qualifications, but a substantial share of adults who are low-skilled in numeracy (25.1%). Since the crisis started, the share of those at risk of poverty increased sharply not only among the low-educated but also among those with higher qualifications.

2.3. Future demand and supply scenarios for low-skilled adults

This section uses data provided by Cedefop's labour force and skills forecast 2015 ([28]). Baseline projections are provided using current economic and demographic trends along with projected changes in macroeconomic circumstances. The underlying assumption ([29]) in the baseline forecast model is

([28]) Year 2015 values represent forecasts (i.e. not historical values) for consistency and comparability reasons with the 2020 and 2025 values.

([29]) Model assumptions are based on DG ECFIN's GDP growth projections from November 2014.

for the EU-28 to achieve, on average, a modest economic recovery following the recession of recent years; average GDP growth will be about 2% a year between 2015 and 2025, although with significant variation between individual countries (Cedefop, 2015).

Table 4. **Population by qualification level, aged 25 to 64, EU-28, 2015-25**

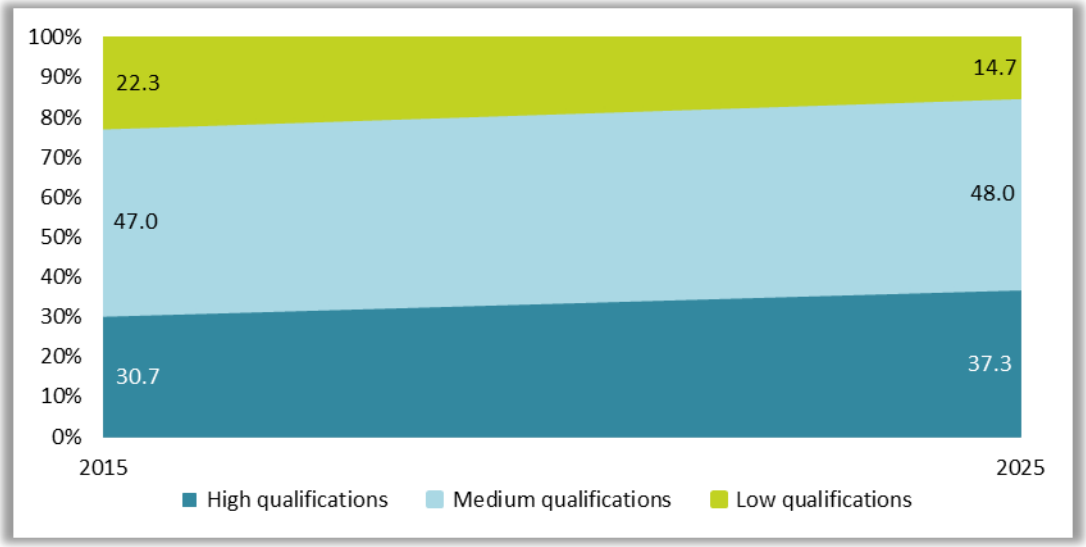
Level of qualifications	2015		2025		
	Population (million)	% of the EU-28	Population (million)	(million)	% of the EU-28
High	84.9	30.7	100.1	100.1	37.3
Medium	129.8	47.0	128.6	128.6	48.0
Low	61.7	22.3	39.5	39.5	14.7
EU-28 total	276.4	100.0	268.2	268.2	100.0

Source: Cedefop, skills forecasts, 2015 database and own elaborations.

2.3.1. Low-skilled adults

The skills profile of the EU-28 population aged 25 to 64 is anticipated to upgrade by 2025 (Table 4). The Cedefop forecast shows that during this period there will be a significant reduction in the share of the EU-28 total population aged 25 to 64 holding low qualifications to 14.7%, while the share of adults with high-level qualifications will further increase to reach 37.3% of the total, and adults with medium-level qualifications will broadly remain stable (Figure 23).

Figure 23. **Projections of population aged 25 to 64 by qualification level, 2015-25**



Source: Cedefop, skills forecasts, 2015 database and own elaborations.

The number of adults aged 25 to 64 with low qualifications, is projected to fall by about 22 million (-36%) between 2015 and 2025, while the total adult population is projected to decrease only slightly (-3%) (Table 5).

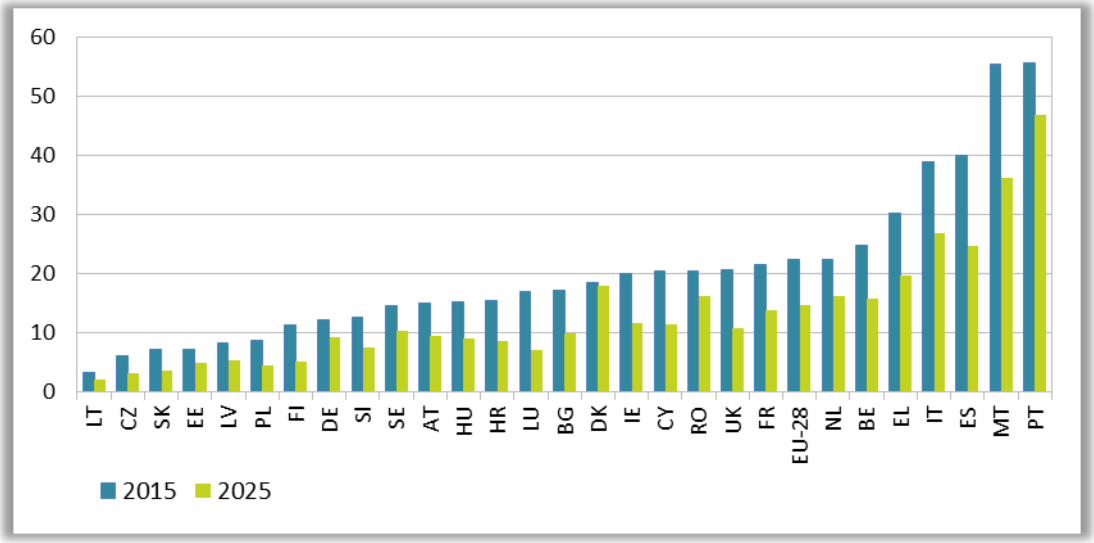
Table 5. **Change in population aged 25 to 64, EU-28, 2015-25**

Level of qualifications	2015	2025	Change	
	Population (million)			%
High	84.9	100.1	15.2	17.9
Medium	129.8	128.6	-1.2	-0.9
Low	61.7	39.5	-22.2	-36.0
EU-28 total	276.4	268.2	-8.3	-3.0

Source: Cedefop, Skills forecasts, 2015 database and own elaborations.

At country level, while the shares of low-skilled adults are forecast to reduce in all Member States, changes in the expected proportion of low-skilled adults tend to confirm current disparities (Figure 24).

Figure 24. **Share of low-skilled adults aged 25 to 64 by country, 2015-25 (%)**



Source: Cedefop, skills forecasts, 2015 database and own elaborations.

When considering the adult population, the older adult age group 45 to 64 accounts for the greatest proportion of low-qualified. Looking ahead, the current age profile of the low-skilled is expected to change only slightly over the next 10 years.

2.3.2. Low-skilled adults as part of the EU-28 labour force

In line with the trends projected for the total adult population, the number of adults with low qualifications in the labour force ([30]) will decrease from 39.1 million in 2015 (18.1% of the total) to 26.2 million in 2025 (12.2%). The share of adults with medium-level qualifications in the labour force is forecast to remain broadly stable, while highly qualified will reach 40.5% of the total (Table 6).

Table 6. **Labour force aged 25 to 64, EU-28, 2015-25**

Level of qualifications	2015		2020		2025	
	Labour force (million)	*%*	*Labour force (million)*	*%*	*Labour force (million)*	*%*
High	74.0	34.3	81.08	37.4	86.8	40.5
Medium	102.4	47.5	102.87	47.5	101.5	47.3
Low	39.1	18.1	32.73	15.1	26.2	12.2
All levels/EU-28	21.4	100.0	216.67	100.0	214.5	100.0

Source: Cedefop, skills forecasts, 2015 database and own elaborations.

Low-qualified adults in the labour force are projected to fall by 33% between 2015 and 2025, despite a total adult labour force basically stable over the same period (Table 7). Since the share of adults in the labour force with medium-level qualifications will decrease only marginally, a substantial shift of the active population towards high qualifications (+17.4) is expected (Table 7).

Table 7. **Change in labour force aged 25 to 64, EU-28, 2015-25**

	Labour force (million)		*%*
Level of qualifications	2015	2025	Change
High	74.0	86.8	17.4
Medium	102.4	101.5	-0.8
Low	39.1	26.2	-33.0
All levels/EU-28	215.4	214.5	-0.4

Source: Cedefop, Skills forecasts, 2015 database and own elaborations.

([30]) The labour force represents people in the population 25 to 64 who are economically active, i.e. employed and actively seeking jobs. People who are not considered as labour force are those voluntary unemployed (not seeking a job and, even if offered, likely to refuse it), disabled, retired or on parental leave etc. The calculations are based on the demographic forecasts and assumptions on the future development participation (activity) rates by different age groups, genders and countries.

In line with the predicted decline in low-skilled adults as a share of the population, the share of the labour force aged 25 to 64 with low qualifications is also projected to reduce considerably by 2025 across the EU Member States(Table 8).

Table 8. **Proportion of the labour force aged 25 to 64 with low qualifications, EU Member States**

Member States	2015 (%)	2025 (%)
Belgium	17.9	11.5
Bulgaria	12.1	7.4
Czech Republic	4.0	2.1
Denmark	14.7	14.7
Germany	9.7	7.6
Estonia	5.9	4.4
Ireland	15.1	8.6
Greece	26.5	17.8
Spain	35.6	21.6
France	17.0	11.2
Croatia	10.8	6.2
Italy	32.2	22.6
Cyprus	16.8	9.5
Latvia	6.5	4.6
Lithuania	n/a	n/a
Luxembourg	14.0	5.8
Hungary	11.1	7.2
Malta	45.2	29.3
Netherlands	17.7	12.7
Austria	11.2	7.0
Poland	5.6	3.2
Portugal	50.9	41.7
Romania	15.4	13.3
Slovenia	9.2	5.3
Slovakia	4.8	2.7
Finland	8.3	3.7
Sweden	12.1	8.4
UK	16.9	9.8
EU-28	18.1	12.2

Source: Cedefop, skills forecasts, 2015 database and own elaborations.

Chapter 3.
Who are the low-skilled? Characteristics, determinants and risks among EU adults

While future trends in low skills suggest that shares of low-skilled adults will continue to decrease, current trends also indicate how low-skilled people are particularly disadvantaged and vulnerable on the labour market. Against this scenario, effective policy interventions tackling low skills, require a clear understanding of who are the low-skilled and what are the risk factors of becoming low-skilled.

3.1. Characteristics of low-skilled adults: cognitive skills and other factors

The purpose of this section is to investigate, using PIAAC data, the relationship ([31]) of cognitive skills and factors (both skills-related factors, such as formal education and training, and personal characteristics, such as family background and use of skills) which may influence the development of cognitive skills.

Table 9 presents the results of a pooled regression analysis estimating the relationship between numeracy and literacy proficiency scores among adults aged 25 to 65 in the 16 EU Member States surveyed by the PIAAC ([32]) and a set of variables identified by previous studies as affecting skill acquisition: personal characteristics, parental background, educational and training attainment, work experience and spells of unemployment and inactivity (see Annex 3 for details).

Although from this analysis it is not possible to infer causation precisely (Box 4), we provide evidence on the existence of statistically significant correlations which highlight the existence of association or relationship between cognitive skills and the other variables analysed.

([31]) The main purpose of this analysis is to investigate correlations between cognitive skills and formal education or training: analysis of causality is beyond the scope of the present study.

([32]) PIAAC data for Cyprus are not included in this analysis.

Table 9. **Pooled OLS regression on literacy and numeracy scores: coefficient estimates**

	Literacy	Numeracy
Demographic background		
Age 35-44	-1.34***	0.54
Age 45-54	-6.31***	-1.91***
Age 55-65	-11.42***	-6.14***
Female	-2.08***	-11.19***
Foreign-born and foreign-language	-24.31***	-24.80***
Parental background		
Both parents foreign-born	-13.26***	-12.83***
One parent foreign-born	-2.60***	-2.96***
Neither parent has attained upper secondary education	-10.39***	-10.27***
At least one parent has attained secondary and post-secondary, non-tertiary education	-6.40***	-6.44***
Education and training		
Low education	-33.28***	-36.73***
Medium education	-17.79***	-19.26***
No formal or non-formal education and training in the previous 12 months	-4.35***	-3.46***
Computer skills		
No computer experience	0.18	-8.77***
Work experience and unemployment		
Never had paid work including self-employment in past	-14.21***	-20.28***
Unemployed or inactive since maximum 12 months	-5.00***	-7.07***
Unemployed or inactive since at least 12 months but less than five years	-6.46***	-10.29***
Unemployed or inactive since at least five years	-6.37***	-11.62***

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

NB: Least squares regressions analysis controlled also for frequency of use of information processing skills at home (reading, writing and numeracy); number of books at home; perceived general health; country fixed effects. Dependent variables: literacy score and numeracy score.

Sample: Population aged 25-65, excluding retired people, students, permanently disabled people and individuals in compulsory military or community service. The (omitted) reference categories are: aged 25-34; male, good health; male; native born and native language; neither parents are foreign born; both parents having attained at least secondary education; have more than 25 books at home; high level of education attained; having participated into formal or non-formal education or training in the previous 12 months; having computer experience; using frequently writing, reading, and numeracy skills at home (i.e. belonging to the highest quintile of the index of frequency of use of information processing skills at home); in employment; living in Austria.

Source: Our calculation on OECD survey of adult skills (PIAAC) 2012.

As summarised in Figure 25, analysis shows a strong positive relationship between the level of formal education and the level of proficiency in literacy and numeracy: on average, the proficiency score gap between individuals with high education and those with low education is 37 points in numeracy and 33 points in literacy. This is consistent with results found in literature (e.g. Green and Riddell, 2015; Leuven et al., 2010; Banks and Mazzonna, 2012; Carlsson et al., 2012).

Box 4. **Endogeneity and reverse causality among skills factors**

The cross-sectional nature of the PIAAC survey makes it difficult to infer causality due to the fact that both schooling and training (as well as computer experience and use of skills in everyday life) are related to cognitive skills and so are potentially endogenous variables. Unobservable ability may also affect educational and training choices as well as cognitive skills levels. The omitted factors are likely to end up in the error term of the ordinary least squares (OLS) regression and likely to be correlated with the variables of interest (such as schooling, training, use of skills at home). As a result, an endogeneity problem is likely to bias the estimated effects of education and training on the level of cognitive skills.

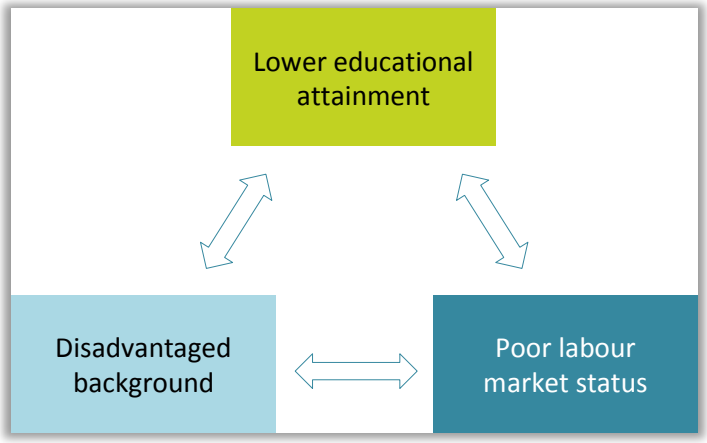
To address such concerns would require a longitudinal dataset or a dataset where ability is known and predetermined with respect to schooling and other skill factors. Another way to handle endogeneity is to use an IV estimator (rather than OLS), as some authors have done when estimating returns on education and skills. For example, Brunello et al. (2009); Hanusek et al. (2013); Cappellari et al. (2015); and Green and Riddell (2015) use compulsory school reforms or time and space variation in compulsory schooling laws to instrument years of schooling. Cappellari et al. (2015, abstract) find that 'most of the endogeneity of skills appears to reflect the endogeneity in education, suggesting that it is the same set of unobservables that favours human capital accumulation in both dimensions'.

Cognitive skills are also associated with work experience and labour market status. People who have never worked show lower levels of cognitive skills: other things being equal, their numeracy score is, on average, 20 points lower than their employed counterparts; data also show that longer unemployment spells are associated with lower levels of cognitive skills. Even controlling for age and level of formal education, people unemployed or inactive for at least five years have average numeracy scores 11.6 points lower than those in employment. The numeracy score of those unemployed or inactive for less than 12 months is, on average, only seven points lower the employed. This analysis shows that unemployment and career interruptions may cause technical skills obsolescence and confirms the results of a meta-analysis from psychological literature on skill decay and retention (Arthur et al., 1998 cited in OECD, 2011).

Analysis also shows a strong relationship between low cognitive skills and disadvantaged background. There is a particularly strong relationship between proficiency in information processing skills and parental background, especially in migrant background, although the strength of the association varies widely across and within countries between different age groups ([33]). For foreign-born

([33]) For example, OECD (2013a) shows that, even when educational attainment and socioeconomic and immigrant background are accounted for, age continues to have a strong relationship to proficiency. There are, however, some country differences,

Figure 25. **Characteristics of adults with low cognitive skills**



Source: Cedefop.

people and non-native language speakers the 24 point reduction in average proficiency score in numeracy and literacy is higher than that between highly educated and medium-educated of 18 and 19 points for literacy and numeracy, respectively ([34]). These results are consistent with findings of a study based on the IAL survey ([35]) which found that, together with age and occupation, speaking a first language other than the one used for testing is a major determinant of performance in literacy (OECD and Statistics Canada, 2000). The education level of parents is also associated with cognitive skills proficiency: individuals whose parents have not obtained an upper secondary education degree score 10 fewer points, on average, in numeracy than those with at least one parent with upper secondary education. Parental background plays an important role in producing both cognitive and non-cognitive skills (Heckman et al., 2006). Several studies have shown that even before pupils start school, there is a large gap in cognitive ability between children from high and low socioeconomic backgrounds. One British study found that

---

even though on average across countries, the association between the parents' educational attainment and cognitive skills proficiency is stronger for the adult population as a whole (16 to 65) than for young people (15 to 24); in the Czech Republic, Denmark, Estonia, Slovakia and the UK (England/Northern Ireland), the relationship is stronger among young people than among the overall adult population (OECD, 2013a).

([34]) The OECD 2013a report shows that the negative relationship between skills and foreign-language background is stronger than that between skills and foreign-born background; second-generation immigrants or persons belonging to a language minority score higher than foreign-language immigrants, and closer to the average score of native-born adults.

([35]) International adult literacy survey, implemented over the period 1994-98.

nearly a fifth of the gap in test scores between the richest and poorest children is explained by an apparent 'direct' link between the childhood cognitive ability of parents and that of their children (Gregg and Goodman, 2010 cited in Blanden and McNally, 2014).

The relationship between cognitive skills and other skills factor variables, such as education and training, use of skills at home, is mostly bidirectional (reverse causality) and mutually reinforcing. For example, the relationship between proficiency in information-processing skills and participation in initial and continuing education and training, as well as engagement in activities such as reading and writing, use of numeracy and the use of ICTs is a two-way relationship.

3.2. Determinants of low skills

To identify what determines low-skilled status among adults, we performed a variance decomposition analysis ([36]) which allows us to assess to what extent the variables considered are able to explain the differences ([37]) in the cognitive skills scores observed among the individuals in the sample.

Results, summarised in Figure 26, show how the level of formal education attained and frequency of use of information processing skills in everyday life (reading, writing, numeracy) explain most of the observed difference in cognitive skills. Both factors present a strict relationship with cognitive skills which is bidirectional and mutually reinforcing (Box 4).

Personal characteristics (gender, age, migrant status and language spoken) and, especially, family background (migrant status, parental education level) are also responsible for a large portion of the difference in cognitive skills scores. These factors show a larger contribution in explaining the variance of literacy than numeracy.

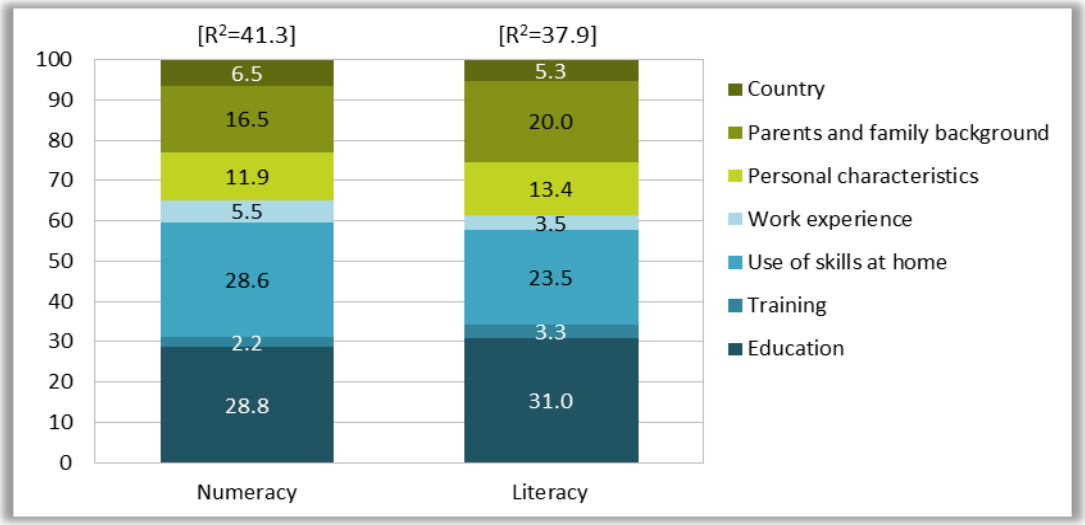
Lack of work experience or long periods of unemployment or inactivity and having participated in training also contribute towards explaining the variance of cognitive skill levels. As accumulation of human capital does not end with school, training is a way to adapt and enhance existing skills. This is especially relevant for older workers, whose skills accumulated at school are likely to be substantially depreciated, and for the less-educated, who run the risk of social (and labour market) exclusion (Bassanini et al., 2005). The low contribution of training

([36]) Similar to OECD (2014), we used the fields regression-based decomposition technique, which performs an exact decomposition of the outcome variable variance into the variance attributable to each explanatory variable and the residual.

([37]) Observed variance, R^2 which reflects how much of the variance (i.e. the difference) observed in the cognitive skill scores can be explained by the variables of the model.

observed in the analysis can be partly explained by the fact that the variable used for measuring training experience refers only to the 12 months before the survey and does not measure the total amount of training accumulated during the life course. Also, measuring the cognitive skills effects on participation (as opposed to non-participation) in training could underestimate the real effect of training, since it does not consider duration, content and other qualitative aspects of training. At the same time, the endogeneity problem discussed above (Box 4) may bias estimates of the effects of training on cognitive skills. According to our results, institutional factors (country fixed effects) explain a small part of the observed variance, with no major difference across age groups (Figure 27).

Figure 26. **Determinants of the variation in numeracy and literacy proficiency scores**



NB: Total variance explained in parenthesis.
Proportion of the explained variance (R^2) in literacy and numeracy explained by each factor (rescaled to 100). Results obtained using Fields (2004) regression-based decomposition technique of Equation 1 estimates (Annex 3).

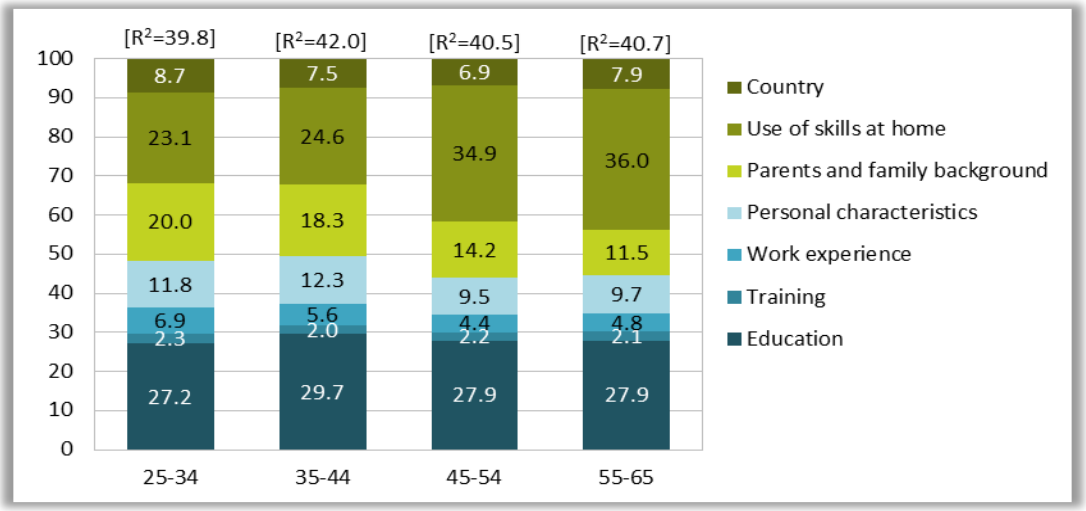
Where: Education: highest level of formal education attained; Training: having undergone formal or non-formal education or training during the 12 months preceding the survey; Use of skills at home: frequency of use of numeracy, reading and writing skills in every-day life; Work-experience: not having had work experience or experiencing short or long periods of no employment. Personal characteristics: gender, age, perceived health, immigrant and language status. Parent and family background: level of educational attainment of parents, immigrant background, number of books at home; Country: fixed effects.

Source: Cedefop calculation on OECD survey of adult skills (PIAAC) 2012.

The results by age group show that the contribution of parental background and of personal characteristics to the observed difference in cognitive skills tends to decrease with age, while the contribution of the set of variables representing the frequency of use of skills at home increases with age. These results are consistent

with other findings from empirical literature analysing survey results on literacy proficiency scores ([38]). For example, Desjardins (2003), in analysing the determinants of literacy using IALS data, finds that education remains the most important predictor of literacy proficiency after accounting for all other factors, and that home background measured by parents' education level is also a strong predictor of literacy proficiency.

Figure 27. **Determinants of the variation in numeracy scores by age group**



NB: Proportion of the explained variance (R^2) in literacy and numeracy explained by each factor (rescaled to 100). Results obtained using Fields (2004) regression-based decomposition technique of Equation 1 estimates (Annex 3).

Where: Education: highest level of formal education attained; Training: having undergone formal or non-formal education or training during the 12 months preceding the survey; Use of skills at home: frequency of use of numeracy, reading and writing skills in every-day life; Work-experience: not having had work experience or experiencing short or long periods of no employment. Personal characteristics: gender, age, perceived health, immigrant and language status. Parent and family background: level of educational attainment of parents, immigrant background, number of books at home; Country: fixed effects.

Source: Cedefop calculation on OECD survey of adult skills (PIAAC) 2012.

Alongside these personal and human capital variables, job characteristics may play a role in determining low cognitive skills among (employed) adults.

Results from an OLS regression on employed adults, presented in Table 10 ([39]) confirm a strong relationship between the level of cognitive skills and type of

([38]) OECD and Statistics Canada, 2000; Statistics Canada, 2005; OECD, 2013; 2014; Desjardins, 2003.

([39]) Restricting the sample to employed workers could result in sample selection bias as low-skilled workers are more likely to be unemployed. To address the potential selection into employment, we modelled jointly both the selection into employment and the cognitive equation using a Heckman two-stage regression analysis. Results showed no statistically significant effects of selection into employment so the analysis reports the simple OLS estimates.

occupation. As shown in Figure 28, workers employed in elementary occupations score 20 fewer points on average in cognitive skills than managers. There is a significant gap in cognitive skill proficiency between workers in high-skilled occupations (ISCO 1-3) or clerical support workers (ISCO 4) and those in semi-skilled (ISCO 5-8) and unskilled occupations (ISCO 9).

Table 10. **Pooled OLS regression on literacy and numeracy scores on employees: selected coefficient estimates (*)**

	Literacy	Numeracy
Total work experience (years)		
Experience	0.13	0.31***
Job-related characteristics		
Firm		
• public sector	-3.00***	-5.71***
• micro (1-10 employees)	-5.17***	-5.76***
• small (11-50)	-4.55***	-4.92***
• medium (51-250)	-1.97***	-3.03***
Contract type		
• fixed term job	-1.87***	-2.95***
• part time job	-1.72***	-3.10***
Occupations (ISCO 08)		
• professionals	0.76	0.35
• technicians and associate professionals	-4.20***	-5.11***
• clerical support workers	-3.93***	-5.82***
• service and sales workers	-12.70***	-16.48***
• craft and related trades workers	-15.96***	-16.51***
• plant and machine operators and assemblers	-16.84***	-19.54***
• elementary occupations	-19.25***	-22.47***
Education and training		
Low education	-24.49***	-27.69***
Intermediate education	-11.68***	-13.35***
Non-job-related formal or non-formal education and training in the previous 12 months	5.01***	4.19***
Job-related formal or non-formal education and training in the previous 12 months	2.11***	2.00***

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

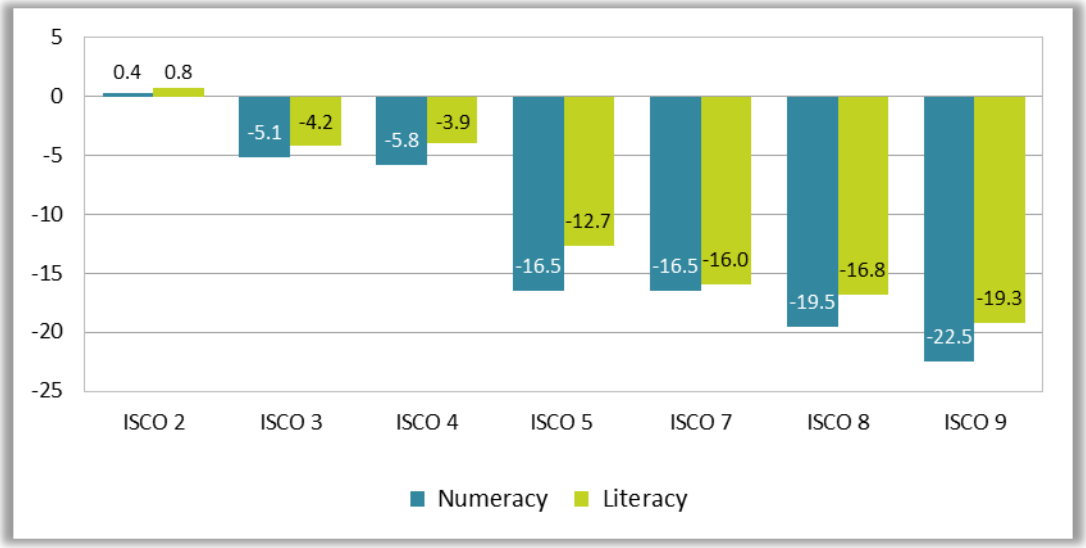
NB: Least squares regressions controlling also for frequency of use of reading, writing and numeracy skills at home, a squared term for work experience; number of books at home; perceived general health; country fixed effects. Dependent variables: literacy score and numeracy score.

Sample: population aged 25-65, excluding retired people, students, permanently disabled people and individuals in compulsory military or community service. The (omitted) reference categories are: those aged 25 to 34; male, good health; male; native born and native language; neither parents are foreign born; both parents having attained at least secondary education; having more than 25 books at home; high level of education attained; having participated into formal or non-formal education or training in the previous 12 months; having computer experience; being in highest quintile of the index of frequency of use of writing, reading, and numeracy skills at home; in employment; living in Austria.

Source: Cedefop calculation on OECD survey of adult skills (PIAAC) 2012.

These results are consistent with literature which shows a link between occupations requiring the performance of complex tasks and levels of cognitive skills, even after controlling for education (Desjardins and Warnke, 2012). There are also indications that job-complexity has an effect on skills growth rate. Analysis of production functions for adults' verbal and non-verbal cognitive skills on a longitudinal dataset found that post-school tenure in skilled jobs has significant positive effects on both types of cognitive skill (Behrman et al., 2014).

Figure 28. **Relationship between the level of literacy and numeracy proficiency and occupation held**



NB: OLS regression of numeracy proficiency score on employees aged 25 to 65 with one job only; excludes workers employed in non-profit organisations, in the armed forces and skilled agricultural, forestry and fishery workers.

Control variables: job-related characteristics (firm size, sector – public, private –, occupation at 1-digit of ISCO-08, contract type, a dummy for full-time work, experience and its square), demographic characteristics (gender, age, perceived health, migrant status), parental background (parents' highest level of education attained and migrant background), use of skills at home, country fixed effects.

ISCO 1: Managers (omitted category); ISCO 2: Professionals, ISCO 3: Technicians and associate professionals; ISCO 4: Clerical support workers; ISCO 5: Service and sales workers; ISCO 7: Craft and related trades workers; ISCO 8: Plant and machine operators, and assemblers; ISCO 9: Elementary occupations.

Source: Cedefop calculation on OECD survey of adult skills (PIAAC) 2012.

The positive relationship between work experience and proficiency in numeracy skills also emerges for employed adults ([40]). Figure 29 shows the increase in the level of numeracy skills for different age groups, controlling for personal and job-related characteristics. The effect of work experience on cognitive skills is more

([40]) Similar results are found for literacy.

pronounced for older workers, probably because of a self-selection effect in that individuals near retirement age who continue working are predominantly those working in high-skilled occupations and with higher cognitive skills than average workers of the same age group.

Figure 29. **Relationship between years of work experience and numeracy score**

(*) Years of paid work during lifetime. Calculation based on coefficient estimate of a OLS regression of numeracy proficiency score on a sample of employees aged 25-65, with controls for: job-related characteristics (firm size, sector – public, private –, occupation at 1-digit of ISCO-08, contract type, a dummy for full-time work, experience and its square), demographic characteristics (gender, perceived health, migrant status), parental background (parents' highest level of education attained and migrant background), use of skills at home, country fixed effects.

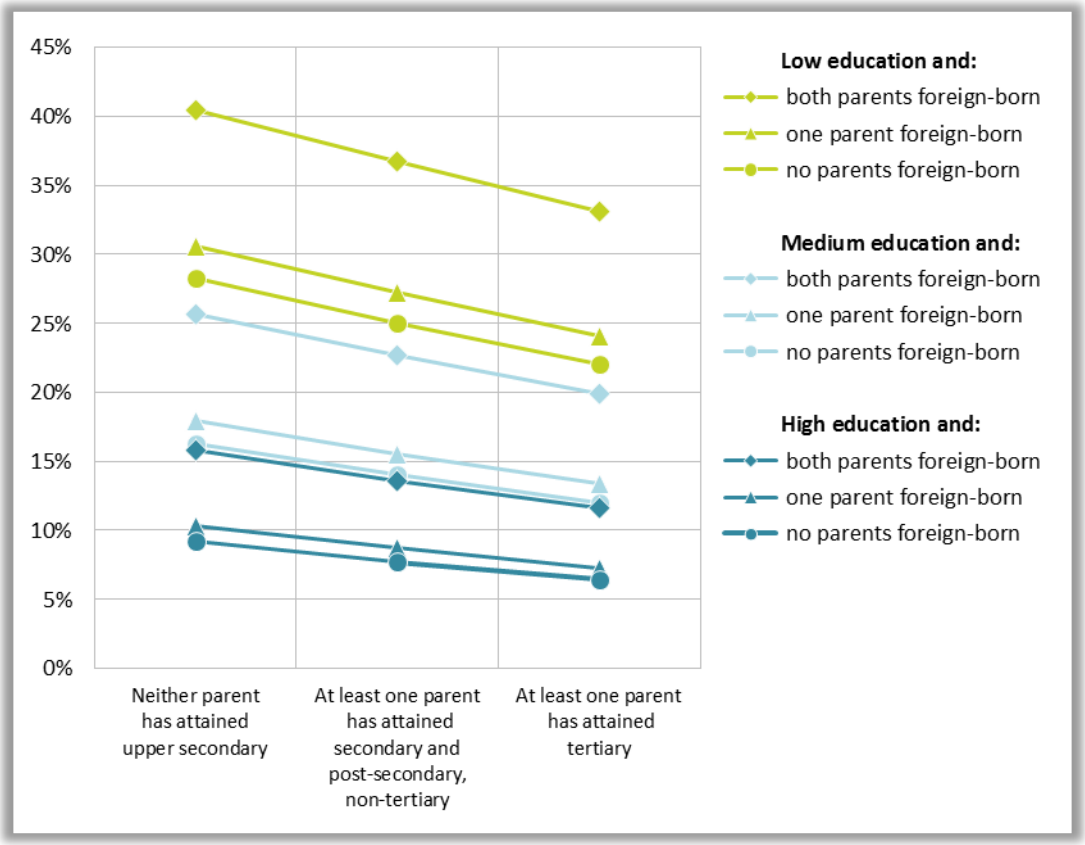
Source: Cedefop calculation on OECD survey of adult skills (PIAAC) 2012.

Another result is related to the effect of training: having attended non-job-related training has a higher positive impact on cognitive skills than having attended job-related training. This result could be explained by the fact that, other things equal, workers who freely decide to engage in training have higher cognitive skills on average. Heckman (1999, cited in de Grip and Zwick, 2004) found that ability fosters further learning. Analysis of data from a Norwegian survey on adults in formal continuing education found that even when controlling for factors that may cause differences in motivation, low-skilled adults attending primary or lower secondary programmes were more likely to state that they were required to undertake training, compared to adults attending education programmes of higher levels (Daehlen and Ure, 2009).

3.3. The risk of being low-skilled

In line with the analysis of the characteristics and determinants of low skills, a probit regression analysis ([41]) on numeracy skills ([42]) shows that the probability of being low-skilled is strongly related to the level of education attained (Figure 30): on average, low-educated adults are three times more likely to be low-skilled (27%) than those who are highly educated (9%).

Figure 30. **Predicted probabilities of being low-skilled in numeracy by education level, migrant status of parents and highest level of education attained by parents**



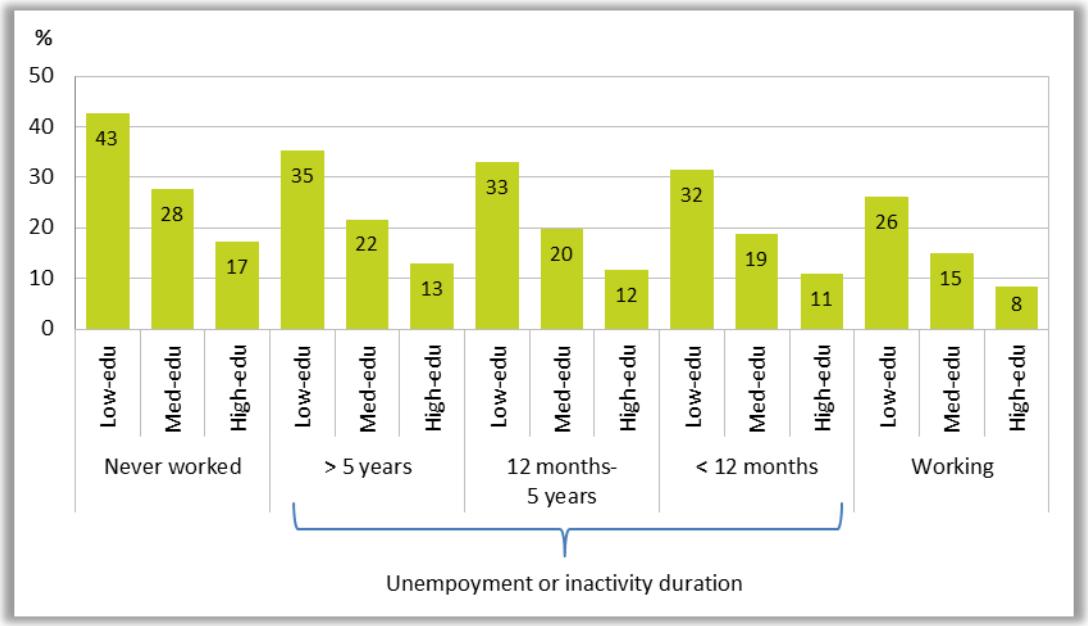
Source: Cedefop calculation on OECD survey of adult skills (PIAAC) 2012.

([41]) We used average adjusted predictions and adjusted predictions at representative values. For more details see Annex 3. In the sample analysed, the incidence of low-skilled people in numeracy is 17%.

([42]) This part of the analysis concentrates and presents results only on numeracy skills, since literacy and numeracy proficiency scores are highly correlated (coefficient is 0.86) and produce similar results.

The probability of having low levels of cognitive skills is also closely related to parental background: having a migrant background seems to play an important role in determining the probability of having low proficiency in cognitive skills. An average adult with low educational attainment and foreign-born parents with low qualifications has a 40% probability of being low-skilled in numeracy; this probability declines to 22% for an average adult with low educational attainment and two native parents, if at least one completed tertiary education. Similar differentials, but to a lesser extent, are evident among adults having attained upper secondary education (-14 percentage points) and those having attained tertiary education (-9 percentage points).

Figure 31. **Predicted probabilities of being low-skilled by work experience and highest education attained (%)**



NB: Adjusted predictions at representative values for estimates of a probit regression where the dependent variable is the probability of being low-skilled scoring at or below proficiency level 1 (scores up to 226 points).

Sample: Population aged 25-65, excluding retired people, students, permanently disabled people and individuals in compulsory military or community service. The omitted categories are: aged 25-34; male, good health; male; native born and native language; neither parents are foreign born; both parents having attained at least secondary education; having more than 25 books at home; high level of education attained; having participated into formal or non-formal education or training in the previous 12 months; having computer experience; using frequently writing, reading, and numeracy skills at home (i.e. belonging to the highest quintile of the index of frequency of use of information processing skills at home); in employment; living in Austria.

Source: Cedefop calculation on OECD survey of adult skills (PIAAC) 2012.

Results also show a strong relationship between work experience and the probability of being low-skilled in numeracy, which is higher among individuals who never worked and those experiencing unemployment or inactivity spells.

Figure 31 shows that for each level of educational attainment, the probability of being low-skilled decreases with the intensity of work experience. Adults with tertiary education and no work experience also have a higher probability of being low-skilled than a worker with upper secondary education and work experience.

Chapter 4.
The consequences of low skills

The idea that education and higher levels of skills are associated with a wider range of benefits for individuals (and their families), employers, society and the economy as a whole is largely shared in literature.

In addition to increased employability and higher earnings for individuals, and higher productivity and economic growth for the economy as a whole, a more recent strand of analysis focuses on the social and non-market benefits of education and skills, such as improved health, social and civic engagement, and lower involvement in criminal activities.

The analysis presented in this section, based on PIAAC and EU-SILC (Box 5) data, will lay the foundations for a costing framework presented in the next chapter.

Figure 32. **Benefits of higher levels of skills**

Source: Cedefop.

4.1. Benefits of higher skills for individuals

4.1.1. Employability

Several studies in literature explore the positive impact of education on individual employability (e.g. Cedefop, 2013; Dorsett et al., 2010; Dickson and Harmon, 2011; Dickson and Smith, 2011; Heinrich and Hildebrand, 2005). In line with this evidence, descriptive statistics presented in Chapter 2 suggest that low-skilled adults are more likely to experience spells of inactivity and unemployment and that, once employed, they tend to be employed in low-skilled occupations.

Table 11. **Predicted probabilities of being employed**

	Coefficients (1)	Margins (2)
Education		
Low education	-1.23***	-0.14***
Medium education	-0.65***	-0.07***
Cognitive skills		
Low-skilled in numeracy	-0.47***	-0.05***
Computer skills		
No computer experience	-0.63***	-0.07***
Personal and family characteristics		
Age 35-44	0.39***	0.04***
Age 45-54	0.66***	0.08***
Age 55-65	0.38***	0.04***
Foreign-born and foreign-language as first language	-0.58***	-0.07***
Perceived general health: poor/fair	-0.77***	-0.09***
Female	-0.12***	-0.09***
Have children	0.33***	-0.03***
Female* having children	-0.72***	
Constant	3.09***	
Pseudo R^2	0.1526	
Observations	70 186	70 186

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

NB: Logistic regression. Dependent variable: being employed = 1, 0 otherwise (including both unemployed and inactive people). Low-skilled in numeracy = scoring less than 226 points (on a scale of 0-500 points).

Sample: population aged 25-65, excluding retired people, students, permanently disabled people and individuals in compulsory military or community service. The omitted reference categories are: high level of education attained; not being low-skilled in numeracy; having computer experience; aged 25-34; good health; native born and native language; male, not having children; being male without children; living in Austria.

Source: Cedefop calculation on OECD survey of adult skills (PIAAC) 2012.

Box 5. **The differing importance of educational qualification for employment probabilities**

Brozovicova et al. (2012) analysed the odds of being employed in five EU Member States (Bulgaria, Spain, Hungary, Romania and Slovakia) and found a high degree of heterogeneity in the effects of low levels of education (ISCED 0-2) on labour market outcomes. Estimating a probabilistic binary choice model for each country using 2010 EU-LFS data showed that having low qualifications reduced individuals' odds of being employed by about 10% in Bulgaria, 14% in Spain and Hungary, 17% in Romania, and of 23% in Slovakia. The role of low educational attainment also varied within countries, being more negative in sparsely populated areas than others.

Other empirical research focusing on the demand for labour found that having educational qualifications is less important for low-skilled occupations. For example, results emerging from a qualitative analysis of 36 case studies and employer interviews in five UK industries employing a large share of low-skilled/low-paid workers (call centres, hotels, food processing, retailing and hospitals), showed that qualifications play a marginal role in recruitment, retention and progression (Lloyd and Mayhew, 2010).

Similar results are found by Kureková et al. (2012) and literature they review.

For example, Jackson (2001) in analysing 322 job adverts chosen from national, regional and local British newspapers, found that only 40% included a qualification requirement of any kind. Educational qualifications were very important for managerial and professional positions, and vocational qualifications were important for the remaining positions. Similarly, in a more recent study Jackson et al. (2005), performing a content analysis of around 5 000 jobs adverts, found that qualifications appeared as a requirement in only 26% of all advertised jobs, but were required only in around 10% of advertisements for the technical and operative, sales and personal service occupational categories.

Results from a logistic regression ([43]) on PIAAC ([44])([45]) data (Table 11) confirm that the level of education enhances the likelihood of being employed ([46]): compared to adults with tertiary education, the chance of being employed decreases by 7% for those with an upper secondary degree, and by 14% for people with less than upper secondary education. The negative effect of low education on employment probabilities is different across and within countries, depending on the characteristics of labour demand and the countries' institutional settings (Box 5).

([43]) Details on the methodological approach adopted and the selected sample are provided in Annex 4.

([44]) PIAAC data for Cyprus are not included in this analysis.

([45]) As for Section 3.3, this part of the analysis concentrates and presents results only on numeracy skills, since literacy and numeracy proficiency scores are highly correlated (coefficient is 0.86) and produce similar results.

([46]) The analysis used average adjusted predictions and adjusted predictions at representative values.

The level of cognitive skills plays a significant role in increasing the odds of being employed: for people low-skilled in numeracy the chances of being employed are reduced by 5% ([47]). Computer experience is another important skill factor increasing the likelihood of being employed (+7% for adult population) ([48]).

Figure 33. **Predicted probabilities of being employed by education level, low skills in numeracy and computer use experience (35 to 44 years old)**

NB: Low-skilled in numeracy = scoring less than 226 points on a scale of 0-500 points.

Adjusted predictions at representative values on estimates of a logistic regression, where the dependent variable is the probability of being employed = 1, 0 otherwise including both unemployed and inactive people. Sample: population aged 25-65, excluding retired people, students, permanently disabled people and individuals in compulsory military or community service. The omitted reference categories are: high level of education attained; not being low-skilled in numeracy; having computer experience; aged 25-34; good health; native born and native language; male, not having children; being male without children; living in Austria.

Source: Cedefop on OECD survey of adult skills (PIAAC) 2012.

([47]) This is consistent with other studies, like those reported in Dench et al. (2006) reporting the results of several UK studies showing that, although different employment impacts emerge depending on the data used and analytical approach adopted, all find that higher levels of cognitive skills are associated with greater probabilities of being employed.

([48]) Similar findings emerge from Kureková et al. (2012).

Having both low skills in numeracy and no computer experience has a higher impact on reducing employment probability than level of formal education (Figure 33). For example an average adult aged 35 to 44 not having attained an upper secondary degree but possessing computer and numeracy skills has more chances of being employed (78%) than an upper secondary school graduate with low skills in numeracy and no computer experience (69%).

4.1.1.1. *Labour market transitions among low-skilled adults: a low-skills trap?*

Having established that educational level and cognitive skills play a role in determining the probability of being employed, analysing the labour market transitions of low-skilled workers offers the opportunity to explore the determinants of transitions across labour market statuses.

Box 6. **The EU-SILC data**

The analysis of the labour market transitions is based on the European survey on income and living conditions (EU-SILC). The EU-SILC is a rotating panel survey, where individuals are interviewed for a maximum of four years, and the sample is refreshed regularly with new members; over two years there is a 75% overlap in the longitudinal sample, and over four years there is a 25% overlap. The longitudinal EU-SILC microdata cover 27 Member States (excluding Germany, for which data are not released for research) and other non-Member States like Norway and Iceland.

The 2012 dataset is the most recent available, though its use for our analysis is constrained by microdata being unavailable as yet for Ireland, Croatia, Romania, Slovakia and Sweden, reducing the aggregate sample, and the change in the ISCO adopted since 2011, as it is not possible to convert the two classifications without some loss or distortion of information.

The analysis considers the 2008-11 and 2005-08 periods using the ISCO-88 for transitions over a three-year period to analyse the changes over time in transition patterns, and, separately, the new ISCO-08 for the yearly transitions between 2011 and 2012.

The dataset contains yearly individual labour market information. The descriptive analysis, with the exception of the econometric estimation, is performed with the appropriate longitudinal sample weight supplied by Eurostat.

Since the EU-SILC survey gives no information on individual cognitive skills, we use the ISCED level of education attained as a proxy for skills (low education: ISCED 0-2, intermediate education: ISCED: 3-4, high education: ISCED 5-8). The EU-SILC survey is also lacking information on in-job training.

Using EU-SILC data for individuals aged 25 to 65 (Box 6), allows analysing the transitions of employed workers into employment, unemployment and

inactivity. To classify 'activity status' ([49]) and 'occupation' ([50]) four groups are considered ([51]): high-skilled jobs (HSJ), semi-skilled jobs non-manual (SSJ), semi-skilled manual jobs (SSMJ) and low-skilled jobs (LSJ).

Box 7. **Classification of occupations into job levels**

The ISCO changed in 2012 and the two classifications are not directly comparable at the 2-digit level. We used 2-digit level ISCO-88 up to 2011 and ISCO-08 from 2012 onwards.

Using the ISCO-88, we have grouped occupations as follows:

- the major groups between 1 and 3 are classified as high-skilled jobs (HSJ);
- the major groups 4 and 5, excluding the minor group 51, are classified as semi-skilled non-manual jobs (SSJ);
- the major groups 6, 7 and 8, excluding the minor group 61, are classified as semi-skilled manual job (SSMJ);
- the 9 major groups and the minor groups 51 and 61 are classified as low-skilled jobs (LSJ)**.**

Using the ISCO-08, we have grouped occupations as follows:

- HSJ: the major groups between 1 and 3;
- SSJ: the major groups 4 and 5, excluding the minor group 51 and 53;
- SSMJ: the major groups 6, 7 and 8, excluding the minor groups 61 and 62;
- LSJ: the 9 major groups and the minor groups 51, 53, 61 and 62.

Transitions have been calculated using transition matrices at the aggregate EU level ([52]). These matrices report the unconditional transition probability of an

([49]) The reference variable is 'self-defined current economic status (PL030)', that captures the respondent's perception of their main activity status for the current period and it may differ from the strict ILO definition.

([50]) The reference variable is the 'occupation (PL050 for ISCO-88 and PL051 for ISCO-08)', and it refers to the main job (the current job for employed people and the last main job for people who do not work). The ISCO-88 (2 digits) is used. From 2012 onwards ISCO-08 is used. If multiple jobs are held or were held, the main job is the one with the greatest number of hours usually worked. When identifying the ISCO code, interviewers should have referred, if applicable, to the code given the preceding year(s), to avoid unjustified changes in the variable.

([51]) We have considered the groups used in the descriptive analysis in Chapter 2, but also the 'distribution' of PIAAC numeracy scores between occupations.

([52]) The sample for 2012-11 covered Member States but excluding DE, IE, HR, RO, SK and SE, plus two EFTA countries (NO and IS). The sample for 2011-08 covered Member States except for DE and IE, plus two EFTA countries (NO and IS). The sample for the 2008-05 period covered Member States except for BG, DE, HR and RO, plus two EFTA countries (NO and IS). Note: DE is not in the sample because

individual to move to state j in the current period, given that s/he was in the state i in the previous one ([53]). The estimated transition probabilities are likely to depend on individual characteristics and on job characteristics.

Over a one-year period (2011-12) stability rates are quite high for all types of occupation, except for the unemployed. However, low-skilled workers have a higher probability of losing their job than others. Specifically, 6.3% move to unemployment and 3.3% move to inactivity. Conversely, high-skilled workers enjoy higher employment stability, with a 90.7% probability of remaining in the same occupation category (Table 12).

Table 12. **Labour market occupations yearly transition matrix, longitudinal population 2011-12**

Origin 2011	Destination 2012						
	HSJ	SSJ	SSMJ	LSJ	Unemployed	Inactive	Total
HSJ	90.7	2.9	1.3	1.2	2.4	1.5	100
SSJ	5.9	84.4	1.2	1.8	4.1	2.5	100
SSMJ	2.9	1.2	86.3	2.3	5.7	1.7	100
LSJ	3.5	1.7	2.3	82.9	6.3	3.3	100
Unemployed	5.6	5.0	6.3	8.1	63.8	11.1	100
Inactive	2.7	2.3	1.4	3.7	7.7	82.3	100
Total	31.5	13.5	14.4	14.8	10.7	15.1	100

NB: HSJ: high-skilled job; SSJ: semi-skilled non-manual job; SSMJ: semi-skilled manual job; LSJ: low-skilled job. Sample: population aged 25-65, excluding students and retired persons.

Source: Cedefop analysis of Eurostat microdata, EU-SILC.

However, it is well known that during upward business cycles there are higher flows between occupations, higher outflows from unemployment, and lower long-term unemployment rates. An employed adult has a higher probability of entering a better job in terms of occupational level ([54]). During periods of crisis, there is a higher risk of long-term unemployment for the unemployed, as well as fewer chances for the employed to upgrade their occupation. These risks are higher for low-skilled individuals who face reduced employment opportunities and

---

the dissemination of the longitudinal microdata is not allowed. IE is not included in the 2011 sample because the data are not clean.

([53]) $P_{ij} = d_{ij}/N_i$ where d_{ij} stands for the number of individuals in state i in the initial period who move to state j in the following period, and N_i is the number of individuals in state i in the initial period.

([54]) Theoretical literature that focuses on labour market matching models with job-to-job transitions predicts that booms are times which allow employed workers to upgrade into better jobs, while opening jobs for unemployed workers, albeit of lower quality (Krause and Lubik, 2007).

a job quality penalty if they succeeded in finding a job (OECD, 2014). To illustrate the impact of the economic crisis on labour market dynamics, Table 13 shows transitions over a three-year period: 2005-08 and 2008-11.

Before the crisis, stability rates for employed people of all skills levels were higher, as were exit rates from unemployment and transitions from low-skilled jobs to high-/semi-skilled jobs. However, during the financial crisis stability rates decreased by 2.8 percentage points for semi-skilled manual jobs and by 2 percentage points for low-skilled jobs, while for high-skilled jobs the stability rate decreased by only 1 percentage point. During the crisis more adults working in low-skilled jobs (from 3.8% to 9.2%) and semi-skilled manual jobs (from 4.6% to 10.1%) lost their jobs as transitions to unemployment increased ([55]).

Table 13. **Labour market occupations transition matrix, longitudinal population 2005-08 and 2008-11**

Origin	Destination											
	2005-08						2008-11					
	HSJ	SSJ	SSMJ	LSJ	Unemp-loyed	Inactive	HSJ	SSJ	SSMJ	LSJ	Unemp-loyed	Inactive
HSJ	87.5	3.7	2.1	2.1	1.9	2.7	86.5	3.9	2.0	1.9	3.4	2.5
SSJ	15.0	71.1	2.1	3.8	3.8	4.1	13.3	70.5	1.8	3.6	6.5	4.2
SSMJ	5.4	1.7	80.2	5.1	4.6	3.0	4.0	1.7	77.4	3.9	10.1	2.9
LSJ	5.4	3.3	6.4	74.9	3.8	6.2	4.3	3.1	4.4	72.9	9.2	6.1
Unemp-loyed	10.5	7.8	13.7	15.2	33.3	19.4	8.8	6.0	6.8	13.4	45.3	19.7
Inactive	5.8	4.8	3.2	7.5	4.9	74.0	5.3	3.3	1.8	6.8	8.2	74.7
Total	32.0	12.2	18.1	16.2	5.9	15.6	32.0	11.8	15.5	16.0	9.4	15.4

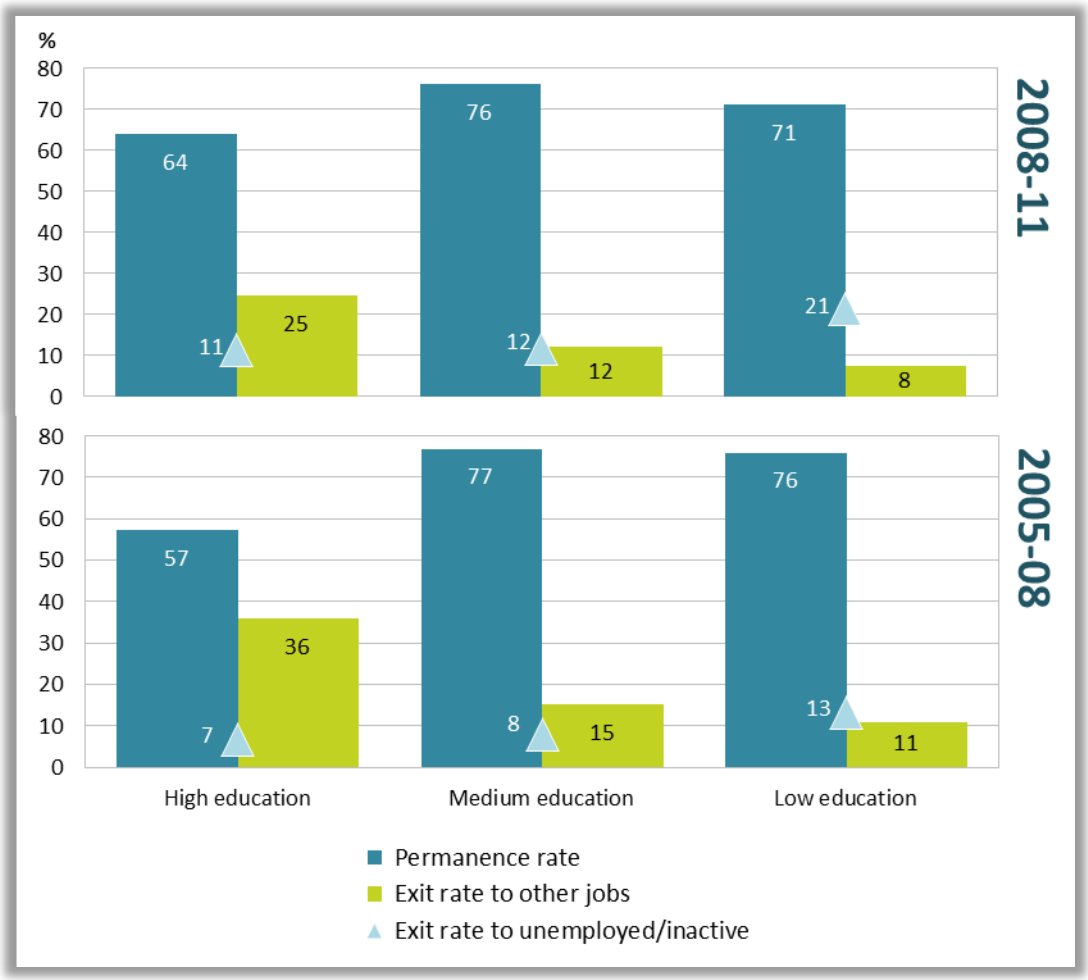
NB: HSJ: high-skilled job; SSJ: semi-skilled job; SSMJ: semi-skilled manual job; LSJ: low-skilled job. Sample: population aged 25-65, excluding students and retired persons.

Source: Cedefop elaboration on Eurostat microdata, EU-SILC.

Labour market flows from low-skilled jobs by education level presented in Figure 34 show that workers employed in low-skilled jobs and with low qualifications tend to have higher exit rates to unemployment and inactivity (21%), and lower exit rates to higher skilled jobs (8%). During the crisis, the situation worsened across all educational levels, but workers with lower qualifications experienced the worst transitions in the labour market.

([55]) The results are consistent with an empirical study (Bachmann et al., 2014) that analysed the change in labour market transition before and after the crisis, and found similar results: an increase in the transition rate from employment to unemployment, higher permanence rates in unemployment, and lower transition rates from unemployment.

Figure 34. **Labour market flows from low-skilled jobs, by gender and education, longitudinal population 2008-11; 2005-08**

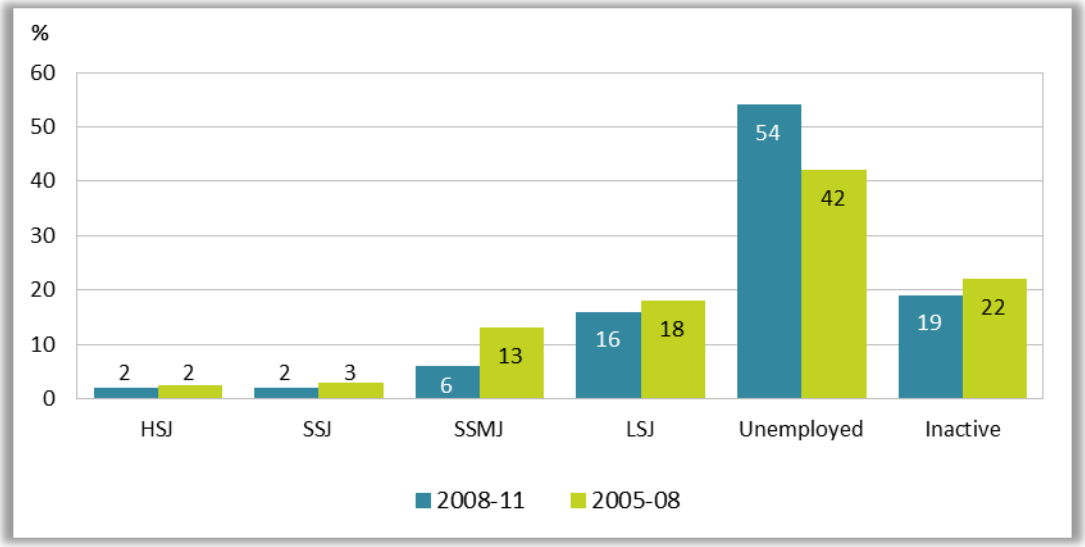


NB: Permanence rate: case of 'no-movement' in LSJ. Exit rate to other jobs: movements from LSJ to SSMJ, SSJ, HSJ. Exit rate to unemployed/inactive: movements from LSJ to unemployed/inactive.
Sample: population aged 25-65, excluding students and retired persons.

Source: Cedefop analysis of Eurostat microdata, EU-SILC.

Before the financial crisis the long-term unemployment rate for people with low qualifications was 41.7%. With the crisis it increased to 53.8% and exit rates from unemployment to jobs other than low-skilled ones shrank drastically; transitions from unemployment to semi-skilled manual jobs declined from 12.8% to 6% (Figure 35).

Figure 35. **Labour market flows from unemployment for people with low qualifications (ISCED 0-2), longitudinal population 2005-08 and 2008-09 (%)**



NB: HSJ: high-skilled job; SSJ: semi-skilled job; SSMJ: semi-skilled manual job; LSJ: low-skilled job. Sample: unemployed aged 25-65, with low education (ISCED 0-2).

Source: Cedefop elaboration on Eurostat microdata, EU-SILC.

4.1.1.2. *Determinants of transitions*

Educational attainment has an impact on the risk of remaining in a low-skilled occupation. Results from a multinomial logit regression ([56]) Table 14 show that, all other variables constant, adults with low levels of education are three times more at risk ([57]) of 'remaining in a low-skilled job' compared to 'moving to higher level occupations' than their more educated peers. The relative risk of falling into unemployment or inactivity for adults with low levels of education compared to moving to higher level occupations is 4.2 times more likely for unemployment and 4.4 times more likely for inactivity compared to highly educated adults.

An additional year of work experience is expected to reduce the risk of 'remaining in a low-skilled job' relative to 'moving to higher level occupations' by a factor of 0.97.

([56]) The multinomial logit specification has also been tested for the independence of irrelevant alternatives (IIA) hypothesis using Small and Hsiao's test, which indicated that IIA was not violated. Methodological approach can be found in Annex 4.

([57]) A risk ratio greater than 1 indicates an increase in the risk of the outcome of interest relative to the reference category, with all other variables in the model held constant. Further methodological details can be found in Annex 4.

Table 14. **Determinants of labour market transition: relative risk ratios**

Variables	(1) LSJ to HSJ/ SSJ/SSMJ	(2) LSJ to LSJ	(3) LSJ to unemployed	(4) LSJ to inactive
Intermediately qualified	Reference outcome	2.099***	3.177***	2.795***
		(0.274)	(0.826)	(0.877)
Low-qualified		2.977***	4.210***	4.405***
		(0.426)	(1.132)	(1.410)
Female		1.791***	1.158	4.103***
		(0.162)	(0.160)	(0.764)
Number of children (<=4 yrs old)		0.941	0.953	0.923
		(0.0695)	(0.111)	(0.218)
Fem*N. of children(<=4 yrs old)		1.158	1.114	2.723***
		(0.136)	(0.203)	(0.696)
Married		0.912	0.825	0.918
		(0.0888)	(0.118)	(0.152)
Age		1.060***	1.099***	1.147***
		(0.00949)	(0.0128)	(0.0143)
Work experience		0.972***	0.919***	0.917***
		(0.00805)	(0.00981)	(0.00997)
Household size (person)		1.093**	1.017	0.972
		(0.0380)	(0.0517)	(0.0615)
Bad health		1.454*	3.295***	9.348***
		(0.328)	(0.873)	(2.422)
Unemployment spell		0.318***	5.824***	0.994
		(0.0470)	(0.934)	(0.221)
Fixed-term contract		0.855	1.151	1.693***
		(0.101)	(0.184)	(0.315)
Self-employment		1.821***	0.923	2.156***
		(0.220)	(0.192)	(0.443)
Constant		0.283***	0.0111***	0.000455***
		(0.0835)	(0.00510)	(0.000268)
Observations	6 578	6 578	6 578	6 578

* p<0.1 **p<0.05 ***p<0.01. Standard errors in parentheses.

NB: Multinomial logit model. Dependent variable: labour market transition from LSJ (1 for LSJ to HSJ/SSJ/SSMJ, 2 for LSJ to LSJ, 3 for LSJ to unemployed, 4 for LSJ to inactive). The reference categories are: high education, male, non-married, without health problems, not having been unemployed at least one time between the initial period and the reference period, employee with a permanent contract.

Sample: population aged 25-65, excluding retired population, student and inactive people.

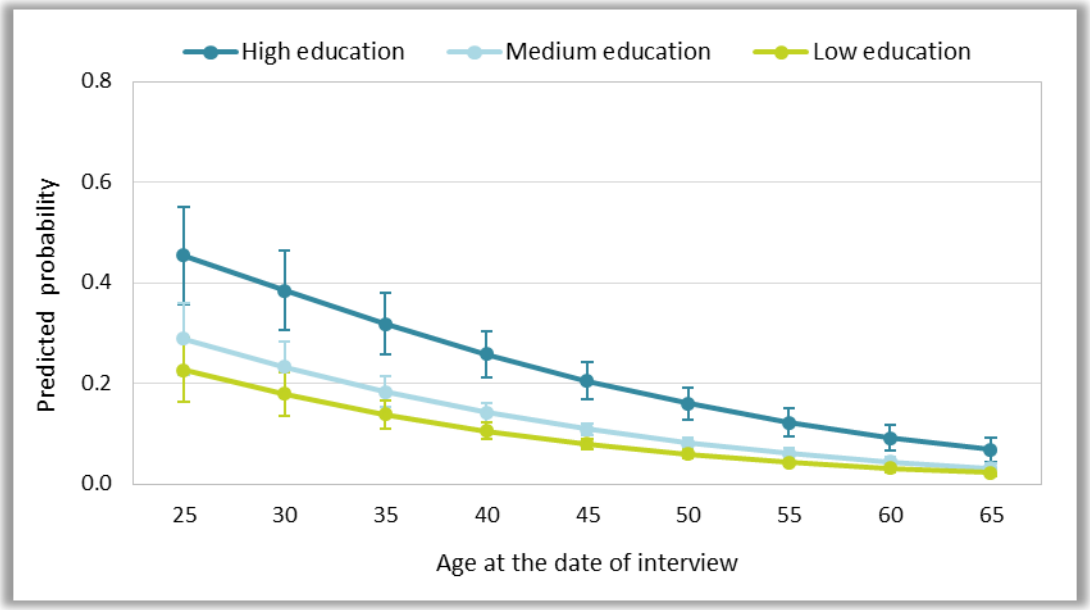
Source: Cedefop calculation using EU-SILC survey 2011.

Predicted probabilities of moving from a low-skilled job to a high-skilled/semi-skilled job, by level of education and age ([58]) (Figure 36) tells us that job mobility tends to decrease with age, and adults with low qualifications have a

([58]) Predicted probabilities at different ages were computed while holding all the other variables constant at their mean.

higher probability of remaining in low-skilled jobs at any age. While for younger workers educational attainment matters much ([59]), the gap between workers with low and high qualifications drops as age increases. Younger highly educated people may enter the labour market with a low-skilled job, but are more likely to move to a better job in the future (even if also to become unemployed). In contrast, older highly educated people employed in low-skilled jobs are more likely to remain trapped in low-skilled jobs (low-skills trap) probably due to the effects of skill obsolescence.

Figure 36. **Predicted probability of moving to a high-skilled/semi-skilled job by education and age, 2008-11**



NB: Predicted probabilities obtained from multinomial logit.

Source: Cedefop calculation on EU-SILC survey 2011.

4.1.2. Individual returns

Having established that low-skilled adults are more likely than their more skilled peers to experience lower employability and poorer transitions in the labour market, it may be reasonable to assume that they are also more likely to earn less and to accumulate less work experience.

([59]) The probability of moving to a higher level occupation is significantly higher for highly educated young workers (45% for an individual aged 25) than for young workers with low qualifications (22% for an individual aged 25). Similar results have been found by empirical literature (Bernardi and Garrido, 2008) focused on mobility among unskilled people in Spain.

In the traditional human capital theory (Becker, 1964; Becker and Chiswick, 1966; Mincer, 1958; 1974), it is assumed that individuals rationally choose to engage in education and give up earnings today in return for higher earnings in the future. The level of investment in education depends on how different people feel about giving up some of today's consumption in return for future rewards (Borjas, 2010) and on expectations about the lifetime earnings premium associated with employment at higher qualification levels.

Countless studies evaluate private returns on education. While results vary according to the country/ies of observation and datasets used, how education is captured ([60]) and the different assumptions, model specifications and methodologies ([61]), consensus emerged on the positive impact on earnings of participation in education.

A meta-analysis on the results of several studies on returns on education report an average varying between 6.5% and 14% (Harmon et al., 2003). Similar conclusions are reported in Heinrich and Hildebrand (2005) who estimated returns varying between about 4% to 14%, while Montenegro and Patrinos (2014), building on their previous work (e.g. Psacharopoulos and Patrinos, 2004) report an average return on schooling of about 10%. Results are higher for females than for males and are the highest for tertiary education. Badescu et al. (2011) estimating the wage differentials caused by differences in educational attainment across 24 Member States using EU-SILC 2005 data for full-time

([60]) Education has generally been captured either using years of schooling (e.g. Montenegro and Patrinos, 2014; Mendolicchio and Rhein, 2011; Card and Lemieux, 2001; Flores et al., 2013) or qualifications level as a proxy for educational attainment to capture the non-linearity of education returns (e.g. Davia et al., 2009; Badescu et al., 2011; Quintini, 2014).

([61]) Several methodological issues arise from estimating returns on education in the Mincerian tradition. Two prominent issues are the endogeneity of the educational variable (the possible existence of heterogeneity due to unobserved ability, which assumes that more able individuals invest more in education and would earn more at any level of education as they are able to convert schooling into human capital more efficiently than the less able. For an extensive discussion on the issue see Card, 1999) and the selectivity bias of participation in employment. Most studies address the heterogeneity in skills investment and returns either including some measures of innate ability or family background information (e.g. Flores et al. (2013) use the Hausman and Taylor (1981) estimator, while Badescu et al. (2011) include variables on parental education and a variable measuring the financial situation of the family), or using sources of exogenous variations such as reforms in compulsory schooling laws (e.g. discussion in Heinrich and Hildebrand, 2005; Woessman, 2014). Bias due to selectivity in employment has been generally addressed using a Heckman selection model (e.g. Hanusheck and Schwerdt, 2013; Mendolicchio and Rhein, 2011).

employees aged 25 to 65, report an average 43% return associated with university degrees. However, the authors observe great variability across countries. For those who did not attain secondary education there is, on average, a wage penalty of 17%.

Education alone does not capture all the dimensions of low skills. With the emergence of international comparative tests of skills in representative samples of the adult population, several scholars integrated the study on the returns on education using also cognitive and basic skills as measured by PIAAC (Chapter 2), the international adult literacy survey (IALS, the predecessor of PIAAC) or other test scores coming from national surveys. These studies using skills' test scores also demonstrate the positive impact of skills on earnings. However, as with education, results vary considerably depending on datasets, countries, assumptions and model specifications. For example, Hanushek and Schwerdt (2013) estimate earnings returns on cognitive skills across 22 OECD countries using PIAAC and focus on full-time employees aged 35 to 54 ([62]). Results ([63]) show great variation across countries but, on average, one standard deviation increase in numeracy skills translates into an increase in hourly wages of 17.8%.

Carbonaro (2006) studies the effect of different institutional mechanisms related to the wage setting process on the relationship between cognitive skills and earnings across different OECD countries using IALS ([64]) and focusing on full-time workers aged 25 to 65. Results ([65]) reveal significant and positive returns on literacy skills in both liberal and social market economies, although higher in the liberal market economies than in the social ones.

A number of studies focus on the returns on skills in individual countries. However, while several exist for the US (e.g. Tyler, 2004; De Anda and Hernandez, 2007) fewer look at EU Member States and most of these are focused on the UK. For example, Vignoles et al. (2011) evaluate the impact of

([62]) According to the authors, their decision to focus on prime-age workers is due to imperfect job matches and the difficulty of observing skills in early career stages which may understate the returns on skills for young people.

([63]) The authors estimate a Mincerian type equation with numeracy skills instead of years of schooling. To control for unobserved heterogeneity they include a set of observable characteristics such as parental education and occupation category.

([64]) IALS identifies three types of skill: prose literacy, document literacy, and quantitative literacy. In the model the scores of the three types are averaged and used as a skill indicator.

([65]) Results are estimated by a linear regression using multi-level methods (individuals nested in countries) to capture the effect of national level variables on individual skill characteristics and to control for unobserved heterogeneity. In the model the scores of the three types of skills are averaged and are used as a skill indicator.

basic skills on hourly wages in the UK using data from the British cohort survey (BCS) and the national child development study ([66]). Findings from the BCS reveal that an increase in one standard deviation in literacy is associated with 14% higher earnings, while an additional standard deviation in numeracy skills translates into 11% higher hourly wages. Results from the national child development survey show slightly larger impacts: an increase of one standard deviation in literacy and numeracy skills results in 15% higher wages.

With the growing importance of ICT skills and digital competences and the evidence that they effectively contribute to increase the likelihood of being employed, some literature focuses specifically on returns on ICT skills.

Sakellariou (2009) analyses the returns on computer and language skills for young graduates in Vietnam using the higher education graduate tracer survey. Results show a high computer wage premium among tertiary education graduates at around 80%. Dolton and Pelkonen (2004) estimate the returns on computer use, using the workplace employment relations survey for the UK. The authors use broader concepts of ICT skills (office IT function, manual function, and creative function) and find a 3% wage premium for using a computer and a 2.4% return for the office IT function. Borghans and ter Weel (2006) differentiate between the importance of IT in day-to-day work, the level of specification and the effectiveness of computer use to calculate the returns on ICT skills in the UK. Results show that while the ability to write documents and to carry out mathematical analyses yields significant labour-market returns, the ability to use a computer effectively has no substantial impact on wages. These estimates suggest that writing and maths can be regarded as basic skills, but that the higher wages of computer users are unrelated to computer skills.

As training effectively contributes to increasing and updating one's skills and competences, some studies focus on the impact of training on earnings. Vignoles et al. (2004) found that in the UK male workers who undertook work related training between 33 and 42 years old experienced a 4-5% higher wage growth than workers who did not. In Italy, Brunello et al. (2012) found that that one additional week of training increases monthly net earnings by 1.36%, substantially less than the 3% or more often found in the rest of literature for Europe.

([66]) A Mincer equation is estimated, substituting years of schooling by age 34 literacy and numeracy test scores. To control for unobserved heterogeneity they include a wide set of personal characteristics as well as the lags of previous skill levels and wages. Heckman selection model is used to correct the bias due to selection into employment.

In addition to concepts of skills supply using educational attainment and skills acquisition, skills demand concepts have been used as an alternative classification to understand the economic impact of skills on individuals.

Ingram and Neuman (2006) estimated returns on 'intelligence', 'fine motor skills', 'coordination', and 'strength' obtained via a factor analysis from the *Dictionary of occupational titles (DOT)* ([67]) for the years 1971 to 1998. Results show that returns on intelligence were around 12% during the 1970s and increased significantly during the 1980s reaching a stable 21% in the 1990s. Returns on motor skills (related to jobs requiring working with small tools or instruments) were relatively small from the beginning of the period, and further reduced to 4.2% by the 1990s. Returns on coordination rose from 1% in 1971 to 2.7% in 1998. Returns on strength (ability to perform heavy physical tasks) had basically no wage premium in the 1970s, but increased over time reaching a 4% earnings return. Capatina (2014), similar to Ingram and Neuman (2006), performed a factor analysis to obtain two sets of skills coming from the *Dictionary of occupational titles*: physical and cognitive. Results show that the wage premium associated with one standard deviation in cognitive skills increased from 6% in 1980 to 22% in 2010. Returns on physical skills remained almost constant (around zero) over this period. Abraham and Spetzler (2009) estimate returns on skills in the US in 2003 and 2004 using two different datasets (current population survey and occupational employment statistics) and using the occupational information network (O*NET) ([68]) to obtain three sets of skills: analytical, interpersonal, and physical. Estimations reveal a much higher wage premium associated with analytical skills than that interpersonal skills and physical activity.

While most literature reviewed refers to the US, Kelly et al. (2010) focus on Ireland and use a graduate follow-up survey to estimate the economic returns on field of study and competences among young graduates in 2001 who entered the Irish labour market in spring 2002. They considered five competences: communication, technical skills, team working, leadership and ability to work under pressure. Results show that only technical skills have a positive wage premium of 4% and do not vary much across the earnings distribution. Conversely, ability to work under pressure results in a 2% wage penalty.

([67]) Information technology associates: *Dictionary of occupational titles*: http://www.occupationalinfo.org/
In 1995 it provided 53 job characteristics.

([68]) The O*NET classification was first introduced in 1998 and identifies 41 job characteristics or activities.

In conclusion, regardless of the specific focus of analysis, evidence in literature suggests an undeniable wage premium associated with higher levels of skills and education.

4.1.3. Impact on individual health

In addition to monetary benefits associated with higher levels of skills and education, numerous studies (Grossman, 2006; Cutler and Lleras-Muney, 2012) have shown that education strongly correlates with health and well-being. Field (2009) reports the positive effect of education on health, in particularly mental disorders, while Lochner (2011) reports improved health-related behaviours. Hammond and Feinstein (2005) and Jenkins (2011) find significant benefits of participation in learning on increasing participants' self-confidence and their perceived well-being.

The seminal work of Grossman (1972) laid out theoretical foundations explaining the effect of education on health. The author argues that health is partly the result of choices and so individuals can manipulate certain factors to affect their health. The more educated will choose different health inputs as they face different budget constraints. This is referred to as 'allocative efficiency'. Education is also expected to improve health even when having the same set of health inputs at the same prices. This is usually referred to as 'productive efficiency'.

While the observed correlation between education level and health outcomes later in life may be due to lower educational attainment, it could also be driven by the fact that poor health may lead to lower educational attainment, or education and health could be simultaneously affected by other factors. For instance, family background is likely to drive both educational attainment and health in early life. Whether education affects health outcomes is, therefore, an empirical question.

Several studies have tried to identify the causal link between the level of education and health outcomes. Most studies identify the effect of education on health using the exogenous increase in the number of years of education caused by changes in compulsory school leaving age. Using this identification strategy, studies from Germany (Kempter et al., 2011), the Netherlands (Van Kippersluis et al., 2011), Sweden (Spasojevic, 2010), the UK (Silles, 2009) and a selected number of EU Member States, including south European countries (Brunello et al., 2015) show significant impacts of education on health outcomes. However, Arendt (2005) finds no effect in Denmark, Albouy and Lequien (2009) in France, and Oreopoulos (2007), Braakmann (2011) and Clark and Royer (2013) in the

UK. Meghir et al. (2012) find little if no long-lasting effects of education in Sweden.

The main limitation of this approach is that the impact of education on health is measured only for the young people who responded to the change in school leaving age, which happened 50 years ago. Other studies used surveys with detailed information about a range of individual characteristics, including family background, to control for all cofounding factors. For instance, Conti et al. (2010) show that in the UK higher educational attainment is associated with better self-reported health.

The health outcomes used vary widely across studies. Some focus on mortality (Van Kippersluis et al., 2011; Albouy and Lequien, 2009; Clark and Royer, 2013) while other use reported health – self-perceived health, long-term health problems – (Kempter et al., 2011; Brunello et al., 2015) or health-related behaviours, such as smoking as in Conti et al., 2010. The main purpose of these studies is to establish the causal effects of education on health, so they do not use measures of health traditionally used in the evaluation of healthcare programmes, such as the quality-adjusted life years (QALYs). Groot and Maassen van den Brink's study (2007), which estimates the effect of education on health in the Netherlands on QALY, is a notable exception. While QALYs are typically used to quantify the impacts of health care programmes, they can also consider health outcomes in cost-benefit analysis of policy interventions or estimate social costs and could be used to estimate the social costs associated with low-skilled adults.

In evaluating the impact of a youth programme in the UK, Nafilyan and Speckesser (2014) estimated health benefits for achievers of low and intermediate skills levels; these were consistently around a gain in 0.03 QALY weight per year. Based on a monetary value estimate of GBP 30 000 per QALY applied in most other studies, the authors estimated lifetime benefits of achieved qualifications of GBP 42 000. Most of this benefit affects individuals (due to better health/life quality) and, to a lesser extent, healthcare spending in public budgets. In this particular study, health benefits of higher level skills were almost as high as the individual lifetime net earnings gain.

4.1.4. Impact on individual criminal behaviour

Crime statistics show a strong negative correlation between educational attainment and crime, well documented in literature. For instance, in 2001, more than 75% of convicted people in Italy had no upper secondary qualification (Buonanno and Leonida, 2006). In the UK, 47% of prisoners said that they had no qualifications in 2012, compared to 15% of the general working age

population in the country (Ministry of Justice, 2012). In the Netherlands, 27% of early school leavers were suspected of a crime in comparison to 7% of non-early school leavers (Ministry of Education, Culture and Science, 2010). Among Swedes born between 1943 and 1955, male offenders had spent on average 0.7 years less in school than those not convicted (Hjalmarsson et al., 2011).

Following the seminal work of Becker (1968) there is consensus in economic literature that educational attainment is expected to affect criminal behaviour through three channels: income effects, time availability and patience or risk aversion. Education is expected to discourage participation in criminal activities, as it improves labour market prospects and increases the opportunity cost of crime. Young people who are enrolled in school may have fewer opportunities (and time) to engage in criminal activities than if they were on the streets: this is usually referred to as the 'incapacitation effect'. Education may also teach individuals to be more patient. This would discourage crime since more emphasis would be put on long-term outcomes, which would imply a greater deterrent effect of long prison sentences.

Several empirical studies have tried to estimate the causal effect of education on crime. Following Lochner and Moretti (2004), which used changes in state compulsory schooling laws in the US, most studies using European data use changes in compulsory school leaving age to identify a causal impact of educational attainment on criminal activity; they tend to find a crime-reducing effect of education. Lochner and Moretti (2004) find that a one-year increase in education is predicted to reduce male arrest rates by 11%.

Estimating the effect of educational attainment on youth conviction rates for three cohorts born between 1981 and 1983 in England, Sabates (2008) finds that the increase in educational attainment between cohorts is associated with reductions in conviction rates for most offences (burglary, theft, criminal damage and drug-related offences) but not for violent crime. Machin et al. (2011) find that, among males, a one-year increase in average schooling levels reduces conviction rate for property crime by 20% to 30% in England and Wales.

Hjalmarsson et al. (2011) show that among males in Sweden, one additional year of education reduces the probability of conviction by 7.5%, of incarceration by 16%, and the number of crimes by 0.4 per male. Among females, it reduces the probability of conviction by 11% and the number of crimes by 0.09. Buonanno and Leonida (2006) use a panel of 20 Italian regions between 1980 and 1995 to show that a 10 percentage point increase in high school graduation rates results in a 4% decrease in property crime rates and a 3% decrease in total crime rates. There is no evidence that university completion reduces crime. Groot and Maassen van der Brink (2010) use a Dutch dataset on criminal behaviour to

estimate the effect of education on five types of criminal offence. The results show that the number of years of education significantly reduces shoplifting and violence, but increases tax fraud offences.

Finally, Meghir et al. (2011), using Swedish data, show that there are inter-generational effects of education on crime. Young men whose fathers were affected by an increase in the compulsory schooling age have a 2.5% lower probability of being convicted.

4.2. Benefits of higher skills levels for society

Further impacts of higher levels of skills and education affect not only individuals but also outcomes such as civic engagement, participation in elections and the general functioning of society. Growing literature examines these effects of education, though much of this research is descriptive.

Cedefop (2011) shows that initial vocational education and training is positively associated with several social outcomes: individuals who completed vocational education and training report significantly higher levels of civic participation and self-rated satisfaction with their job and financial situation. Hoskinks et al. (2008) suggest that there is a significant democratic return associated with formal education while Kuppens et al. (2015) show that in the UK higher levels of education are associated with a wide range of positive outcomes: better health and well-being, higher social trust, greater political interest, lower political cynicism, and less hostile attitudes towards immigrants.

While the relationship between education and civic and social engagement has long been acknowledged (See Campbell, 2006, for a review), there is little empirical evidence of whether the relationship is causal. Dee (2004), finds that graduating from high school increases voter turnout and tolerance; he also finds a positive effect on newspaper reading and group memberships. Milligan et al. (2003) reach a similar conclusion for the UK, where more years of schooling increase voter turnout, although the effect is smaller than in the US. They show that increased level of education has a positive effect on the likelihood of following political campaigns, attending political meetings (in the US) and developing interests in politics in the UK. Using a similar approach, Siedler (2010) fails to find any causal effect of education on voting turnout in Germany. In a study using Norwegian data for secondary school students, Lauglo and Øia (2007) find that doing well in school and, especially, expecting to continue to higher education, are positively associated with civic engagement, both interest and participation.

Results from Schuller et al. (2004) which mix case study analysis based on 145 interviews among adults aged between 16 and 70 in the UK, with data analysis drawn from the 1958 British cohort study or national child development study (NCDS), show that learning generally leads to a wide range of benefits. Participants in adult learning are more likely to give up smoking and increase their level of exercise and life satisfaction. The quantitative analysis also shows clear evidence of the effects of learning in increasing tolerance, decreasing political cynicism, less authoritarian attitudes and heightened political interest. Results also report an increase in membership of organisations and tendency to vote in the 1997 election compared to 1987. Overall, results suggest that learning encourages more democratic value orientations and stimulates an interest in civic engagement. While the quantitative analysis cannot unequivocally establish the sequencing of participation in learning and its possible benefits, biographical analysis of the case study data demonstrated the accumulative effects of learning in reinforcing sequences: because I learn I develop these benefits and not the other way around.

Taken together, evidence from the case study and the longitudinal survey data converge on the same conclusions: participation in education has a range of non-market benefits that extend beyond the classroom into personal life and the community.

4.3. Benefits of higher skills levels for employers/firms

While there is substantial evidence on the engagement of employers in vocational education and training and investment in skills, we know surprisingly little about the impact of skills on firms (Conlon et al., 2012). The investment in skills could be repaid by increased labour productivity, a reduction in recruitment costs for higher skilled workers, saving of downtime due to lack of skilled staff, improved employer attractiveness for better talent because of offering training opportunities, and positive internal diffusion of knowledge. Although these are probably the main reasons why firms engage in training, empirical evidence of a long-term return on skills investment for employers, with the exception of apprenticeships (e.g. Hogarth et al., 2012; Pfeiffer et al., 2009), is limited and often inconclusive (e.g. Conlon et al., 2011).

A review of literature on firm-level effects of skills, related to different measures of skills and their impact on firm profitability, uncovered a few rigorous studies on firm-level returns on education compared to a rich evidence body on the private and aggregate returns on education. Most of the evidence for Europe comes from studies carried out using UK data, but there are also examples from

Belgium, Portugal and the US. While they all find positive impacts on productivity, they also highlight the potential endogenous bias arising from more productive firms attracting higher educated workers.

Disney et al. (2003) analysed productivity growth in UK manufacturing (1980 to 1992) using measures on the adoption of new technologies, which explains about 5%-18% of the productivity growth. Dearden et al. (2005) suggest that about half of the productivity gain brought about by training results in an 'employer return on skills investment' (based on vocational education and training spending). Galindo-Rueda and Haskel (2005) study the impact of educational attainment of the local labour force on firm-level productivity in the UK. They use merged data from the annual business inquiry and employer skill survey to estimate the effect of the share of workers with different qualification levels on company productivity, measured as the logarithm of gross value-added. They find that companies with larger shares of highly educated, male and full-time workers tend to be more productive.

Martins and Jin (2010) suggest that workers can learn from their colleagues and that this positive externality is reflected at firm-level. Using the Portuguese dataset *quadros de pessoal* and an aggregated version of individual Mincer equations, they estimate the effect of average schooling years of a firm's workers on its productivity, measured as the log of average real hourly earnings of that particular firm. The results indicate that profitability returns on education are between 14.2 and 18%.

Moretti (2004) uses data from the American census of manufacturers merged with the census of population to calculate the magnitude of education spillovers on manufacturing plant productivity. He estimates a Cobb-Douglas production function, where the dependent variable is the output of each plant and the explanatory variable of interest is the fraction of college graduate workers. By using a panel dataset, he is able to include time-interactions to control for potential sources of bias. The results show that a 1% increase in the share of college graduates in the city where the plant is located is associated with a 0.5-0.6 percentage point increase in output.

Riley and Robinson (2011) estimate the effect of the intangible capital stock on labour productivity growth at firm-level using the annual business inquiry (using labour costs for ICT, R&D and organisational capital as investment in intangibles) and find significant impacts of human capital variables on firm profitability.

Lebedinski and Vandenberghe (2013) use the Belgian dataset Bel-first to assess education's contribution to Belgian companies' productivity levels. They estimate a fixed effects model based on a Cobb-Douglas production function that

allows for labour heterogeneity. The companies' productivity is proxied by the value-added per worker and they focus on the effect of the composition of employees' educational attainment. They also control for the number of workers, capital, share of females, number of hours worked annually per employee and proportion of workers with open-ended contracts. The results of the fixed effects model suggest that university graduates are 23% more productive than school graduates. While the generalised method of moments (GMM) model indicates that university graduates exhibit a productivity advantage of 1.42 (42%) relative to primary graduates.

Literature suggests positive effects of human capital investment at company level in terms of productivity. Education equips people with the skills and competences that enable them to be more productive at work. It also equips people with the knowledge and competences which enable them to generate and adopt new ideas that spur innovation and technological progress (Woessman, 2014).

4.4. Benefits of higher skills levels for the economy

Over recent decades a large body of literature emerged examining the role of human capital in determining the level and growth of GDP per capita. Two broad sets of theoretical models have been developed to explain how education affects long-term growth. The classical growth models developed in the 1950s which build directly on the microeconomic theory of human capital; and the so-called endogenous growth models, which highlight the role of education in diffusing new technologies and new ideas.

Mankiw et al. (1992) estimate a Solow growth model augmented with human capital, measured as the average percentage of working-age population in secondary school during 1960-85. The estimation results suggest that a 1% increase in the average share of working-age population enrolled in secondary education translates into a 0.7% increase in GDP per working-age person. Conversely, Barro and Lee (1994) estimate an endogenous growth model using a panel dataset with a wide set of explanatory regressors, which include average years of secondary education of the adult male population at the beginning of the period studied. The results show that an increase in one year of secondary schooling translates into a 1.4% increase in per worker GDP growth. Benhabib and Spiegel (1994) estimate four different cross-country growth regressions based on a Cobb-Douglas aggregate production function. Human capital investment is proxied by the average level of log average human capital stock as measured by Kyriacou (1991). They do not find a significant impact of growth in

human capital on economic growth but they find that a 1% increase in the stock of human capital increases per capita GDP growth between 12% and 17%.

Fundamentally, neoclassical models imply that a one-off increase in the stock of human capital leads to a one-off increase in productivity growth, while endogenous models suggest that the same one-off increase in human capital can lead to a permanent increase in productivity growth. In the short term both models produce similar results, each dependent on their specifications, but in the long term the endogenous models imply significantly higher returns on investment in human capital (Wilson and Briscoe, 2004). Regardless of the specific models adopted, there is strong evidence that higher education increases productivity and higher levels of national growth.

Empirical research in recent years has shown that if education is measured by the skills learned, the education of a population is very closely linked to a its nation's long-term growth rate. However, in these analyses education is measured by actual achievement (test scores as proxies) rather than educational attainment. Studies adopting years of education as proxy for the education variable report a much weaker association with economic growth, suggesting that it is learning outcomes rather than attainment which matter (Woessman, 2014). At EU level this calls for continued focus on mutual learning and cooperation in education and training policies across Member States. Regardless of the models adopted, the macroeconomic benefits of education are undeniable: for example Woessman (2014) reports that an increase in educational achievement by 50 PISA ([69]) points translates into 1 percentage point higher rates of economic growth in the long term. According to the author, if the EU was successful at improving an average student's achievement by the equivalent of 25 PISA points, this would result in an economic gain of a staggering EUR 35 trillion.

4.5. Conclusions

As Dickson and Harmon (2011) put it, at individual level education can define major life outcomes (such as occupation and wage) and also contribute to improving one's individual satisfaction, well-being, self-esteem, self-awareness and consideration of the future. It may promote trust, civic engagement, active

([69]) The programme for international student assessment (PISA) is a triennial international survey which aims to evaluate education systems worldwide by testing the skills and knowledge of 15-year-old students. To date, students representing more than 80 economies have participated in the assessment (https://www.oecd.org/pisa/aboutpisa/pisa-participants.htm).

citizenship and social inclusion. Investment in human capital also affects economic growth through innovation processes: investment in education leads to a more skilled and competent population, which is able to generate and adopt new ideas that spur innovation and technological progress (Heinrich and Hildebrand, 2005).

While this chapter has explored the benefits of education and higher levels of skills in terms of benefits to individuals, employers, society and the economy, all of these benefits are interlinked and spill in all of the four dimensions analysed. For example, higher employability and higher returns also lead to higher revenues for governments in increased returns from taxes, as well as reduced spending on benefits such as income support. While education has an impact on improved individual health and lower involvement in criminal activities, these also impact the public purse in terms of public expenditure in healthcare and on prevention and prosecution of crime. Therefore, education is not only a private good associated with private benefits, but also a 'public good' (Heinrich and Hildebrand, 2005) which is associated with large gains to our economies and societies.

Chapter 5.
The costs of low-skilled adults

This chapter provides an estimate of the costs (and/or foregone benefits) of low skills to individuals, businesses, the economy and society at large. The general framework is largely similar to measuring the outcome of a (possible) public policy aimed at reducing the share of low-skilled adults in the EU. The valuation process is based on robust methodological approaches using empirical data for all EU-28 Member States and – where data are not available – building on findings from literature research on the impact of skills on main socioeconomic variables. The ultimate aim is to estimate – as much as this can be achieved – the individual and social value in monetary terms of a faster increase in the level of skills in Member States compared to the current trend.

5.1. Theoretical background

In economic theory, the human capital approach stresses that educational and training decisions play an important role in determining lifetime earnings (Becker, 1964; Mincer, 1974). However, the level of investment in education and training depends on how different people feel about giving up some of today's consumption in return for future rewards (Borjas, 2010) and on expectations about the lifetime earnings premium associated with employment at higher qualification/skill levels. Following a cost-benefit approach, rational individuals are expected to compare the anticipated net present value of the gain in lifetime earnings with higher qualification/skills (higher wage and employment probability) to the costs of education/training (both direct costs and opportunity costs in terms of foregone earning during the education/training spell).

Following standard microeconomic (neoclassical) principles, wages correspond to marginal productivity and so include microeconomic returns on education/training. The individual earnings return associated with higher level skills can be straightforwardly interpreted as the additional gross value-added (GVA) resulting from higher skills, so that the 'costs of low-skilled adults' can be estimated by comparing counterfactually higher level earnings to earnings observed for low-skilled adults today. In turn, this means that the social costs of low-skilled adults can be derived aggregating the counterfactual increase in individual lifetime earnings for low-skilled adults due to higher level skills (subject to discounting and further adjustments).

However, the economic benefit of higher-level skills to society at large (social benefit) is likely to differ from mere aggregation of individual lifetime earnings in various ways:

(a) extensions to standard microeconomic models, which allow for market imperfections (mobility barriers, firm-specific human capital, and non-perfect competition) suggest that individual wages may understate the full return on skills investment. First, since employers capture part of the increases in productivity, the impact of investment in skills on productivity usually exceeds the impact on wages (McIntosh, 2007; Hogarth et al., 2012; Pfeiffer et al., 2009) ([70]). In addition, a microeconomic analysis of implications for all stakeholders should also consider the perspective of the public sector in terms of relevant public expenditure and revenues;

(b) further, non-individual benefits would not be captured in aggregations without further assumptions. While skills investment may generate positive externalities and spillovers both within organisations and in the economy at large, a microeconomic analysis should also consider the impact of existing skills on returns since it may not be a realistic assumption at aggregate level to expect constant returns on skills (e.g. Cedefop, 2014);

(c) more generally, understanding the net benefits of higher level skills would require a macroeconomic approach suitable to considering deadweight losses, substitution and displacement effects at the system level.

The main obstacle in estimating the full extent of social costs of low-skilled adults results from lack of suitable research data, to capture returns beyond individual workers in terms of skills composition of the workforce, and the availability of unbiased case-control groups. Macroeconomic approaches also suffer from limitations: the lack of consideration of non-market values and distributional effects which estimates based on national accounts cannot include. Data available for the estimate in this specific exercise, which includes an unprecedented period of economic downturn, reduces the ability of the models to evaluate fully the role of spillovers and externalities which arise from public investments in human capital.

This is why we present results from both microeconomic and macroeconomic approaches, their explanatory value as well as their limitations.

([70]) Basically, all these papers refer to Dearden et al., 2005.

Table 15. **Approaches used to estimate the cost of low skills**

Microeconomic analysis		
	Benefits/reduced costs	**Costs/reduced benefits**
Individuals/ families	• individual wage return • higher probability (odds ratio) to be employed and/or to participate in the labour market • improved health, reduced crime • other intangibles such as well-being, social inclusion	• direct monetary costs such as education/training fees, learning materials) • opportunity costs (often not accounted in literature) such as lower or no earnings when acquiring skills, loss of unemployment benefits, family/leisure time)
Employers/ firms	• productivity gains and higher returns on investment • saving of downtime due to lack of skilled staff and saving of recruitment costs	• staff costs of individuals (when people engage in training, but do not contribute such as in apprenticeships) • course fees and/or staff costs of supervising staff on training; other direct costs for workshops, learning materials
Fiscal/public sector	• higher activity rate and lower unemployment reduce unemployment and out-of-work social benefits, ALMP public expenditure • higher wages increase tax revenues • better health reduces healthcare spending • reduced crime/positive effects on communities – reduce costs to legal and social assistance systems	• costs for education/training spending (equivalent to upper secondary qualifications) • reduced revenues for people participating in education
Macroeconomic analysis		
	Benefits	**Costs**
Society at large	• higher productivity and economic growth → no simple aggregation of individual benefits (deadweight loss, displacement and substitution effects) • merit wants, positive externalities, and distributional objectives, such as reduction of inequalities, social exclusion, gender gaps, crime; increase in non-monetary well-being, citizenship.; reduction in the black/informal economy	• increase in aggregate spending on education and training (accounting problems)

Source: Cedefop elaboration.

5.2. The impact of skills at microeconomic level

5.2.1. Individual costs of low skills for young adults

Empirical estimates of the incremental benefit (wage returns) that individuals can achieve through further investment in skills beyond ISCED 2 are based on the Mincer earning function, one of the most widely used models in empirical economics.

5.2.1.1. *Relevant definitions of low-skilled adults*

While low-skill is a multidimensional phenomenon, available data sources limit estimates of the costs of adult low skills to three main definitions:

(a) low-skilled people: people with low educational attainment, at or below lower secondary school (ISCED 0-2) ([71]);

(b) low-skilled jobs: people working in elementary occupations (major group 9 in ISCO-08) ([72]);

(c) skills obsolescence: people with educational attainment at ISCED 3 or above, who work in either elementary occupations (S1, ISCO major group 9) or in elementary occupations, low-skilled employment, craft and related trades workers or in skilled employment in agriculture (S2, ISCO-08 major groups 6-9).

5.2.1.2. *Data: EU-SILC versus EU-LFS*

Both, the EU-LFS and the EU-SILC micro data contain consistent codes for occupation (major groups of ISCO-08) and education concepts (ISCED levels). We use EU-SILC data because of the superior quality of earnings data compared to EU-LFS data ([73]). Data from 2011 EU-SILC ([74])includes important characteristics which allow mitigation of sources of bias in empirical earnings functions, particularly background characteristics of the parental household and the parents' education levels at age 14. Although the overall sample of EU-SILC, which varies between about 8 000 in Iceland and 44 000 in Italy, is smaller than EU-LFS, sample sizes are large enough to estimate models separately for every EU-28 Member State using a consistent concept of low skills and further variables required in Mincer models (such as work experience and gender).

([71]) A similar approach is followed in other studies previously mentioned (Davia et al., 2009; Quintini, 2014) who focus on qualifications attainment as the key skills variable. EU-SILC refers to the 'highest level of qualifications attained' (in ISCED levels) and we specifically focus on the returns on upper secondary education relative to a base category combining 'lower secondary education' and lower levels (primary/pre-primary).

([72]) Consistent with evidence reviewed in previous section of this study (e.g. Machin and Van Reenen, 1998).

([73]) EU-LFS only includes monthly take home pay in deciles, and is not available for all countries.

([74]) At the time the study was carried out, more recent data were available from EU-SILC for 2012-13.

5.2.1.3. *Earnings and skills: the role of contextual factors*

This analysis uses the EU-SILC variable cash and near-cash income (PY010G) in euros per year adjusted to the working hours (PL060). The resulting earnings variable is unaffected by part-time effects and comparable for people in dependent employment and self-employment ([75]). To account for the effect of unemployment on returns on skills, the earnings variable is set to zero for the unemployed. Wage returns can be estimated straightforwardly also for low-skilled jobs (as all people working in low-skilled jobs are observed with a wage) or skilled people working in low-skilled employment.

In the Mincer model, a causal relationship between education level and earnings is identified only if all factors that influence both the probability to achieve particular education qualifications and earnings in adulthood are included in the regression model. If factors such as parental background ([76]) are not accounted for, the estimated coefficients are likely to be biased. For this reason the analysis uses a two-step Heckman selection model, including a number of further observable characteristics affecting labour supply, such as gender, age, marital status, whether there are any children under the age of 18 in the household, the use of paid childcare and childcare by relatives and the spouse's employment status and level of education, characteristics of parental education background, and household characteristics. Results from the probit model show that significant selection bias can be observed in most countries (except in Belgium and Germany).

5.2.1.4. *Earnings and skills: more than just education and training*

To avoid overestimating the value of formal education and training, the specification adopted explains earnings in two main ways:

(a) as a function of education and training experience;
(b) as a function of work experience (as a second order term, with a flattening profile over the life-course).

Inclusion of work experience is important as it recognises that skills are not only acquired in formal education but also on the labour market as individuals

([75]) We further adjust this hourly variable by removing observations with extreme values of observed earnings, at the 99-percentile and the 1-percentile of the distribution.

([76]) If children from more privileged family backgrounds tend systematically to earn more at any level of education (because, for instance, they have access to their parents' network), then omitting information about parental background would overestimate the role of education.

continually invest in improving their human capital while working. Therefore, the inclusion of work experience contributes to robust and realistic estimations.

Box 8. **Specification adopted to estimate earnings differentials due to differences in skills**

The general specification of the Mincer equation adopted in this study is as follows:

$$\ln y = \ln y_0 + rS + \beta_1 EX + \beta_1 EX^2$$

where, y_0 represents hourly earnings of someone without education and work experience. *S* is a measure for education (such as years of education completed or a set of dummy variables to identify the type and level of highest qualification attained by individuals); *EX* shows the number of years of (potential) labour market experience.

In line with the scope of this study, the Mincer model is estimated separately for all EU-28 Member States and for the adult population (age 25 to 65), making use of cross-section data from EU-SILC. We estimate these models in samples of *i* individuals in the different Member States with *k* discrete categories of educational attainment (with ISCED 0-2 representing the base category of low education):

$$\ln y_i = \ln y_0 + r_k S_{k,i} + \beta_1 EX_i + \beta_1 EX_i^2 + \varepsilon_i$$

where ε represents the error term of the empirical model. The empirical estimate estimates of the coefficient at the margin of low and intermediate skill-levels (ISCED 3 over ISCED 2) can be interpreted as the incremental wage increase intermediate versus low skills.

5.2.1.5. *Findings*

Table 16 shows estimated coefficients of ISCED 3 compared to a base category including the adult population 'below upper secondary education' (ISCED 0-2). While the findings of a naïve OLS model suggest substantial and significant earning premiums of ISCED 3 for all Member States, the Heckman selection model ([77]) shows more realistic estimates of the wage premium as the differential risk of unemployment by skills groups and parental background characteristics are included ([78]). Nonetheless, return on skills is above 20% in most countries presenting significant coefficient estimates.

([77]) Heckman selection model has been used to address the selectivity bias of participation in employment (e.g. Hanusheck and Schwerdt, 2013; Mendolicchio and Rhein, 2011).

([78]) Differential risk of unemployment by skills groups and parental background characteristics are included to address the issue of endogeneity of the educational variable.

Table 16. **Incremental returns on skills**

	ISCED 3 over ISCED 0-2		ISCO 8 (over ISCO 9)	Working ISCO 9 ISCED 3- (over all ISCED 3)
	(1) OLS	(2) Heckman model	(3) OLS	(4) OLS
BE	0.162***	0.135***	0.169***	-0.141***
BG	0.299***	0.388***	0.282***	-0.154***
CZ	0.274***	0.163***	0.254***	-0.296***
DK	0.132***	-0.047	0.118***	-0.191***
DE	0.201***	0.174***	0.120***	-0.434***
EE	0.142***	0.099*	0.224***	-0.302***
IE	0.148***	0.199***	0.068	-0.295***
EL	0.259***	0.104**	0.291***	-0.153***
ES	0.233***	0.113***	0.231***	-0.294***
FR	0.145***	0.071**	0.113***	-0.094***
HR	0.313***	0.171***	0.159***	-0.145***
IT	0.354***	0.208***	0.261***	-0.260***
CY	0.353***	0.214***	0.542***	-0.568***
LV	0.234***	0.095**	0.411***	-0.348***
LT	0.107*	-0.108	0.203***	-0.269***
LU	0.379***	0.314***	0.241***	-0.455***
HU	0.252***	0.160***	0.213***	-0.198***
MT	0.305***	0.215***	0.249***	-0.242
NL	0.222***	0.170***	0.241***	-0.162***
AT	0.311***	0.189***	0.167***	-0.271***
PL	0.268***	0.102***	0.326***	-0.227***
PT	0.371***	0.367***	0.090*	-0.218***
RO	0.240***	0.013	0.297***	-0.158***
SI	0.257***	0.263***	0.165***	-0.244***
SK	0.233***	0.159***	0.203***	-0.236***
FI	0.100***	0.013	0.198***	-0.201***
SE	0.392***	0.080	0.146*	-0.098*
UK	0.186***	0.222***	0.054	-0.194***

* p<0.05; **p<0.01; ***p<0.001

NB: Analysis: Linear regression model with Heckman correction (ISCED) or OLS (ISCO).

Weight: pb040/personal cross-sectional weight.

Selection: EU-28 (pb020/country); age range 25-65 (derived combining PB130/month of birth, PB140/year of birth, PB100/month of personal interview, PB110/year of personal interview, impute month of birth where unobserved); outside education pe010/current education activity; selection in labour force (pl031/self-defined economic status).

Dependent variable: hourly wages (derived combining pl060/number of hours usually worked in main job; py010g employee cash or near case income; truncated 1/99%iles; logged).

Variables included: Mincer variables: level of education pe040 'highest ISCED level attained'; occupation pl050/ISCO-88 major group; work experience (derived combining pb110/year of survey, pe030/year when highest level of education was attained); pb150/sex.

Background characteristics: children under 18 years (derived from personal register based on rb010/year of survey, rb080/year of birth, rb220/father id, rb230/mother id, rl030 childcare at centre, rl040 childcare day-care, childcare childminder/rl050), spouses economic status (derived from pl031/self-defined economic status)

Source: Cedefop estimate on EU-SILC, 2011.

The estimated wage returns for people working in better jobs than elementary occupations (ISCO 8 over ISCO 9) are also significant in almost all countries, ranging between 9% in Portugal and 54% in Cyprus (column 3 of Table 16.

Column 4 of Table 16 presents estimates for mismatch, i.e. workers with ISCED 3 or above employed in elementary occupations. The estimated coefficients are consistently negative and significant in most Member States (except in Malta) and show that positive wage returns associated with ISCED 3 or above qualifications are, on average, lower than of people with these qualifications working in higher skilled jobs. In most countries the wage penalty is around 20% to 30%, although there are countries where it is much higher, including Germany (-43.4%), Estonia (-30.2%), Cyprus (-56.8%) and Luxembourg (-45.5%).

5.2.1.6. *Cumulative (foregone) earnings for individuals aged 25 to 29*

To estimate monetary values of returns on skills for individuals aged 25 to 29 ([79]), we use the observed cash earning and the estimated coefficients from the Mincer models to derive the full lifetime earnings gains over the 40 years post-25 in the labour force, subject to average trend growth and discounting ([80]). We focus on cumulative returns of investing in ISCED 3 qualifications as opposed to ISCED 0-2 by using the salary of individuals aged 25 to 29 ([81]). As shown in the first column of Table 17, cumulative returns vary widely across Member States.

5.2.1.7. *Opportunity costs: education and training come to a cost*

To derive net costs of low skills at the micro/individual level, we parameterise the opportunity cost of investing in an ISCED 3 qualification as the forgone income of the years spent studying, i.e. the income which would have resulted from working with a lower secondary qualification right after leaving education. Based on EU-SILC

([79]) While we used EU-SILC data from 2011 to estimate costs of low skills to individuals based on the different demand and supply concepts of low-skills concepts set out in Chapter 1, we confined the valuation of the monetary costs of low skills to ISCED education variables: first because an estimate of the time spent to acquire higher level of skills is possible only for ISCED levels; and second, because demand-orientated concepts of low skills can all only be applied to employed people while the analysis is to involve the whole population.

([80]) Assuming an average trend in economic growth of 2% and a discount rate of 3.5%.

([81]) Obtained from EU-SILC data 2012. Estimated earnings are independent of people's employment probabilities since we considered both employed and unemployed individuals (the latter with wages set to 0).

Table 17. **Costs of low level skills to the individual**

Country	Cumulative earnings from higher skills (EUR)	Investment costs to individual (EUR)	Net benefit of higher skills in (EUR) (=costs of low skills)	Cumulative earnings/ investment costs ratio
BE	75 200	21 400	53 800	3.5
BG	14 900	1 900	13 000	7.8
CZ	24 900	11 500	13 400	2.2
DK	–	44 800	–	–
DE	53 400	15 600	37 800	3.4
EE	18 500	16 200	2 300	1.1
IE	68 500	10 500	58 000	6.5
EL	22 200	5 900	16 300	3.8
ES	30 900	11 900	19 000	2.6
FR	31 000	17 200	13 800	1.8
HR	13 500	5 600	7 900	2.4
IT	96 200	20 900	75 300	4.6
CY	55 900	15 600	40 300	3.6
LV	8 700	7 500	1 200	1.2
LT	–	2 500	–	–
LU	277 500	34 500	243 000	8.0
HU	10 800	6 100	4 700	1.8
MT	84 800	13 700	71 100	6.2
NL	147 000	52 700	94 300	2.8
AT	82 700	23 700	59 000	3.5
PL	12 500	5 900	6 600	2.1
PT	90 300	12 200	78 100	7.4
RO	–	5 500	–	–
SI	74 200	27 700	46 500	2.7
SK	13 700	6 000	7 700	2.3
FI	–	38 200	–	–
SE	–	24 100	–	–
UK	76 000	33 400	42 600	2.3

NB: Values rounded to nearest EUR 100 and only for countries where the return on ISCED 3 qualifications (compared to ISCED 0-2) was statistically significant at 95% level.

Analysis: valuation.

Weight: none/individual.

Selection: EU-28 (pb020/country); age range 25-65 (derived combining PB130/month of birth, PB140/year of birth, PB100/month of personal interview, PB110/year of personal interview, impute month of birth where unobserved); outside education pe010/Current education activity; selection in labour force (pl031/self-defined economic status).

Valuation parameters:

- life-course income differential at age 25 – derived from Table 16/country-specific returns on ISCED 3 and work experience coefficients [Heckman models]; py010g_2/employee cash or near-cash income [zero for unemployment]; period: 40 years; discount rate: 3.5% p.a.; growth rate: 2% p.a.;
- opportunity costs: income of low skills aged 15-24 assuming that most people take their qualification at this age – derived from pe040/level of education, py010g_2/employee cash or near-cash income [zero for unemployment]; and duration to acquire ISCED 3 (derived from pe040/level of education, pe030/year when highest level of education was attained); duration changed in Portugal, Finland and Sweden to officially reported figures due to small cells; discount rate/growth rate in opportunity costs: assume none.

Source: EU-SILC 2011 (impact)/EU-SILC 2012 (valuation) and Cedefop calculations.

data, observed earnings are multiplied by the average duration needed to achieve upper secondary education in the different Member States ([82]). The result of these calculations is reported in the second column of Table 17.

5.2.1.8. *Net benefit of skills investment for the average young adult*

As a result of both the incremental return on lower skills and the opportunity costs of skills acquisition (excluding direct costs), we derive net benefits of skills investment in terms of learning returns. These (foregone) net benefits are usually highest in high-income economies, particularly Luxembourg and the Netherlands, and lower in countries such as Estonia, Latvia, Hungary, and Poland ([83]).

The average net benefit of higher skills is about EUR 44 000. Although few reference points are available to validate our findings, our estimate is largely consistent with results obtained for individual countries where similar approaches have been applied (Colon et al., 2011).

One of the strengths of this approach is that we account for the individual's opportunity costs, that is the foregone earnings that individuals could have earned working in lower skill regular employment during the period of further education/training. Opportunity costs are often not accounted for in existing analyses of returns on further education and training (e.g. McIntosh, 2007). Other types of costs and benefits, both monetary and non-monetary, are not considered at this stage due to lack of reliable information and/or the high degree of subjectivity that would need to be introduced in the analysis ([84]).

5.2.2. Empirical estimates of the impact of skills on health

Several studies have shown that health is one of the strongest predictors of well-being and one of the main economic benefits of higher levels of basic skills and key competences in the population. In this section we compare health outcomes between the low-skilled (ISCED 0-2) and the group with marginally higher skills (ISCED 3).

([82]) According to EU-SILC, across the EU between two and four years are typically needed to acquire an upper secondary degree.

([83]) An adjustment in purchasing power standards (PPS) would be likely to reduce differences between countries.

([84]) Such as intangible costs related to the loss of leisure time, and the effort of learning; possible wages and other monetary benefits gained during an apprenticeship or other vocational training experience; intangible benefits in terms of happiness and satisfaction because of a positive learning experience. Direct costs (tuition fees, learning materials, or travel and childcare costs) may also affect individuals when they are not supported by employers or the government.

5.2.2.1. *Observed health differentials (ISCED-0-2 versus ISCED 3)*

EU-SILC contains several health-related questions. Table 18 shows the difference in the proportion of respondents with ISCED 2 and 3 reporting:

(a) long-lasting/chronic illness or condition;
(b) good or very good health;
(c) limitation in activities because of health problems;
(d) unmet medical needs or treatment.

Table 18 shows a wide cross-country variation in the proportion of respondents to the different questions, partly due to structural differences across the countries (age structure, quality of the health care system, expectations towards health and tolerance of illness). However, statistically significant differences in the proportion of respondents can be observed between the low-skilled and those with upper secondary education (ISCED 3).

For instance, differences between ISCED 0-2 and ISCED 3 can be observed for respondents reporting that they suffer from a long-lasting/chronic illness or condition. The incidence of long-lasting/chronic illness is twice as high among the low-skilled as for those with upper secondary education in Croatia, the Czech Republic and Malta. In Malta for example, 20.8% of low-skilled adults report suffering from long-lasting health problems, compared to 9.6% of those with upper secondary education, a difference of 11.2 percentage points. Substantial differences also are observed in Belgium, Cyprus, Finland, Ireland, Portugal and the UK. Similar results can be observed for the other questionnaire variables.

5.2.2.2. *Impact of skills on quality-adjusted life years (QALYs)*

Health differentials between groups are typically measured in quality-adjusted life years (QALY) weights, an index scale ranging from 0 to 1, where 1 refers to perfect health and 0 to near death ([85]). QALY weights can be derived directly from health questionnaires or can be estimated through probit regressions using information on self-perceived health (Cutler and Richardson, 1997). EU-SILC includes self-perceived health questions which appear to be strongly correlated with the prevalence of long-term and activity-limiting health problems

([85]) For instance, a value of 0.8 means that the present year of life is estimated to be worth 0.8 year of life in perfect health.

Table 18. **Skills and health: systematic differences in the proportion of ISCED 2 and 3 respondents (ISCED 3 – ISCED 0-2)**

	Long-lasting/ chronic illness or condition	Very good or good health	Limitation in activities because of health problems	Unmet need for medical examination
BE	-0.089***	0.097***	-0.106***	-0.032***
BG	0.000	0.061***	-0.001	-0.089***
CZ	-0.144***	0.165***	-0.147***	-0.03*
DK	-0.016	0.053	0.035	-0.017
DE	-0.069***	0.139***	-0.136***	-0.054***
EE	-0.015	0.004	-0.018	-0.034
IE	-0.097***	0.09***	-0.069***	-0.027**
EL	-0.075***	0.095***	-0.081***	-0.019
ES	-0.04***	0.074***	-0.042***	0.000
FR	-0.076***	0.096***	-0.061***	-0.013
HR	-0.117***	0.231***	-0.099***	-0.059***
IT	-0.038***	0.093***	-0.071***	-0.043***
CY	-0.117***	0.127***	-0.055***	0.017*
LV	-0.002	-0.019	-0.007	-0.058***
LT	-0.062*	-0.004	-0.030	-0.016
LU	-0.068***	0.115***	-0.061***	0.002
HU	-0.077***	0.146***	-0.083***	-0.084***
MT	-0.112***	0.123***	-0.032***	-0.021***
NL	-0.017	0.067***	-0.025	-0.003
AT	-0.079***	0.191***	-0.099***	-0.008
PL	-0.039**	0.115***	-0.043***	-0.046***
PT	-0.114***	0.207***	-0.074***	-0.046***
RO	-0.027***	0.043***	-0.044***	-0.05***
SI	-0.08***	0.164***	-0.091***	-0.002
SK	-0.047*	0.12***	-0.076**	-0.075***
FI	-0.143***	0.105***	-0.042	-0.007
SE	-0.071**	0.039	-0.067**	-0.049*
UK	-0.113***	0.151***	-0.088***	0.001

* p<0.1 **p<0.05 ***p<0.01
Weight: pb040/personal cross-sectional weight
Selection: EU-28 (pb020/country); Age range 25-65 (derived combining PB130/month of birth, PB140/year of birth, PB100/Month of personal interview, PB110/year of personal interview, impute month of birth where unobserved); Outside education pe010/Current education activity.
Dependent variable column 1: ph020/Long-term health problems.
Dependent variable column 2: ph010/Very good or good health.
Dependent variable column 3: ph030/Limitation in activities because of health problems.
Dependent variable column 4: ph040/Unmet need for medical examination.
Variables included: Level of education pe040 'Highest ISCED level attained'

Source: EU-SILC, Cedefop estimate.

The probit approach is used by Groot and Maassen van den Brink (2007) to estimate the effect of education on health in the Netherlands. In the empirical modelling we have to distinguish between the true quality of health, H^*, a latent variable which cannot be directly observed, and the subjective measure of health, H^S, which is measured by the self-perceived health question. The latent quality of health variable is assumed to be related to educational attainment in the following way:

$$\mathrm{H}^* = \sum_{\mathrm{i}=3}^{6} \beta_{\mathrm{i}} \mathrm{ISCED}_{\mathrm{i}} + \mathbf{x}\gamma + \varepsilon$$

Where $ISCED_i$ is equal to 1 if the respondent's highest qualification is of level *i*. ISCED 0-2 is the excluded category, so that β_i measures the differential in latent health associated with $ISCED_i$ qualification, compared to low-skilled adults. **x** is a vector of individual characteristics (including parental backgrounds) and ε is an error term capturing unmeasured factors.

The observed health status H^S is a categorical ordered response variable and is assumed to be related to the latent variable in the following way:

$$\mathrm{H}^{\mathrm{S}} = \mathrm{k} \leftrightarrow \alpha_{\mathrm{k}-1} < \mathrm{H}^* \leq \alpha_{\mathrm{k}}, \mathrm{k} = 1, \ldots, 5$$

Here n is the number of response categories (5 for the general health question in EU-SILC) and α_i are threshold levels. The coefficients can be estimated using ordered probit models.

Cutler and Richardson (1997) provided an easy way to calculate the QALY weight based on coefficients from ordered probit regressions. The β coefficients are not scaled (in theory they can range from $-\infty$ to $+\infty$) and need to be normalised to derive a QALY weight (which ranges between 0 and 1). Normalisation is obtained by dividing the coefficient by the difference in the thresholds of the upper and lower category. The QALY weight for qualification of level i is given by:

$$\mathrm{QALYw}_{\mathrm{i}} = \frac{\beta_{\mathrm{i}}}{\alpha_4 - \alpha_1}$$

The QALY weight measured by this approach can be interpreted as the difference in QALY weight between low-skilled adults and those with qualification $ISCED_i$, controlling for relevant individual characteristics.

The main issue is that differences in QALY weight across education may also be affected by other factors such the level of parental resources (Cutler and Lleras-Muney, 2012). This is why we use data from the 2011 EU-SILC, which

contains an *ad hoc* module on intergenerational transmission of disadvantages. This module asks people aged 25 to 59 questions about their parental background when they were around 14 and allow us to include in the model specification the following characteristics of the individuals ([86]):

(a) gender;
(b) age (five-year bands);
(c) time since highest qualification was obtained (five-year bands);
(d) migration status;
(e) region (NUTs 1);
(f) father's and mother's education level;
(g) father's and mother's activity status;
(h) financial situation of the household;
(i) tenancy status.

5.2.2.3. *Valuation of individual health differentials*

The differential in QALY weight can be used to derive monetary values of the health cost of low skills. The EuroVaQ project developed different methods to determine the monetary value of a QALY across several Member States (Donaldson et al., 2010). For this study, following a conservative approach we take the mid-point of the different estimates to derive the health cost of low-skilled adults in Member States ([87]) We also show the cumulative difference in QALYs under the conservative assumption that the life expectancy at age 25 is the same for low-skilled adults as for the average individual. Appropriate discounting is used to account for the fact that individuals tend to value benefits today more than benefits expected to occur in the future ([88]).

Table 19 shows the cumulative difference in QALYs between low-skilled adults and those with upper secondary education, plus estimates of the lifetime

([86]) Individual characteristics such as activity status, marital status, and income were not included in the model, as part of the effect of education on health may go through these channels (they are considered to be 'bad' controls). It must be considered that there are other factors that may drive the correlation between health and education that we could not capture, such as intertemporal preferences of individuals. Since information such as health status in childhood was not available, we were also unable to address potential reverse causality (effect of health on educational attainment).

([87]) Although the EuroVaq final report (Donaldson et al., 2010) did not present estimate of value per QALY for France, it presents estimates of value per life year. Value per QALY in France was imputed based on the ratio of value per QALY to value per life year in the other countries.

([88]) We used a 3.5% discount rate, and 2% expected growth.

health costs associated with low-skilled adults in the countries for which estimates of value per QALY are available. In most countries, low-skilled adults are expected to enjoy significantly less QALYs than those with upper secondary education, although significant cross-country variation can be observed. In addition to QALY differentials, estimates of lifetime health costs of being low-skilled are also considered in the analysis. Although these estimates are available in seven Member States only, this permits an estimate of the lifetime health costs associated with low skills.

Table 19. **Lifetime health costs of low skills**

	QALY weight differentials ISCED 3 over 0-2 (A)	Life expectancy at age 25 (B)	Lifetime differences in QALYs (C=A*B)	QALY value (D)	Lifetime health costs (not discounted) (E=C*D)	Lifetime health costs (discounted) F=E (NPV)[a]
DK	0.129***	55.9	7.2	36 983	266 278	177 532
ES	0.025**	58.6	1.5	79 459	119 189	79 465
FR	0.072***	58.0	4.2	42 476	178 399	118 942
HU	0.092***	51.5	4.7	31 744	149 197	99 472
NL	0.084***	57.0	4.8	56 789	272 587	181 738
SE	0.089*	57.5	5.1	51 054	260 375	173 596
UK	0.111***	56.7	6.3	60 032	378 202	252 153

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

([a]) net present value

NB: Values per QALY refer to the mid-point values from the three different estimates in the EuroVaQ report (Donaldson et al., 2010).

Analysis: valuation.

Weight: none/individual.

Selection: EU-28 (pb020/country); age range 25-65 (derived combining PB130/month of birth, PB140/year of birth, PB100/month of personal interview, PB110/year of personal interview, impute month of birth where unobserved); outside education pe010/Current education activity.

Valuation parameters:

- quality-adjusted life years (QALYs) monetary value – derived from ordered probit analysis of EU SILC 2011 ad hoc module (intergenerational transmission of disadvantages, life expectancy at age 25 Eurostat [series name]; per-QALY monetary values (Donaldson et al., 2010); period: 40 years; discount rate: 3.5% p.a.; growth rate: 2% p.a.;
- quality-adjusted life years (QALYs) monetary value – alternative derived from ordered probit analysis of EU SILC 2011 ad hoc module (intergenerational transmission of disadvantages, life expectancy at age 25 Eurostat [series name]; per-QALY monetary value changed to EUR 31 250 (based on National Institute for Health and Care Excellence in the UK/midpoint (NICE, 2013)); adjusted to other countries based on GDP per capita differentials [series nama_10_pc].

Source: EU-SILC 2011 (impact)/Cedefop calculations; life expectancy at age 25: Eurostat.

Results from countries where full information is available confirm that low levels of skills are associated with substantial health costs. The lifetime present value ([89]) of health costs for the average low-skilled would be about EUR 150 000 and a corresponding average QALY value of about EUR 50 000.

([89]) Under the usual assumptions of 3.5% discount rate and 2% growth rate.

As figures acquired from studies such as the EuroVaQ tend to exceed national sources, towards the end of the final estimates provided in this study we assumed a very conservative QALY value of EUR 31 250 (midpoint of estimates provided in the guidelines used by the NICE-UK (NICE, 2013)). The estimates for other countries are calculated weighting the QALY value for the GDP of the country concerned (GDP ratio).

5.2.3. Valuation of the impact of skills on crime

It is widely recognised in specialised literature that there are benefits to education and training in relation to crime. These are not considered by individuals themselves and so help increase the social return on education and training distinct from the private return. Five possible channels can be identified.

(a) income effects, since education and training raise the opportunity cost of time spent engaged in criminal activity or in subsequent incarceration;
(b) direct effects on risk aversion, since education and training may reduce discount rates of individuals and, therefore, the propensity to commit crime because of the associate risk of future punishments;
(c) direct (positive) effects on the return on crime may also occur if education and training may increase the earnings one can derive from crime, the association of crime and education is positively influenced;
(d) direct effects on reducing motivation to commit crime, relevant especially for teenagers who tend to participate in criminal activities generally for futile and hedonic reasons.

However, only a few studies provide concrete monetary measures of the benefits arising from the crime-reduction effect of education and training; they generally do not identify the magnitude of the benefit separately for individuals and society at large as this is particularly difficult to measure. The available estimates can be interpreted as social savings from crime reduction associated with higher level of education/skills.

For this study, the best estimates of the effects of education and training in monetary terms are provided by Lochner and Moretti (2001; 2004) and Machin et al. (2011).

(a) Lochner and Moretti (2004) estimate the effect of education in the US on participation of criminal activity and find that schooling significantly changes criminal behaviours. They distinguish between social and private return on education and estimate that social savings is about 20% of private returns associated to with high school graduation. From this it is estimated that a one percentage point increase in male high school graduation rate would have resulted in around 95 000 fewer crimes taking place in 1990 for a

social benefit of USD 1.4 billion (at 1993 price), leaving aside many of the costs associated with crime and including only a partial list of all crime. On this basis, an underestimate of the social benefits per additional male graduate would be about EUR 5 000 at current price (USD 3 000 in 2008 ([90]));

(b) Machin et al. (2011) study the crime-reducing potential of learning, framing the analysis in a regression-discontinuity setting under the assumption of an increase in the age of leaving from education and training. The empirical analysis identifies a robust, causal impact of education on property crime. They estimate the social benefits from crime reduction that would follow from a 1% reduction in the percentage of individuals with no qualifications: this would result in about 0.9% fall in property crime convictions, producing a total net social benefit of 30 million GBP (in 2007 prices) over a 10-year span. The study suggests that the social benefits from the crime-reducing effect of education are EUR 16 000 at current price (GBP 10 000 in 2007 prices) per additional male qualification.

In their empirical analysis, Machin et al. (2011) identify a robust, causal impact of education only on property crimes, while results on violent crimes were not significant. If their estimates were to be robust and significant also for violent crimes, as for Lochner and Moretti (2004), the full impact of the crime-reducing effect of education would be even higher as the unit cost of violent crimes, as estimated for instance by Dubourg et al. (2005), is substantially higher than property crimes.

5.2.4. Costs of low skills to firms

The key benefits of higher level skills to firms are increased productivity and profitability, which represent a return on investment to the employer, in addition to individual wage increases found in empirical studies. Literature also discusses the effect of skills on further organisational outcomes like innovation or growth. Hogarth et al. (2012), Konings and Vanormelingen (2015), Dearden et al. (2005) found a positive employer return on skills investment with about half of the productivity gain brought about by training. Further benefits of skills investment by employers are lower recruitment costs for skilled workers if they provide in-house training and achieve higher skill levels, which would also increase profitability. While these are tangible benefits, they are difficult to calculate/estimate.

([90]) Based on the estimates converted in 2008 dollar by Lochner and Moretti (2001).

Table 20. **Compensation of employees and operating surplus in 2015**

	Compensation of employees (A)	Gross operating surplus and mixed income (B)	Surplus/compensation ratio (%) (C)
EU-28	6 952 106	5 939 780	85
BE	206 846	162 821	79
BG	18 027	20 474	114
CZ	66 549	84 558	127
DK	140 775	87 205	62
DE	1 538 440	1 187 774	77
EE	9 843	7 947	81
IE	78 294	157 940	202
EL	59 021	94 366	160
ES	509 894	460 156	90
FR	1 136 828	757 891	67
HR	20 816	15 498	74
IT	651 294	768 014	118
CY	7 690	7 252	94
LV	10 585	11 014	104
LT	15 334	17 887	117
LU	24 847	21 698	87
HU	45 949	45 162	98
MT	3 851	3 884	101
NL	331 798	274 612	83
AT	163 418	132 676	81
PL	156 634	221 550	141
PT	77 546	78 095	101
RO	51 784	89 374	173
SI	18 774	14 503	77
SK	29 942	40 756	136
FI	102 460	80 355	78
SE	211 892	142 434	67
UK	1 280 194	982 678	77

Source: Eurostat, GDP income components.

5.2.4.1. *Benefits to employers of higher level of education and skills*

Apart from theoretical reasons ([91]), the main difficulty with estimating the employer benefit of higher level skills is the lack of suitable research data. Although some empirical estimates are available in literature (e.g. Konings and Vanormelingen, 2015; Crépon et al., 2003; Hellerstein et al., 1999; Hellerstein

([91]) In a hypothetical perfect completion economy factors of production, capital and labour, would be allocated and paid for in accordance to their marginal. As a consequence, workers paid below their true level of productivity would find alternative employment and, in the longer term, wages and productivity would be aligned. However, more recent literature explains why productivity of employees is to increase more than their wages in response to training.

and Neumark, 2007), to provide a comprehensive estimate of the overall benefits of skills investment at EU level, we will make use of data provided by Eurostat on GDP income components ([92]) and specifically of the gross profit ratio of non-financial corporations as a proxy for firms' profits.

For the purpose of our estimate a surplus/compensation ratio has been calculated to complement the cumulative (foregone) earnings for individuals and take into account added value created during the production process which remunerates capital and employers' work more generally.

Table 21 shows the ratio between compensation of employees and surplus remunerating capital and employers' work at 85% in 2015. That is to say that about 46% of the added value distributed to employees and 'employers' goes to the latter. This is a value close to the above empirical findings and is stable over time.

On this basis, in addition to the cumulative returns for individuals the average further return for employers due to the increased productivity of investing in ISCED 3 qualifications as opposed to ISCED 2 is about EUR 37 000. This is calculated applying the surplus/compensation ratio to the average net benefit of higher skills for the individual (about EUR 44 000) derived from Table 17.

Table 21. **GDP components: surplus/compensation ratio 2011-15**

	2011	2012	2013	2014	2015
EU-28	**86%**	**84%**	**85%**	**85%**	**85%**

Source: Eurostat, GDP income components.

5.2.4.2. *Further costs and benefits of higher level of education and skills*

In addition to the direct productivity effect of higher level skills benefiting the individual or firms, further positive returns at higher levels of aggregation are possible: diffusion processes within firms; productivity effects along the supply chain; and industry-wide 'upskilling', for example through labour turnover. This suggests that total returns on skills exceed individual returns because of spillover effects both within firms and in the economy at large. For example, a recent Conlon et al. (2012) survey of international empirical evidence reported an additional 9% to 12% return resulting from intra-firm diffusion. These are

([92]) GDP income components include: (i) compensation of employees, that is the total remuneration, in cash or in kind payable by an employer to an employee; (ii) gross operating surplus and mixed income, that is the surplus on production activities before the interest, rents or charges, plus the remuneration for the work carried out by the employer; (iii) taxes less subsidies on production and imports.

increases in wages of workers not directly involved in education and training, but which result from diffusion of benefits deriving from co-workers investing in education and training. They are therefore non-private returns on the educational investment. Ignoring these externalities inevitably understates the full impact arising from skills investment.

However, direct costs for education/training have not been considered so far. Usually direct costs to acquire ISCED 3 qualifications are mostly borne by the public sector and partly by individuals and their families. Employers may also face investment costs for employee skills development. Some studies provide estimates for such costs, for example in relation to apprenticeships (e.g. Hogarth et al., 2012; Pfeiffer et al., 2009): these include staff costs for participants in training/skills development ([93]) and set-up costs, learning materials/other consumables, administrative costs, training workshops delivered in-house, and course fees if not paid for by the government. However, systematic information at EU level on employer investment in skills suitable for empirical estimates is not currently available.

5.2.5. The public budget costs of low skills: a satellite account

While there are additional benefits from higher level skills affecting the public budget in the long term, for example via multiplier effects and higher economic growth, at micro level we focus on some tangible measures of public budget effects:

(a) investment for skills acquisition:
    (i) education/training spending to facilitate higher level skills;
    (ii) relatively lower revenues in compulsory insurance contributions and direct and indirect taxes due to people engaging in skills investment rather than working at lower level skills;
(b) benefits of higher levels skills:
    (i) increased employment probability and higher average wages result in net earnings increase, which feeds through to public budgets via increased labour taxes;
    (ii) higher earnings have additional effects on indirect taxes ([94]);

([93]) Wages, compulsory insurance, including social security insurance, discretionary payments, pension contributions; course fees and/or staff costs of supervisors (wages, related employer compulsory insurance, including social security insurance, discretionary payments, pension contributions).

([94]) Considering the life-course earnings of individuals the assumption is that all disposable income is ultimately (either directly or indirectly) spent on consumption.

(iii) the effect of lower out-of-work benefits (because of improved employment resulting from higher level skills) for public budgets in the longer term, in relation to the life-course labour market trajectory of low-skilled people compared to the comparatively higher skilled.

Full valuation of the total costs of low skills on public budgets is not possible for lack of suitable data. However, existing data allow us to estimate the public budget necessary to improve skills levels (based on data for education spending), and cash-flow associated with higher labour and consumption taxes resulting from increased incomes and higher-level skills.

5.2.5.1. *Valuation of public budget effects of individual earnings returns*

The individual net benefits of higher level skills in terms of increased earnings have a direct link to public budgets through increased labour taxation and consumption taxes, which can be valued in monetary terms.

This component is not included in the final estimate as it would largely result in a duplication (income tax is included in the gross wage returns of individuals), but it is possible to estimate the effect on the public budget using the results obtained in the Mincer models (where significant): increased individual life course earnings can be calculated with a marginal labour tax, including social insurance contributions (Table 22, column 2) corresponding to the income tax rate and the social security contributions (SSC) for earnings amounting to 67% of the average wage paid by a married individual with two children ([95]).A further effect on public budget results from a potential return from value-added taxes (VAT) due to the impact of net income on consumption.

For the average individual in the average country (arithmetic average), the potential return for the public budget is about EUR 27 000.

5.2.5.2. *Valuation of public budget effects created by out-of-work benefits*

To estimate the life-course differences in gross benefit payments between the low-skilled (ISCED 0-2) and the group with marginally higher skills (ISCED 3), we look separately at unemployment benefits and other benefits. Other benefits include old age benefits (pensions, care and disability allowance if above retirement age), survivor benefits (survivor's pension and death grant), sickness benefits (paid sick leave), disability benefits (disability pension, care allowance)

([95]) European Commission: *Tax and benefits indicators database (2012)*: https://ec.europa.eu/info/business-economy-euro/indicators-statistics/economic-databases/tax-and-benefits-indicators-database_en

and education allowance (grants, scholarships and other education help received by students). Benefits which are received at the household level (such as housing and child benefits) are excluded from this analysis.

Table 22. **Implications for tax revenue**

	Net benefit (*)	Marginal tax rate (in %), 2012 (**)	Net return rounded	Average VAT (2012) (***)	VAT return rounded
BE	75 200	55	41 400	21	8 700
BG	14 900	22	3 300	20	700
CZ	24 900	31	7 700	20	1 500
DE	53 400	47	25 100	19	4 800
EE	18 500	25	4 600	20	900
IE	68 500	31	21 200	23	4 900
EL	22 200	28	6 200	23	1 400
ES	30 900	39	12 100	18	2 200
FR	31 000	42	13 000	20	2 600
IT	96 200	40	38 500	21	8 100
LV	8 700	33	2 900	21	600
LU	277 500	34	94 400	17	16 000
HU	10 800	35	3 800	27	1 000
MT	84 800	22	18 700	18	3 400
NL	147 000	48	70 600	21	14 800
AT	82 700	44	36 400	20	7 300
PL	12 500	30	3 800	23	900
PT	90 300	25	22 600	23	5 200
SI	74 200	22	16 300	20	3 300
SK	13 700	30	4 100	20	800
UK	76 000	32	24 300	20	4 900

NB: (*) Return estimates not significant for DK, LT, RO, SE and FI. (**) marginal tax rate not comparable for CY and HR; marginal tax rate (in %) - income tax and social insurance contributions for earnings corresponding to two thirds of the average wage (for married individuals with two children), not available for some countries. (***) European Commission: *Taxation and customs union*, 1 July 2011 https://ec.europa.eu/taxation_customs/home_en [retrieved 29.1.2012].

Analysis: valuation.

Weight: none/individual

Selection: EU-28 (pb020/country); age range 25-65 (derived combining PB130/month of birth, PB140/year of birth, PB100/month of personal interview, PB110/year of personal interview, impute month of birth where unobserved); outside education pe010/Current education activity; selection in labour force (pl031/self-defined economic status).

Valuation parameters:

- net return from increased labour taxation – derived Table 22, column 4; marginal tax rate in % in 2012 from European Commission, tax and benefits indicators database, 2012 (income tax and SSC for earnings amounting to 67% of the average wage paid by a married individual with two children) http://ec.europa.eu/economy_finance/db_indicators/tab/;
- net return from increased VAT consumption – Derived Table 22, column 4; marginal tax rate in % in 2012 from European Commission, tax and benefits indicators database, 2012 (income tax and SSC for earnings amounting to 67% of the average wage paid by a married individual with two children, http://ec.europa.eu/economy_finance/db_indicators/tab/) and VAT rates (European Commission, 2014).

Source: EU-SILC (2012); European Commission, tax and benefits indicators database, 2012; European Commission: *Taxation and customs union*, 1 July 2011. https://ec.europa.eu/taxation_customs/home_en [retrieved 29.1. 2012].

Table 23. **Differences in life course receipt of benefits between ISCED 0-2 and 3 (based on EU-SILC 2012)**

	Unemployment benefits (EUR)	Other benefits (EUR)	Total difference (EUR)
BE	27 000	1 600	28 600
BG	-300	-2 300	-2 600
CZ	500	2 900	3 400
DK	60 700	12 100	72 800
DE	18 800	-500	18 200
EE	-300	3 000	2 700
EL	100	600	700
ES	5 900	1 900	7 800
IE	36 500	10 800	47 300
FR	600	800	1 400
HR	1 400	100	1 600
IT	8 100	2 000	10 100
CY	9 800	-2 600	7 200
LV	0	-1 500	-1 500
LT	-500	-2 000	-2 500
LU	16 600	3 400	20 000
HU	5 500	0	5 500
MT	8 200	3 300	11 500
NL	4 500	6 500	11 000
AT	14 200	-4 600	9 600
PL	-100	-1 800	-1 900
PT	2 000	900	2 900
RO	0	400	400
SI	-1 700	600	-1 100
SK	1 200	600	1 900
SE	2 000	11 800	13 800
FI	19 800	3 000	22 900
UK	8 200	4 900	13 100

NB: Totals may not add up because of rounding.

Model type: none/valuation.

Weight: pb040/personal cross-sectional weight.

Selection: EU-28 (pb020/country); age range 25-65 (derived combining PB130/month of birth, PB140/year of birth, PB100/month of personal interview, PB110/year of personal interview, impute month of birth where unobserved); outside education pe010/current education activity

Valuation parameters:

- life-course differential in unemployment benefits at age 25 (py090g/Unemployment benefits; pe040/level of education; annual averages in age range 25-65 (derived/see above in four bands); period: 40 years; discount rate: 3.5% p.a.; growth rate: 2% p.a.);
- life-course differential in other benefits at age 25 (sum of py100g/Old-age benefits, py110g/survivor' benefits, py120g/sickness benefits, py130g/disability benefits, py140g/education-related allowances; pe040/level of education; annual averages in age range 25-65 (derived/see above in four bands); period: 40 years; discount rate: 3.5% p.a.; growth rate: 2% p.a.

Source: Cedefop calculations on EU-SILC 2011 (impact)/EU-SILC 2012 (valuation).

First we estimate benefits by age group ([96]) for people with ISCED 0-2 compared to ISCED 3, setting benefit payments to zero for those who do not receive any. To derive life-course difference, for every individual aged between 25 and 34 we assume that the observed difference in benefit payment will apply for every year between 25 and 34, subject to 2% growth and appropriate discounting. Then, for every year between 35 and 44, we assume that the corresponding differential applies. We apply this method until age 64. Finally we sum up differences in benefit payment for every year to estimate the difference in life-course benefit payment between the low-skilled and the higher skilled individuals.

Table 23 shows estimates of life-course differential in receipt of benefit payments for all Member States between the low-skilled (ISCED 0-2) and the group with marginally higher skills (ISCED 3). In many Member States, the life-course difference in benefit payment comes mostly from differences in the receipt of unemployment benefits ([97]). There is a wide cross-country variation: the average amount of unemployment benefits depends on both the incidence of unemployment and the generosity of the unemployment benefits system. However, in most Member States, low-skilled individuals tend to receive more unemployment benefits than those with a marginally higher level of skills. The average amount of other benefits received by the low-skilled individual also varies considerably across countries ([98]).

5.2.5.3. *Valuation of public budget effects of creating higher skills levels*

To estimate public spending on education and training to achieve qualifications at ISCED 3 levels, we use the public education final expenditure in upper secondary education (ISCED 3) in 2012 (Table 24, column 1) and the total number of students enrolled in upper secondary education ([99]) during the academic year 2012/13 (Table 24, column 2). From this, total public spending per participant is

([96]) 25 to 34, 35 to 44, 45 to 54 and 55 to 64.

([97]) One limitation of this analysis is that estimates are based on observed differences in benefit receipt and are not further adjusted for differences in demographic characteristics such as gender and race (although age differences between the two groups are partly accounted for since the analysis is based on age groups).

([98]) In almost all countries, larger benefits payments are observed for older individuals (55 to 64) than any other age group. This is due to pensions being included in the other benefit category. In most countries, low-skilled individuals tend to receive, on average, larger benefit payments.

([99]) The figure for France corresponds to the total number of full-time students.

estimated taking into account the empirically observed average years spent in upper secondary education in every country (EU-SILC 2012).

On average across the Member States for which has been possible to get an estimate, the public spending on education and training to achieve qualifications at ISCED 3 levels is about EUR 18 000.

Table 24. **Public spending in ISCED 3 qualifications 2012/13**

	Public expenditure in upper secondary education in million EUR (2012) (A)	Total students enrolled in upper secondary education (full-time equivalents 2013) (B)	Yearly spending per participant (EUR, rounded) (C=A/B)	Average years spent in upper secondary education (D)	Total spending rounded (E=C*D)
BG	295	270 558	1 100	3.86	4 200
CZ	1 571	431 932	3 600	4.37	15 900
DE	24 402	2 557 611	9 500	4.00	38 100
EE	175	42 853	4 100	3.56	14 500
ES	8 535	1 477 376	5 800	2.95	17 000
FR	24 573	2 581 511	7 100	3.13	12 600
CY	278	32 128	8 700	2.97	25 700
LV	199	69 324	2 900	3.38	9 700
LT	209	89 677	2 300	2.31	5 400
LU	414	24 345	17 000	2.82	48 000
HU	944	472 434	2 000	4.28	8 600
AT	3 354	369 842	9 100	4.33	39 300
PL	3 310	1 410 886	2 300	3.33	7 800
PT	1 758	372 708	4 700	3.00	14 200
RO	765	832 592	900	3.49	3 200
SK	652	222 339	2 900	3.74	11 000
SE	5 789	429 414	13 500	3.00	40 400

NB: Some countries either do not report data or data not reliable: BE, DK, IE, EL, IT, HR, MT, NL, SI, FI, UK.

Average years spent in upper secondary: empirically observed from EU-SILC (2012). Exceptions: FI (Official Statistics of Finland: *Progress of studies [e-publication]*, 2012); PT (Ministry of Education, 2007); SE (Cedefop, 2014)

Analysis: valuation.

Weight: none/individual.

Selection: N/A

Valuation parameters: duration in education from opportunity cost calculation (Table 17) multiplied by education expenditure from Eurostat database (derived using education final expenditure in upper secondary education (ISCED 3) in 2012 [educ_uo_fine02] and total number of students enrolled in upper secondary education during the academic year [educ_uoe_enrs04].

Source: Eurostat database.

5.2.6. Limitations in the valuation of microeconomic impacts

The above analysis provides estimates of important inputs for a comprehensive valuation of cost and benefits of low skills from the point of view of the individual actors (individuals, companies and public sector), largely based on microeconomic estimates of the wage impact of skills and other components. The

substantial net earnings increases from higher level skills show the massive cost that low skills represent for individuals in terms of foregone earnings, and therefore a case for public policy to increase educational attainment and upskilling of the adult population.

However, alongside possible effects on productivity/profitability for the economy as a whole, other costs associated with low skills remain clearly excluded from the earnings-based approach, including the economic (non-financial) costs of crime, and the impact on civic/community engagement and social exclusion caused by unemployment, poverty and lack of key competences. Although these costs are substantial, they could be fully estimated at the micro level only by using subjective measures, such as a reservation price, hedonic price, social valuation processes and similar approaches; in many cases these require distributional weights and value judgments.

5.3. Aggregate economic benefits of reducing the share of low-skilled adults by 2025

Under standard assumptions the earnings differential can be used as an approximation of the output gap between different levels of skills. However, estimating the aggregated economic benefit of reducing the size of the low-skilled adult population on the basis of individual earning is likely to be conservative. This is why, in the following, we develop a set of aggregate scenarios to include some of the values which are causally affected by education and skills levels (health and crime), as well as available information about the impact of low skills on public spending.

The following valuation exercise makes important assumptions: constant returns on education, relative stability in the earnings premium, exchange rates, and population trends. The last of these includes the assumption that today's cohorts of low-skilled people can reasonably represent the adult population in the future and are not considerably altered by migration. Although these are all reasonable assumptions, it's clear that such estimates can provide only an indication of the potential magnitude of monetary impacts of the reduction of the share of low-skilled adults on the EU-28 economy.

The analysis compares three scenarios:

(a) a baseline scenario (business as usual), which assumes that population 15 to 54 observed in 2015 would age to the relevant adult cohorts in 2025 (25 to 64 year-olds) and would be affected by the past trend of decreasing levels of low skills, gradually reaching a proportion of low-skilled adults of 14.7% by

2025. This target was chosen in line with Cedefop's forecast scenarios (Section 2.3);

(b) an upskilling scenario, which assumes a further decreasing trend in the proportion of low-skilled adults to reach 7.4% by 2025 (half of the baseline target). A further assumption is that the increased reduction is higher for younger people and gradually lower for the older cohort ([100]). This scenario is challenging as it assumes that is possible to double the current trend in reducing the proportion of low-skilled population, but not impossible when considering that a share of low-skilled around 10% is already a reality in several Member States;

(c) a high hypothetical zero low-skilled scenario, which assumes that by 2025 the proportion of low-skilled in the adult population would be completely eradicated. This scenario is basically unrealistic because of the extensive (and difficult to sustain) investment in adult learning facilities and policies it would require. However, it was included because it represents an interesting reference point for the analysis.

5.3.1. Income effect from upskilling

The empirical results from the microeconomic analysis are based on the returns on ISCED 3 qualifications as presented in previous sections, which shows significant earnings increases in 25 of the 28 Member States. These returns are used to compute the gains in lifetime income resulting from upskilling low-skilled adults, similar to the monetary value estimate of individual lifetime costs of low skills presented in Table 17. These lifetime benefits were based on the assumption that substantial investment in education usually takes place before the age of 25 and the skills-related earnings increase accrues over the whole working life, subject to trend growth and increasing work experience, until people retire at (65 years old).

The aggregation of individual-level impacts/benefits resulting from upskilling the current low-skilled population needs alternative assumptions, since initial skills levels, opportunity costs, and residual working life duration vary with age. Hence:

(a) to parametrise the gross earnings impact for different age groups we use observed gross earnings from EU-SILC in 2012 for low-skilled adults of the

([100]) The share of low-skilled adults in 10 years' time would fall to 7.5% of the share of the business as usual scenario for 25 to 34 (15 to 24 today); to 20% for 35 to 39 (25 to 39 today); to 30% for 40 to 44 (30 to 34 today); to 40% for 45 to 49, 50% for 50 to 54, 80% for 55 to 59, and 95% for 60 to 64.

different age groups and estimate the monetary impact using the coefficients from the Mincer models. The cumulative benefit of the residual working lives for the different age groups is then obtained, making the usual adjustment for increasing work experience, trend growth and discounting;

(b) to parameterise the opportunity costs, we use the empirically observed duration of acquiring the qualifications and assume that the full duration would affect new entrants into the labour market, while older cohorts would upskill in part-time programmes. The time spent outside employment to acquire higher skills is then valued using observed gross earnings from EU-SILC in 2012 for people with low skills of the different age groups and is discounted and adjusted for growth ([101]).

5.3.2. Employer benefits from upskilling

The employer cost associated with low skills is calculated applying the surplus/ compensation ratio presented in Section 5.2.4 to the aggregate income effect of upskilling presented above. This gives us the aggregated value-added created during the production process which remunerates capital and employers' work more generally.

5.3.3. Health, crime and fiscal benefits from upskilling

In addition to the conservative effect on income (earnings and opportunity costs), further economic benefits are considered comparing the upskilling and the zero low-skilled scenario against the baseline/business as usual scenario.

The health cost associated with low skills is based on the differential in QALY weight between low-skilled adults and those with upper secondary education ([102]) (Section 5.2.2). However, since health is a cumulative process

([101]) We assume that the lower share of low-skilled adults can be achieved within the next 10 years (depending on the country-specific duration of upskilling programmes) and that young people 15 to 24 (in 2015) are also upskilled at the same time. Benefits start accruing as soon as the upskilling has taken place and last until the age of 65 and are calibrated depending on the age. For instance, benefits for those aged 15 to 19 today start arising in 2023, since, on average they turn 25 in that year. We assume that within each five-year age band the population is uniformly distributed so that the average age of the 15 to 19 is 17, etc. Returns on skills at younger age (e.g. 20 to 24) are not included.

([102]) We use a QALY value of EUR 31 250 resulting from guidelines for cost-effectiveness used by the National Institute for Health and Care Excellence in the UK (corresponding to GBP 25 000 as the midpoint for determining the cost effectiveness of public health interventions, see NICE (2013)) as figures acquired from willingness-to-pay studies such as the EuroVaQ project exceeded the evidence

and may have a different impact depending on the age at which the higher skills are acquired, we discount the estimates of the differential in QALY weight penalising older cohorts of the population ([103]). For each age group, the annual value of the differential in QALY weight is then summed across the expected remaining years of life and multiplied by the number of people of that age with low skills.

For crime costs, we use the result from Machin et al. (2011) suggesting that the social benefits from the crime-reducing effect of education amount to about EUR 16 000 per additional qualification for males. In line with this, we make the conservative assumption that achieving higher skills levels only reduces criminal activity among low-skilled young males aged 25 to 34 (in 2025). Machin et al. (2011) estimate fiscal costs only on the basis of the total cost of property crime (30%); this assumption makes the estimate even more conservative.

While low-skilled individuals tend to receive more unemployment benefits than those with higher level of skills, other benefits for low-skilled adults are not systematically higher across the EU-28 (Table 23). For earnings returns, we assume that total fiscal costs caused by unemployment benefits vary with the age of individuals and are higher for young people whose residual working lives are shorter.

The aggregate monetary benefit in earnings also leads to further increases in tax revenues from labour taxes and via increased consumption. In the following, we apply marginal tax rates and VAT rates for earnings impact to derive the total fiscal revenue increases of upskilling above baseline. However, the cost of producing higher level skills generates an increase in the public spending. Although this representation excludes the likely impact of higher skills on reduced healthcare and criminal justice costs, the net public spending position is positive in most countries; the fiscal benefits outweigh the spending almost everywhere, with highest gains in large countries and in high income economies

Increasing the educational level of a substantial fraction of the low-skilled adult population would come at a cost. In addition to the opportunity costs, to estimate the fiscal costs of upskilling low-skilled adults we assume the time required to achieve ISCED 3 qualifications to be smaller for adults than for young

---

from national sources. For the other countries, QALY values are imputed based on average QALY and GDP values from the UK and country GDP.

([103]) For instance, those aged 35 to 39 only benefit from 75% of the differential in QALY weight, to account for the fact that they get a qualification at an older age. Those aged 60 to 64 see their QALY weight increased by only 12.5% of the estimated QALY differential.

people as those of primary age would have to acquire higher-level skills in part-time programmes, while continuing employment as their main activity.

5.3.4. Aggregated net effects

Based on the above parameters and estimates, the aggregate earning increases from upskilling over baseline scenario add up to EUR 904 billion. Considering opportunity costs of about EUR 288 billion, the total net benefit would be EUR 616 billion (Table 25).

Table 25. **Aggregate cost-benefit for individual agents: upskilling (7.4%) and zero low-skilled scenarios (0%) (million EUR)**

		Up-skilling scenario (7.4%)	Zero low-skilled scenario (0%)
(+)	Aggregate net income	903 618	1 614 877
(-)	Opportunity costs (foregone earnings)	287 936	453 946
	Net benefit (~GVA)	615 682	1 160 932
(+)	Surplus/compensation	523 330	986 792
	Net benefit including surplus	1 139 012	2 147 724
(-)	Net public spending	156 267	345 010
(+)	Health and crime economic benefits	1 030 044	1 725 841
	Total net benefit (+/-)	2 012 789	3 528 554

NB: All figures are expressed in net present value. Aggregate GVA is computed as the difference between aggregate income increase and costs (foregone earnings).

Source: Cedefop estimations.

Including net public spending and health and crime benefits, the total present value over the 10 years is of EUR 2 013 billion (yearly average value of about EUR 200 billion). A similar calculation made for the hypothetical zero low-skilled scenario led to a 10-year total present value of EUR 3 529 billion (yearly average value of about EUR 350 billion).

5.4. Skills impact at macroeconomic level

Under standard assumptions, an estimate of the social return on investment in education and training to the economy can be obtained by aggregation of foregone individual earnings. Similar approaches have been carried out in some countries like the UK, for example through a cost-benefit model of skills investment facilitated by government intervention (Cambridge Econometrics and IER, 2013) or to derive the economic benefits from investing in apprenticeships (National Audit Office, 2012).

However, simple aggregations of individual benefits estimated at micro-level, have limitations:

(a) individual-level decision-making following the Mincer framework implies that people invest in skills as long as the incremental net returns on qualifications exceed the costs of acquisition. While this is related to net earnings, the true opportunity costs of skills investment for the society to acquire higher level skills (the foregone GDP) would correspond to gross earnings and, therefore, the social investment in education would be understated;
(b) even assuming that education only affects earnings and there are no spillover effects and externalities, because of taxation on labour earnings the social benefits of education investment are also larger than the individual returns and so the social benefits would be understated. Similarly, a further source of social benefits underestimation is the existence of positive employer return on skills investment through productivity gains;
(c) some non-individual returns should be included in the estimate to scale individual returns up to social returns:
    (i) spillover effects and externalities of increased skills on productivity;
    (ii) positive externalities resulting from reduced crime, better health and other intangible social values;
    (iii) multiplier effects from individually higher earnings.

    Lack of consideration of these aspects inevitably underestimates the potential social value of the skills investment.

To help reduce this type of problem, an estimation of social benefits of higher level skills needs should be carried out at a higher level of data aggregation. This is why this section aims at providing an alternative estimate of the costs of low skills to the European economy, using data at national level rather than aggregating individual returns estimated at micro level.

5.4.1. Empirical estimates of the impact of skills on growth

To identify the empirical design of the analysis, the most important studies have been thoroughly reviewed ([104]). These are important because they allow capture of externalities otherwise omitted in a micro approach (Sianesi and Van Reenen, 2000). Literature generally point towards a positive effect of education on aggregate economic growth, consistent with microeconomic evidence, although results are dependent on data quality and the sample of countries considered.

([104]) Barro, 1991; Barro and Lee, 1994; Barro and Sala-i-Martin, 1995; Mankiw et al., 1992; Benhabib and Spiegel, 1994; Pritchett, 2001; Sianesi and Ven Reenen, 2000; Krueger and Lindahl, 2001; Cohen and Soto, 2007; Canton, 2007; Hanusheck and Kimko, 2002; Lodde, 2008; Wilson and Briscoe, 2004.

This approach makes use of macroeconomic variables on the skill levels in all Member States and macroeconomic output measures, i.e. the gross domestic product (GDP). The impact of skills on such aggregates can be best estimated by quantifying the foregone output growth due to low skills in models which explain GDP growth per capita based on factors of production and further variables relevant to macroeconomic output (savings, depreciation of capital, population growth and labour market participation). Coefficients estimated in such models can be interpreted as a ceteris paribus effect of an increase of skills on economic growth in the EU.

Because of the explicit modelling of ISCED levels, the dataset available has limitations: it is comparatively small (about 20 years) and includes almost a decade of unprecedented economic downturn which may tend to understate the impact of skills on economic growth. It is also clear that GDP per capita cannot represent the full value of skills for society which includes related unpriced values such as externalities, distributional considerations and other important determinants of social well-being.

5.4.1.1. *Modelling*

Our analysis follows the main principles of estimating the impact of education on economic growth as suggested by Barro (1991), Mankiw et al. (1992) and Barro and Sala-i-Martin (1995); these estimate 'neoclassical' growth models in the Solow tradition, including a set of human capital variables (Wilson and Briscoe, 2004; for an overview of several studies with such designs). In implementing the empirical model, we estimate the impact of higher level skills (ISCED 3-4 and 5-8) on growth of GDP per capita. The coefficient magnitude and level of significance show the impact of increasing ISCED 3-4 by a percentage point on the per capita growth rate.

The macroeconomic level of analysis aims to obtain a measure of the total effect of skills on GDP per capita as a way to estimate of the costs of low skills to European society. It implicitly encompasses the costs of producing higher level skills and, therefore, represents a net benefit of higher level skills. While the individual-level decision is based on net earnings, including the opportunity costs of the skills investment, the actual effect of skills investment on output could be better approximated by the gross earnings under standard neoclassical assumptions. There are further social costs and benefits of education/training investment, for example the impact of higher skills on health, life expectancy, infant mortality and, therefore, output, which can be partly captured in an aggregate analysis. From this point of view, a macroeconomic analysis obtains a

more comprehensive measure of the impact of higher level skills and the costs of low level skills than the microeconomic approach.

Some studies apply the same variables as in the standard Mincer framework – years of education – in macroeconomic data to estimate a social rate of return on education investment. The coefficient of such growth models can be interpreted analogous to a Mincer individual return for an incremental year of schooling on income (see e.g. Wilson and Briscoe, 2004, p. 44). In the presence of the externality of skills investments (individuals decide on net incomes, but the impact on output refers to gross earnings), total investment required to increase skills and the potential social returns are expected to be higher than suggested by microeconomic Mincer models. However, as found in Wilson and Briscoe (2004), some of the studies find returns which are very similar to microeconomic returns.

In the following analyses, we make use of models which assume a steady state growth and diminishing returns on investment. Although increasing returns on investment in human capital are possible, not least because of the spillover of increased human capital (Wilson and Briscoe, 2004, p. 41), alternative models such as 'endogenous growth' models have serious limitations to be applied in this context: possible endogeneity (richer countries invest more in education and training), and problems with data and measurement of education and training investment.

5.4.1.2. *Data and implementation*

To estimate the empirical specification of the model, we combine macroeconomic data obtained from a tailored request to Eurostat about the qualifications of the population aged 25 to 65 years, with further macroeconomic aggregates from the annual macroeconomic database of the European Commission (AMECO) and the total economy database of the Conference Board for all 28 EU Member States. These data were used to derive dependent and independent variables of the model:

(a) GDP per capita (2014 price level with 2011 purchasing power parities);
(b) savings rate;
(c) population growth;
(d) qualification of the adult population (ISCED 3-4 and 5-8);
(e) labour market participation rate of the working-age population;
(f) working time;
(g) further data affecting macroeconomic aggregates such as the 'openness ratio' (sum of imports and exports as percentage of GDP) and government consumption as a percentage of GDP.

Since education and ISCO data identifying concepts of low-skilled used in this paper have only been available since 1992, the estimates are based on a period of observation of about 20 years. Due to EU enlargement, the nature of the time series dimension of this dataset is unbalanced, which implies that the time series is in parts considerably shorter for the Eastern Member States joining the union after 2000.

Extending from Mankiw et al. (1992), we specify the empirical model to explain the growth rate in GDP per capita Δy in countries *i* and over time *t* (modelled as log differences using values referring to fixed price levels) as the dependent variable of the following model:

$$\Delta y_{it} = \gamma_t + \Delta y_{i,t-1} + \beta_1 s_{it} + \beta_2 n_{it} + \beta_3 ms_{it} + \beta_4 hs_{it} + \beta_5 lfp_{it} + \beta_6 hpl_{it} + \beta_7 op_{it} + \beta_8 gc_{it} + \eta_i + \upsilon_{i,t}$$

with the following in-period covariates:

- s_{it} logarithm of the savings rate
- n_{it} logarithm of the growth rate of the population plus 0.05 representing the sum of exogenous technical change (*g*) and a depreciation rates (δ) (Bond et al., 2001, p. 15)
- ms_{it} share of the population 25 to 65 with ISCED 3-4
- hs_{it} share of the population 25 to 65 with ISCED 5-8
- lfp_{it} ratio of employment to working-age population
- hpl_{it} average hours worked per person employed
- op_{it} openness ratio
- gc_{it} government spending as % of GDP

The specification as a panel data model also allows us to capture a time invariant element η_i on unobserved characteristics that are intrinsic to the different countries and do not change over time. $\upsilon_{i,t}$. is an error term of the empirical model. In estimating panel data models, there is a principal choice of static or dynamic approaches; both aim to remove time invariant level differences between countries, caused by unobservable or unobserved characteristics, in order to obtain unbiased estimates.

In addition to including time γ_t effects in the equation by a series of dummy variables affecting all countries in the same way, we also included the lagged dependent variable; we consequentially estimate the relationship as dynamic panel data (Bond et al., 2001). While such modelling can capture country-specific dynamics better than static panel data models, such as fixed or random effects models, there are econometric problems of estimating models with lagged dependent variables as generally as models including sources of endogeneity.

We address this by estimating the dynamic panel data model using the estimator initially put forward by Arellano and Bond (1991) and later improved by Blundell and Bond (1998).

5.4.1.3. *Findings*

The empirical results of the estimates derived from the macroeconomic data are shown in Table 26. As a model summary, we find support for the dynamic modelling approach in that both the relevant tests for autocorrelation and the lagged endogenous variable are statistically significant. We also see that the magnitude of the coefficient of the lagged endogenous variable shows the greatest impact on growth of GDP per capita.

The findings are generally consistent with the predictions of the Solow model and other empirical growth regressions including human capital variables as summarised in Wilson and Briscoe (2004): the coefficient of the savings rate shows the expected positive and significant coefficient; the rate of population growth affects per capita GDP negatively. The models also show that employment rates do not significantly influence the rate of growth of GDP per capita, while there is a significant impact of working time. Some of the variables relating to economic policy regimes show that economies with a high degree of international trade expressed by the openness ratio are growing at higher rates.

More important, as suggested by Mankiw et al. (1992), human capital variables have been found to show positive and significant coefficients in the regressions ([105]); an increase in intermediate skills (ISCED 3-4) by 10 percentage points increases GDP per capita by 0.1 percentage points ([106]).

A baseline steady state growth can be derived from existing estimates of aggregate output growth and figures of population change. Assuming that the economy is in a steady state in 2015, the ceteris paribus effect derived here shows increased steady state growth rate with decreasing shares of low skills.

([105]) Our human capital variables show a differential impact of the share of intermediate and high-level skills of the adult population (age 25 to 64), which differs from other concepts used in this literature, such as enrolment rates.

([106]) This coefficient is significant, but shows a smaller impact of skills on growth than, for example, the share of the population with high tertiary level skills. A 10 percentage points increase in the share of adults aged 25 to 64 with the highest skills would increase the long-term growth rate of GDP per capita by 0.23 percentage points, twice the size of the coefficient for the intermediate skills.

Table 26. **Macroeconomic model estimates: GDP per capita growth rate**

	Coefficient	Standard error	z	P> z
Lagged dependent variable	0.457	0.043	10.540	0.000
Logarithm of the savings rate	0.008	0.004	2.030	0.042
Logarithm of the growth rate of the population plus 0.05 (exogenous technical change (*g*) and depreciation *d*)	-0.048	0.008	-6.100	0.000
Share of the population 25-65 with ISCED 3-4	0.010	0.005	2.160	0.031
Share of the population 25-65 with ISCED 5-8	0.023	0.009	2.530	0.011
Ratio of employment to working-age population	-0.009	0.015	-0.580	0.562
Average hours worked per person employed	0.000	0.000	2.820	0.005
Openness ratio	0.004	0.001	3.360	0.001
Government spending as % of GDP	-0.064	0.027	-2.380	0.017
Constant	-0.144	0.025	-5.760	0.000
N	523			
Groups	27			
Number of instruments	283		N by G Min.	15
Wald chi2(30)	162026		Mean.	19.37
Prob > chi2	0.000		Max.	22
Arellano-Bond test for AR(1) in first differences: z	-3.86		Pr > z	0.000
Arellano-Bond test for AR(2) in first differences: z	-1.82		Pr > z	0.069
Sargan test of overid. restrictions	chi2(252)= 461.62		Prob > chi2	0.0000
Hansen test of overid. restrictions	chi2(252) = 0.00		Prob > chi2	1.0000

NB: Analysis: dynamic panel data (system GMM).

Weight: n.a.

Selection: EU-28, 1992-2014.

Input variables:

- highest level of qualification (hatlev1d), ISCO (isco1d) (population 25-65);
- total population, employment persons: total economy, final consumption expenditure of general government at 2010 prices (billion national currencies), gross national savings at 2010 prices: total economy, exports of goods and services at 2010 prices, imports of goods and services at 2010 prices
- total GDP in millions of 2014 USD (2014 price level with 2011 PPPs), mid-year population (in thousands of persons) annual hours worked per worker.

Dependent variable: GDP per capita in 2014 USD (2014 price level with 2011 PPPs).

Variables included: GDP per capita (2014 price level with 2011 PPPs); savings rate; population growth; qualification of the adult population (ISCED 3-4/ISCED 5-8); labour market participation rate of the working-age population; working time; openness ratio (sum of imports and exports as percentage of GDP) and government consumption as a percentage of the GDP.

Sources: Eurostat EU-LFS custom aggregation; annual macroeconomic database (AMECO); total economy database, Conference Board.

5.4.2. The long-term impact on the steady-state growth of GDP in 2025-50

5.4.2.1. *Impact of low skill on steady-state growth*

To determine the possible long-term impact on GDP of reducing the share of low-skilled adults, we present a valuation exercise based on the macroeconomic approach discussed in the previous section. This exercise describes the development of GDP per capita once a particular proportion of adults with low

skills (policy target) has been reached and is no longer changing. We interpret the coefficient resulting from the macroeconomic estimates as capturing not only the benefit from upskilling (over a baseline of continuously decreasing share of low-skilled adults), but also long-term effects on the steady-state growth rate of GDP per capita in the setup of a neoclassical growth model.

Results from the macroeconomic analysis show that a 10 percentage point reduction in the long-term proportion of low-skilled adults (those with ISCED 0-2) would increase the long-term GDP per capita growth rate by 0.1 percentage point. We assume that the reduction in the proportion of low-skilled adults translates into a similar increase in proportion of adults with ISCED 3-4, and has no impact on the proportion of adults with ISCED 5-8. Initially, this effect may seem modest but since this is a shift in the GPD per capita growth rate it can have not negligible effects on GDP growth in the long term.

5.4.2.2. *Baseline steady-state GDP per capita growth rate*

We follow the scenarios presented before of a business as usual situation of a proportion of low-skilled adults in the population of 14.7% in 2025 (baseline), 7.4% (upskilling), and the hypothetical 0% (zero low-skilled). These targets are assumed as the long-term proportion of low-skilled adults in steady state; this proportion is no longer changing as of 2025 and the impact of the steady-state growth rate of the GDP per capita is based on the model.

As an estimate of the baseline steady-state GDP growth rate, we use the forecast of GDP growth for the EU-28 in 2021 published in the latest IMF world economic outlook ([107]). In 2021, GDP, in constant prices, is expected to grow by 1.801%. The GDP per capita growth rate, is calculated considering the annual population growth rate based between 2020 and 2030 provided by Eurostat ([108]). Between 2020 and 2030, population is expected to grow by 0.117% annually and we assume it as the population growth trend in long-term steady-state.

5.4.2.3. *Results*

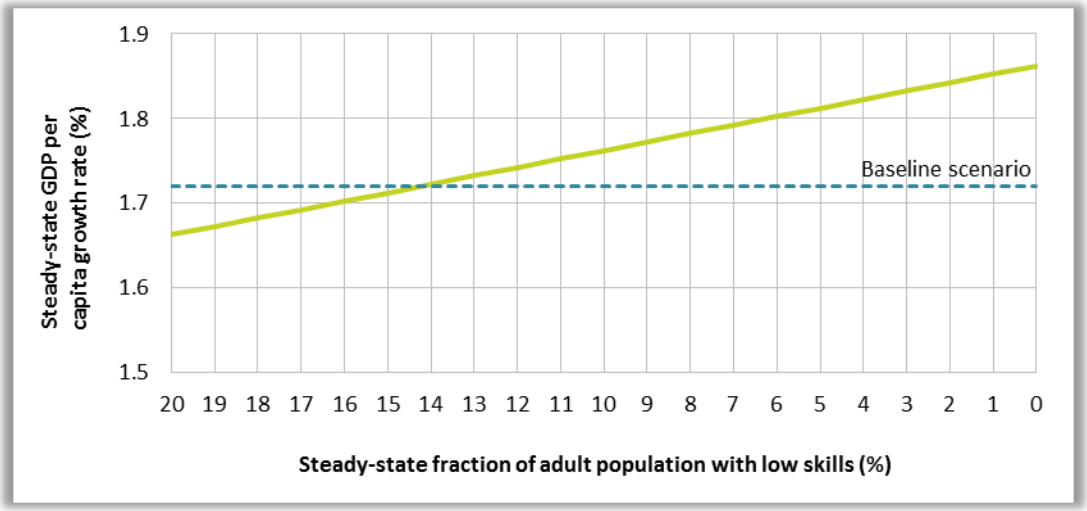
The solid line in Figure 37 shows estimates of the steady-state GDP per capita growth rate in relation to different steady-state proportion of low-skilled adults in the population. The dashed line displays the baseline steady-state GDP per capita growth rate (1.72%), which assumes a long-term proportion of low-skilled adults of 14.7%. Reducing the proportion of low-skilled adults to 7.4% (upskilling

([107]) IMF: *World economic outlook database:* https://www.imf.org/external/pubs/ft/weo/2016/01/weodata/index.aspx

([108]) Eurostat population projections, Series proj_13npms.

scenario) would result into a steady state growth rate of 1.79%, 0.07 percentage points higher than in the baseline scenario; in a hypothetical zero low-skilled scenario, the steady-state growth rate would reach 1.86%, 0.14 percentage points higher than in the baseline.

Figure 37. **Steady-state GDP per capita growth rate in relation to proportion of low-skilled adults**



Source: Cedefop estimation on Eurostat LFS, AMECO and total economy database.

Given the characteristics of this exercise, one implication is that the potential increase in the steady-state growth rate is larger for countries that currently have a larger low-skilled population.

Applying the steady-state growth rate to the 2015 GDP per capita ([109]) (EUR 27 723), we obtain the expected GDP per capita in 2025 (EUR 33 937). On this basis, after 25 years the GDP per capita in the upskilling scenario would be EUR 52 909, to EUR 52 007 for the baseline scenario. With an expected population in the EU-28 increasing by about 15 million by 2050, the long-term annual GDP for the EU-28 would be about EUR 480 billion larger in the upskilling scenario than in the baseline (965 billion larger in the hypothetical zero low-skilled scenario).

Across the average of the 25-year period (2025-50) the increase in the yearly GDP due to the reduction of the share of low-skilled adults set in the upskilling and the zero low-skilled scenarios would be over EUR 200 billion and EUR 410 billion respectively.

([109]) Eurostat, Series nama_10_pc

Conclusions

The economic and financial crisis has profoundly affected labour market dynamics in the Member States. Soaring unemployment rates, especially among certain groups of the population such as low-skilled adults, may lead to serious, long-term consequences. Growing social exclusion, disengagement from the labour market and persistent underuse of an important stratum of the population can lead to hysteresis and permanently lower potential growth.

While future trends in low skills suggest that shares of low-skilled adults will continue to decrease, current trends also indicate how low-skilled people are particularly disadvantaged and vulnerable on the labour market. For policy-makers to design and implement policies tailored to this particular group there is a need to develop a comprehensive and robust evidence base in relation to low-skilled adults in the EU, their volume and characteristics, as well as their economic and social costs.

While the ultimate aim of this study was to estimate the individual and social value in monetary terms of a faster increase in skills levels in Member States compared to the current trend, outcomes from the study allow us to identify several conclusions and also recommendations for future work in this area:

(a) the concept of low-skilled status should be conceptualised as a multidimensional and dynamic phenomenon, which goes beyond educational attainment level and considers both its determinants and effects. It should also include a wider typology of people with low-skills, such as those with obsolete skills and mismatched overqualified workers;

(b) low-skilled adults should be recognised as an increasingly vulnerable segment of the population in most Member States. Evidence shows that being low-skilled is associated with negative consequences for individuals, companies and society as a whole. Empowering low-skilled adults by means of promoting their up-skilling and/or reskilling is clearly associated with large social and economic incentives;

(c) the low-skilled population is a heterogeneous group with different needs and characteristics. Return on investment in skills varies for different groups and is diverse in different Member States. Effective policy actions must recognise this diversity, targeting the different needs and characteristics of low-skilled subpopulations and taking into account national contexts;

(d) policy actions to improve basic skills require an integrated policy approach to designing comprehensive and flexible education and training programmes to meet the needs of the different low-skilled subpopulations. Identifying

obstacles to implementation of policy and programmes, careful monitoring of progress towards established objectives, and responsiveness and adaptability in light of experience and changing circumstances, are key elements of effective policy action;

(e) while analysis provides robust estimates of the potential benefits of a faster increase on skills levels in Member States compared to the current trend, lack of exhaustive data prevents determining a comprehensive figure for the cost of low-skills. Outcomes from the study, while alarming, should be considered as underestimating the real economic and social cost of low skills in Europe and call for immediate action.

List of abbreviations

ALMP	active labour market policy
AMECO	annual macroeconomic database of the European Commission
EU	European Union
EU-LFS	European Union labour force survey
Eurofound	European Foundation for the Improvement of Living and Working Conditions
EU-SILC	European Union statistics on income and living conditions
EWCS	European working conditions surveys
GDP	gross domestic product
GVA	gross value-added
IALS	international adult literacy survey
ICT	information and communications technology
IER	Warwick Institute for Employment Research (UK)
ILO	International Labour Organisation
ISCED	international standard classification of education
ISCO	international standard classification of occupations
LFS	labour force survey
HSJ	Highly skilled job
LMP	labour market policy
LSJ	low-skilled jobs
NEET	not in education, employment, or training
OECD	Organisation for Economic Cooperation and Development
OLS	ordinary least squares
PIAAC	programme for the international assessment of adult competencies
PPP	purchasing power parity
QALY	quality-adjusted life year
SSC	social security contributions
SSJ	semi-skilled non-manual jobs
SSMJ	semi-skilled manual job

References

Abraham, K.G.; Spletzer, J.R. (2009). New evidence on the returns to job skills. *American economic review*, Vol. 99; No 2, pp. 52-57.

Abrassart, A. (2011). *Cognitive skills matter: the employment disadvantage of the low-educated in international comparison*. REC-WP, working paper on the reconciliation of work and welfare in Europe; No 4/11.

Albouy, V.; Lequien, L. (2009). Does compulsory education lower mortality? *Journal of health economics*, Vol. 28; No 1, pp. 155-168.

Arellano, M.; Bond S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *Review of economic studies*, No 58, pp. 277-297.

Arendt, J.N. (2005). Does education cause better health? A panel data analysis using school reforms for identification. *Economics of education review*, Vol. 24; No 2, pp. 149-160.

Arthur, W.J. et al. (1998). Factors that influence skill decay and retention: a quantitative review and analysis. *Human performance*, Vol. 11, No 1, pp. 57-101.

Autor, D.H.; Dorn, D. (2009). *Inequality and specialisation: the growth of low-skill service jobs in the United States*. IZA discussion paper; No 4290.

Autor, D.H. et al. (2003). The skill content of recent technological change: an empirical exploration. *Quarterly journal of economics*, Vol. 118, No 4, pp. 1279-1333. http://www.frbsf.org/economic-research/files/alm-skillcontent-qje.pdf

Bachmann, R. et al. (2014). *Labour market dynamics and worker heterogeneity during the great recession: evidence from Europe.* Ruhr economic papers; No 499.

Badescu, M. et al. (2011). *Returns to education in European countries: evidence from the European Community statistics on income and living conditions (EU-SILC)*. JRC scientific and technical reports.

Banks, J.; Mazzonna, F. (2012). The effect of education on old age cognitive abilities: evidence from a regression discontinuity design. *Economic journal*, Vol. 122, No 560, pp. 418-448.

Barro, R. (1991). Economic growth in a cross-section of countries. *Quarterly journal of economics*, Vol. 106; No 2, pp. 407-443.

Barro, R.; Lee, J. (1994). Sources of economic growth. *Carnegie Rochester Conference on public policy*, Vol. 40, pp. 1-46.

Barro, R.; Sala-i-Martin, X. (1995). *Economic growth*. New York: McGraw Hill.

Bassanini, A. et al. (2005). *Workplace training in Europe.* IZA discussion papers; No 1640. http://ftp.iza.org/dp1640.pdf

Becker, G. (1964). *Human capital*. Second edition. New York: Columbia University Press.

Becker, G. (1968). Crime and punishment: an economic approach. *Journal of political economy*, Vol. 76, No 2, pp. 169-217.

Becker, G.; Chiswick, B.R. (1966). Education and the distribution of earning *American economic review,* Vol. 56, No 1/2; pp. 358-369.

Behrman J.R. et al.(2014). What determines adult cognitive skills? Influences of pre-school, school, and post-school experiences in Guatemala. *Latin American economic review*, Vol. 23; No 1, pp. 1-32.

Beirne, J.; Campos, N.F. (2006). *Educational inputs and outcomes before the transition from communism.* IZA discussion paper series, No 2502, December 2006. http://ftp.iza.org/dp2502.pdf

Benhabib, J.; Spiegel, M.M. (1994). The role of human capital in economic development: evidence from aggregate cross-country data. *Journal of monetary economics*, Vol. 33, pp. 147-173.

Bernardi, F.; Garrido, L. (2008). Is there a new service proletariat? Post-industrial employment growth and social inequality in Spain. *European sociological review*, Vol. 24, No 3, p. 299-313.

Blanden, J.; McNally, S. (2014). *Reducing inequality in education and skills: implications for economic growth*. EENEE analytical reports.

Blundell, R.; Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of econometrics*, No 87, pp. 115-143.

Boeren, E. et al. (2010). Theoretical models of participation in adult education: the need for an integrated model. *International journal of lifelong education*, Vol. 29, No 1, pp. 45-61.

Bond, S. et al. (2001). *GMM estimation of empirical growth models.* CEPR discussion papers; No 3048.

Borghans, L.; ter Weel, B. (2006). Do we need computer skills to use a computer? Evidence from Britain. *Labour*, Vol. 20, No 3, pp. 505-532.

Borjas, G. (2010). *Labour economics* (Sixth edition). London: McGraw-Hill Higher Education.

Braakmann, N. (2011). The causal relationship between education, health and health related behaviour: evidence from a natural experiment in England. *Journal of health economics*, Vol. 30, pp. 753-763.

Brozovicova, K. et al. (2012). *Overview of the labour market situation of low-educated and Roma population and regulations affecting their employment*. Neujobs state of the art report; N.D 19.1.

Brunello, G. et al. (2009). Changes in compulsory schooling, education and the distribution of wages in Europe, *Economic journal*, Vol. 119, No 536, pp. 516-539.

Brunello, G. et al. (2012). Training subsidies and the wage returns to continuing vocational training: evidence from Italian regions. *Labour economics,* Vol. 19, No 3, pp. 361-372. http://doi.org/10.1016/j.labeco.2012.03.002

Brunello, G. et al. (2015). The causal effect of education on health: what is the role of health behaviors? *Health economics*, pp. 1099-1050.

Bukowski, M.; Lewandowski, P. (2005). *Assessing flows out of employment in Poland: evidence from multinomial logit analysis*. EconWPA. http://econwpa.repec.org/eps/lab/papers/0511/0511007.pdf

Buonanno, P.; Leonida, L. (2006). Education and crime: evidence from Italian regions. *Applied economic letters*, Vol. 13, No 11, pp. 709-713.

Calero, J. and Escardíbul, J.O. (2014). *Barriers to non-formal professional training in Spain: an analysis of their evolution in periods of economic growth and crisis, with special attention to the effect of the previous human capital of workers*. Institut d'Economia de Barcelona.

Cambridge Econometrics and IER (2013). *Review of the economic benefits of training and qualifications as shown by research based on cross-sectional and administrative data*. BIS research paper; No 105.

Cameron, A.C.; Trivedi, P.K. (2010). *Microeconometrics using Stata* (revised edition). Stata Press.

Campbell, D.E. (2006). What is education's impact on civic and social engagement? In: *Measuring the effects of education on health and civic engagement. Proceedings of the Copenhagen Symposium.* http://www.oecd.org/edu/innovation-education/measuringtheeffectsofeducationonhealthandcivicengagement.htm

Canton, E. (2007). *Social returns to education: macro-evidence*. Industrial policy and economic reforms paper; No 9.

Capatina, E. (2014). Skills and the evolution of wage inequality. *Labour economics*, Vol. 28, pp. 41-57.

Cappellari, L. et al. (2015). Skilled or educated? Educational reforms, human capital and earnings. Paper presented at the Cedefop/IZA *workshop on Skills and skill mismatch*, Thessaloniki, 29 and 30 October 2015. http://www.iza.org/conference_files/2015_Skill_Mismatch/cappellari_l1064.pdf

Carbonaro, W. (2006). Cross-national differences in the skills-earnings relationship: the role of labor market institutions. *Social forces*, Vol. 84, No 3, pp. 1820-1842.

Card, D. (1999). The causal effect of education on earnings. In: Ashenfelter, O.; Card, D. (eds). *Handbook of labor economics volume 3A*. Amsterdam: Elsevier, 1999.

Card, D.; Lemieux, T. (1994). Changing wage structure and black-white wage differentials. *AEA papers and proceedings*, No 84, No 2, pp. 29-33.

Carlsson M. et al. (2012). *The effect of schooling on cognitive skills*. Cambridge: National Bureau of Economic Research. NBER working paper; No 18484.

Cedefop (2011). *Vocational education and training is good for you: the social benefits of VET for individuals*. Luxembourg: Publications Office. Cedefop research paper; No 17. http://www.cedefop.europa.eu/EN/Files/5517_en.pdf

Cedefop (2013). *Benefits of vocational education and training in Europe for people, organisations and countries*. Luxembourg: Publications Office. http://www.cedefop.europa.eu/en/publications-and-resources/publications/4121

Cedefop (2014). *Macroeconomic benefits of vocational education and training*. Cedefop research paper; No 40. http://www.cedefop.europa.eu/en/publications-and-resources/publications/5540

Cedefop (2015). *Europe's uneven return to job growth*. Briefing note; June 2015. http://www.cedefop.europa.eu/en/publications-and-resources/publications/9098

Cedefop (2016). *Leaving education early: putting vocational education and training centre stage. Volume II: evaluating policy impact*. Luxembourg: Publications Office. Cedefop research paper; No 58. http://www.cedefop.europa.eu/en/publications-and-resources/publications/5558

Clark, D.; Royer, H. (2013). The effect of education on adult mortality and health: evidence from Britain. *American economic review*, Vol. 103, No 6, pp. 2087-2120.

Cohen, D.; Soto, M. (2007). Growth and human capital: good data, good results. *Journal of economic growth*, Vol. 12, pp. 51-76.

Conlon, G. et al. (2011). *Returns to intermediate and low level vocational qualifications*. BIS research paper, No 53.

Conlon, G. et al. (2012). *The impact of investment in intangible assets on productivity spillovers*. BIS research paper; No 74.

Conti, G. et al. (2010). The education-health gradient. *American economic review*: papers and proceedings, Vol. 100, pp. 234-238.

Council of the European Union (2016). Council recommendation of 19 December 2016 on upskilling pathways: new opportunities for adults. *Official Journal of the European Union*, C 484, 24.12.2016. http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016H1224(01)&from=EN

Crépon, B. et al. (2003). *Wages, productivity and worker characteristics: a French perspective.* Centre de Recherche en Economie et Statistique. Working papers 2003-04. http://www.crest.fr/ckfinder/userfiles/files/Pageperso/crepon/CreponDeniauPerezDuarte2002.pdf

Cutler, D.; Lleras-Muney, A. (2012). *Education and health: insights from international comparisons*. NBER working paper, No 17738.

Cutler, D.; Richardson, E. (1997). Measuring the health of the US population. *Brookings paper on economic activity*, pp. 217-271.

Daehlen, M.; Ure, O.B. (2009). Low-skilled adults in formal continuing education: does their motivation differ from other learners? *International journal of lifelong education*, Vol. 28, No 5, pp. 661-674.

Davia, M.A. et al. (2009). *Exploring international differences in rates of return to education: evidence from EU-SILC*. ESRI working paper, No 311.

De Anda, R.M.; Hernandez, P.M. (2007). Literacy skills and earnings: race and gender differences. *Review of black political economy*, Vol. 34, No 3-4, pp. 231-243.

De Grip, A.; Zwick, T. (2004). The employability of low-skilled workers in the knowledge economy. Paper presented at the *LOWER 2004 conference*. London: London School of Economics.

De Grip, A. et al. (2008). Job-worker mismatch and cognitive decline. *Oxford economics papers*, Vol. 60, No 2, pp. 237-253.

Dearden, L. et al. (2005). *The impact of training on productivity and wages: evidence from British panel data*. London School of Economics. CEP discussion paper; No 674. http://cep.lse.ac.uk/pubs/download/dp0674.pdf

Dee, T.S. (2004). Are there civic returns to education? *Journal of public economics*, Vol. 88, pp. 1697-1720.

Dench, S. et al. (2006). *The impact of learning on unemployed, low-qualified adults: a systematic review*. Department for Work and Pensions research report, No 375.

Desjardins, R. (2003). Determinants of literacy proficiency: a lifelong-lifewide learning perspective. *International journal of educational research*, Vol. 39, pp. 205-245.

Desjardins, R.; Warnke, A. (2012). *Ageing and skills: a review and analysis of skill gain and skill loss over the lifespan and over time.* OECD education working papers, No 72, http://dx.doi.org/10.1787/5k9csvw87ckh-en

Dickson, M.; Harmon, C. (2011). Economic returns to education: what we know, what we don't know, and where we are going – Some brief pointers. *Economics of Education Review*, Volume 30, Issue 6, December 2011, pp. 1118–1122. http://www.sciencedirect.com/science/journal/02727757/30/6

Dickson, M.; Smith, S. (2011). What determines the return to education: an extra year or a hurdle cleared? *Economics of education review*, Vol. 30, No 6, pp. 1167-1176.

Dickerson, A.; Green, F. (2004). The growth and valuation of computing and other generic skills. *Oxford economic papers*, Vol. 56, No 3, pp. 371-406.

Dieckhoff, M. (2008). Skills and occupational attainment: a comparative study of Germany, Denmark and the UK. *Work, employment and society*, Vol. 22, No 1, pp. 89-108.

Disney, R. et al. (2003). Restructuring and productivity growth in UK manufacturing. *Economic journal*, Vol. 113, No 489, pp. 666-694.

Dolton, P.; Pelkonen, P. (2004). The wage effects of computer use: evidence from WERS 2004. *British journal of industrial relations*, Vol. 46, No 4, pp. 587-630.

Donaldson, C. et al. (2010). *European value of a quality adjusted life year*. Newcastle University http://research.ncl.ac.uk/eurovaq/EuroVaQ_Final_Publishable_Report_and_Appendices.pdf

Dorsett, R. et al. (2010). *Economic benefits of lifelong learning*. London: National Institute of Economic and Social Research. NIESR discussion paper, No 352.

Dubourg, J. et al. (2005). *The economic and social costs of crime against individuals and households 2003/04*. Home Office online report, No 30/05 http://webarchive.nationalarchives.gov.uk/20100413151441/http://www.homeoffice.gov.uk/rds/pdfs05/rdsolr3005.pdf

Eurofound (2008). *Who needs upskilling? Low-skilled and low-qualified workers in the European Union*. https://www.eurofound.europa.eu/sites/default/files/ef_publication/field_ef_document/ef0897en.pdf

European Commission (2008). *New skills for new jobs: anticipating and matching labour market and skills needs*. Commission staff working document. SEC(2008) 3058. http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52008SC3058&from=EN

European Commission (2013a). *Towards social investment for the growth and cohesion – Including implementing the European Social Fund 2014-20: communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee of the Regions*. COM(2013) 83 final. http://ec.europa.eu/social/BlobServlet?docId=9761&langId=en

European Commission (2013b). Investing in children: breaking the cycle of disadvantage: Commission recommendation of 20 February 2013. *Official Journal of the European Union*, L 59, 2 March 2013. http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32013H0112

European Commission (2014a). *Education and training monitor 2014*. Luxembourg: Publications Office. http://ec.europa.eu/dgs/education_culture/repository/education/library/publications/monitor14_en.pdf

European Commission (2014b). *Taxation trends in the European Union: data for the EU Member States, Iceland and Norway*. Luxembourg: Publications Office. Eurostat statistical books. http://bookshop.europa.eu/en/taxation-trends-in-the-european-union-pbKSDU14001/

European Commission (2015). *Secondary earners and fiscal policies in Europe*. http://ec.europa.eu/justice/gender-equality/files/documents/150511_secondary_earners_en.pdf

European Commission (2016a). *A new skills agenda for Europe. Working together to strengthen human capital, employability and competitiveness*: communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. COM(2016) 381 final. http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52016DC0381&qid=1487328805971&from=EN

European Commission (2016b). *Proposal for a Council recommendation on establishing a skills guarantee*. COM(2016) 382 final. http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52016DC0382&from=en

Field, J. (2009). *Well-being and happiness*. Leicester: National Institute of Adult Continuing Education. IFLL thematic papers; No 4.

Fields, G.S. (2004). *Regression-based decompositions: a new tool for managerial decision-making.* Cornel University: Mimeo.

Flores, M. et al. (2013). *Earnings returns to education, experience and health: evidence from EU-SILC*. ERSA conference papers; No ersa13p1169. http://www-sre.wu.ac.at/ersa/ersaconfs/ersa13/ERSA2013_paper_01169.pdf

Fritsche, S. (2012). *Determinants of training participation: a literature review and empirical support from personal-, job-, employer- and health related factors in Germany*. NETSPAR theses, No 2012-025. http://arno.uvt.nl/show.cgi?fid=128033

Galindo-Rueda, F.; Haskel, J. (2005). *Skills, workforce characteristics and firm-level productivity: evidence from the matched ABI/employer skills survey*. IZA discussion paper series; No 1542.

Gesthuizen, M.; Scheepers, P. (2010). Economic vulnerability among low-educated Europeans: the impact of resources, the group's position, labour market conditions and welfare state arrangements. *Acta sociologica*, Vol. 53, No 30, pp. 247-267.

Goldin, C. (2006). The quiet revolution that transformed women's employment, education, and family. *American economic review*, Vol. 96, No 2, pp. 1-21.

Goldin, C.; Olivetti, C. (2013). Shocking labor supply: a reassessment of the role of World War II on women's labor supply. *American economic review*, Vol. 103, No 3, pp. 257-62.

Goldring, I.; Yamina, G. (2013). *Addressing overqualification of skilled immigrants in the European Union: situations and approaches from the local level.* Realise project. https://realise2020.files.wordpress.com/2011/09/realise-final-publication-for-partners.pdf

Green, F. (2012). *What is skill? An inter-disciplinary synthesis.* London: Institute of Education, University of London. LLAKES research paper; No 20.

http://www.llakes.org/wp-content/uploads/2011/02/Green-What-is-Skill-reduced.pdf

Green, D.A.; Riddell, C.W. (2015). Understanding educational impacts: the role of literacy and numeracy skills. Paper presented at the *Cedefop/IZA workshop on skills and skill mismatch, Thessaloniki, 29 and 30 October 2015*. http://www.iza.org/conference_files/2015_Skill_Mismatch/riddell_w5670.pdf

Groot, W.; Maassen van den Brink, H. (2007). The health effects of education. *Economics of education review*, Vol. 26, pp. 186-200.

Groot, W.; Maassen van der Brinck, H. (2010). The effects of education on crime. *Applied economics*, Vol. 42, pp. 279-289.

Grossman, M. (1972). *The demand for health: a theoretical and empirical investigation*. New York: National Bureau of Economic Research.

Grossman, M. (2006). Education and non-market outcomes. In: Hanushek, E.; Welch, F. (eds). *Handbook of the economics of education*. Elsevier.

Gvaramadze, I. (2010). Low-skilled workers and adult vocational skills-upgrading strategies in Denmark and South Korea. *Journal of vocational education and training*, Vol. 62, No 1, pp. 51-61.

Hammond, C.; Feinstein, L. (2005). The effects of adult learning on self-efficacy. *London review of education,* Vol. 3, No 3, pp. 265-287.

Hanushek, E.A.; Kimko, D.D. (2010). Schooling, labour force quality, and the growth of nations. *American economic review,* Vol. 90; No 5, pp. 1184-1208.

Hanushek, E.A.; Schwerdt, G. (2013). *Returns to skills around the world: evidence from PIAAC*. IZA discussion paper; No 7850.

Harmon, C. et al. (2003). The returns to education: microeconomics. *Journal of economic surveys*, Vol. 17, No 2, pp. 115-156.

Hausman J.A.; Taylor, W.E. (1981). Panel data and unobservable individual effects. *Econometrica*, Vol. 49, No 6, pp. 1377-1398.

Heckman, J.J. et al. (2006). The effects of cognitive and non-cognitive abilities on labour market outcomes and social behaviour. *Journal of labour economics*, Vol. 24, No 3.

Heinrich, G.; Hildebrand, V (2005). Returns to education in the European Union: a reassessment from comparative data. *European journal of education*, Vol. 40, No 1, pp. 13-34.

Hellerstein, J. et al. (1999). Wages, productivity, and worker characteristics: evidence from plant-level production functions and wage equations. *Journal of labor economics*, Vol. 17, pp. 409-446.

Hellerstein, J.; Neumark, D. (2007). Production function and wage equation estimation with heterogeneous labour: evidence from a new matched employer-employee data set. In: *Hard-to-measure goods and services: essays in honor of Zvi Griliches*. National Bureau of Economic Research pp. 31-71.

Hjalmarsson, R. et al. (2011). *The effect of education on criminal convictions and incarceration: causal evidence from micro-data.* Centre for Economic Policy Research discussion paper; No 8646.

Hogarth, T. et al. (2012). *Employer investment in apprenticeships and workplace learning: the fifth net benefits of training to employers study*. Department for Business, Innovation and Skills. Research paper; No 67.

Hoskins, B. et al. (2008). Does formal education have an impact on active citizenship behaviour? *European educational research journal*, Vol. 7, No 3, pp. 386-402. http://journals.sagepub.com/doi/abs/10.2304/eerj.2008.7.3.386

Ingram, B.F; Neumann, G.R. (2006). The returns to skill. *Labour economics*, Vol. 13, pp. 35-59.

Jackson, M. (2001). Non-meritocratic job requirements and the reproduction of class inequality: an investigation. *Work, employment and society*, Vol. 15, No 3, pp. 619-630.

Jackson, M. et al. (2005). Education, employers and class mobility. *Research in social stratification and mobility*, Vol. 23, pp. 3-33.

Jenkins, A. (2011). Participation in learning and well-being among older adults. *International journal of lifelong education*, Vol. 30, No 3, pp. 403-420.

Jaumotte, F. (2003). *Female labour force participation: past trends and main determinants in OECD countries*. Paris: OECD Publishing. OECD Economics Department working papers, No 376. http://dx.doi.org/10.1787/082872464507

Jones, M.K. et al. (2008). Crossing the tracks? Trends in the training of male and female workers in Great Britain. *British journal of industrial relations*, Vol. 46, No 2, pp. 268-282.

Kaufman, H.G. (1995). Salvaging displaced employees: job obsolescence, retraining and redeployment. In: London, M. (ed.). *Employees, careers and job creation.* San Francisco, CA: Jossey-Bass, pp. 105-120.

Kelly, E. et al. (2010). The economic returns to field of study and competencies among higher education graduates in Ireland. *Economics of education review*, Vol. 29, pp. 650-657.

Kempter, D. et al. (2011). Changes in compulsory schooling and the causal effect of education on health: evidence from Germany. *Journal of health economics*, Vol. 30, No 2, pp. 340-354.

Konings, J.; Vanormelingen, S. (2015). The impact of training on productivity and wages: firm-level evidence. *Review of economics and statistics*, Vol. 97, No 2, pp. 485-497. http://www.mitpressjournals.org/doi/pdf/10.1162/REST_a_00460

Krause, M.; Lubik, T. (2007). *On-the-job search and the cyclical dynamics of the labor market.* Deutsche Bundesbank, discussion paper series 1: economic studies; No 15/2007.

Krueger, A.B.; Lindahl, M. (2001). Education for growth: why and for whom? *Journal of economic literature*, Vol. 39, No 4, pp. 1101-1136.

Kuppens, T. et al (2015). Life at both ends of the ladder: education-based identification and its association with well-being and social attitudes. *Personality and social psychology bulletin*, Vol. 41, No 9, pp. 1260-1275.

Kureková, L. et al. (2012). *Qualifications or soft skills? Studying job advertisements for demand for low-skilled staff in Slovakia*. NEUJOBS working paper; No D. 4.3.3.

Kureková, L. et al. (2013a). *Being and becoming low-skilled: a comprehensive approach to studying lowskillness*. NEUJOBS, working paper; No 4.3.1.

Kureková, L. et al. (2013b). *Demand for low- and medium-skilled workers across Europe: between formal qualifications and non-cognitive skills*. NEUJOBS working paper; No 4.3.3.
http://biblioteka-krk.ibe.edu.pl/opac_css/doc_num.php?explnum_id=592

Kyndt, E. et al. (2013). Examining the learning intentions of low-qualified employees: a mixed method study. *Journal of workplace learning*, Vol. 25, No 3, pp. 178-197.

Kyriacou, G.A. (1991). Level and growth effects of human capital. *Economic research reports*, pp. 91-26.

Lauglo, J.; Øia, T. (2007). *Education and civic engagement: review of research and a study on Norwegian youths*. Paris: OECD Publishing. OECD education working papers; No 12.
http://dx.doi.org/10.1787/050484723262OECD

Lebedinski, L.; Vandenberghe, V. (2013). Assessing education's contribution to productivity using firm-level evidence. *International journal of manpower*, Vol. 35, No 8, pp. 1116-1139.

Leuven, E. et al. (2010). Expanding schooling opportunities for 4-year-olds. *Economics of education review*, Vol. 29, No 3, pp. 319-328.

Lloyd, C.; Mayhew, K. (2010). Skill: the solution to low wage work? *Industrial relations journal*, Vol. 41, No 5, pp. 429-445.

Lochner, L. (2011). Non-production benefits of education: crime, health, and good citizenship. In: Hanushek, E.A et al. (eds). *Handbook of the economics of education*, Vol. 4. Amsterdam: North-Holland, p. 183-282.

Lochner, L.; Moretti, E. (2001). *The effect of education on crime: evidence from prison inmates*. National Bureau of Economic Research working paper; No 8605.

Lochner, L.; Moretti, E. (2004). The effect of education on crime: evidence from prison inmates, arrests, and self-reports. *American economic review*, Vol. 94, pp. 155-189.

Lodde, S. (2008). Human capital and productivity growth in the Italian regional economies. A sectoral analysis. *Rivista internazionale di scienze sociali,* Vol. 116, No 2, pp. 211-233.

Machin, S.; Van Reenen, J. (1998). Technology and changes in skill structure: evidence from seven OECD countries. *Quarterly journal of economics*, Vol. 113, pp. 1215-1244.

Machin, S. et al. (2011). The crime reducing effect of education. *Economic journal*, Vol. 121, pp. 463-484.

Mankiw, N. et al. (1992). A contribution to the empirics of economic growth. *Quarterly journal of economics*, pp. 407-438.

Manning, A. (2004). We can work it out: the impact of technological change on the demand for low-skill workers. *Scottish journal of political economy*, Vol. 51, No 5, pp. 581-608.

Martins, P.S.; Jin, J.Y. (2010). Firm-level social returns to education. *Journal of population economics*, Vol. 23, No 2, pp. 539-558.

McIntosh, S. (2007). *A cost-benefit analysis of apprenticeships and other vocational qualifications*. DfES research report; No 834.

Meghir, C. et al. (2011). *The effect of education policy on crime: an intergenerational perspective*. Cambridge (MA): NBER. NBER working paper; No 18145.

Meghir, C. et al. (2012). *Education, health and mortality: evidence from a social experiment*. Cambridge (MA): NBER. NBER working paper; No 17932.

Mendolicchio, C.; Rhein, T. (2011). *The gender gap of returns on education across west European countries*. IAB discussion paper; No 20.

Milligan, K. (2003). *Does education improve citizenship? Evidence from the US and the UK*. National Bureau of Economic Research working paper; No 9584.

Mincer, J. (1958). Investment in human capital and personal income distribution. *Journal of political economy,* Vol. 66, No 4, pp. 281-302.

Mincer, J. (1974). *Schooling, experience, and earnings*. Cambridge, MA: National Bureau of Economic Research.

Ministry of Education (2007). *Education and training in Portugal*. http://www.dgeec.mec.pt/np4/97/%7B$clientServletPath%7D/?newsId=147&fileName=education_training_portugal.pdf

Ministry of Education, Culture and Science (2010). *The approach to school dropout: policy in the Netherlands and the provisional figures of the 2008-09 performance agreements*.

Ministry of Justice (2012). *The pre-custody employment, training and education status of newly sentenced prisoners.* London: Ministry of Justice.

Montenegro, C.E.; Patrinos, H.A. (2014). *Comparable estimates of returns to schooling around the world*. Washington, DC: World Bank Group. Policy research working paper; No WPS 7020. http://documents.worldbank.org/curated/en/2014/09/20173085/comparable-estimates-returns-schooling-around-world

Moretti, E. (2004). Workers' education, spillovers, and productivity: evidence from plant-level production functions. *American economic review*, Vol. 94, No 3, pp. 656-690.

Morrison Gutman, L.; Schoon, I. (2013). *The impact of non-cognitive skills on outcomes for young people*. London: Institute for Education, University of London. https://educationendowmentfoundation.org.uk/public/files/Publications/EEF_Lit_Review_Non-CognitiveSkills.pdf

Nafilyan, V.; Speckesser, S. (2014). *The youth contract provision for 16- and 17-year-olds not in education, employment or training evaluation, econometric estimates of programme impacts and net social benefits*. London: Department for Education Research report; No 318.

National Audit Office (2012). *Adult apprenticeships.* Report by the Comptroller and Auditor General. London: The Stationery Office. https://www.nao.org.uk/wp-content/uploads/2012/02/10121787.pdf

Nelson, M. (2010). The adjustment of national education systems to a knowledge-based economy: a new approach. *Comparative education*, Vol. 46, No 4, pp. 463-486.

NICE (2013). *Judging whether public health interventions offer value for money*. NICE, National Institute for Health and Care Excellence. Local government briefing [LGB10], September 2013. https://www.nice.org.uk/advice/lgb10/chapter/About-this-briefing

OECD (2011). *PIAAC conceptual framework of the background questionnaire main survey*. http://www.oecd.org/site/piaac/PIAAC(2011_11)MS_BQ_ConceptualFramework_1%20Dec%202011.pdf

OECD (2013a). *OECD skills outlook 2013: first results from the survey of adult skills*. OECD Publishing. http://dx.doi.org/10.1787/9789264204256-en

OECD (2013b). *Technical report of the survey of adult skills (PIAAC)*.

OECD (2013c). *The survey of adult skills: reader's companion*. OECD Publishing.

OECD (2014). *OECD employment outlook 2014*. OECD Publishing. http://dx.doi.org/10.1787/empl_outlook-2014-en

OECD (2016). *The survey of adult skills: reader's companion* (second edition). Paris: OECD Publishing. http://dx.doi.org/10.1787/9789264258075-en

OECD; Statistics Canada (2000). *Literacy in the information age: final report of the international adult literacy survey.* Paris: OECD Publications Service. http://www.oecd.org/edu/skills-beyond-school/41529765.pdf

Oesch, D. (2010). What explains high unemployment among low-skilled workers? Evidence from 21 OECD countries. *European journal of industrial relations*, Vol. 16, No 1, pp. 39-55. http://journals.sagepub.com/doi/pdf/10.1177/0959680109355307

Oreopoulos, P. (2007). Do dropouts drop out too soon? Wealth, health, and happiness from compulsory schooling. *Journal of public economics*, Vol. 91, No 1112, pp. 2213-2229.

Pfeiffer, H. et al. (2009). *Kosten und Nutzen der betrieblichen Berufsausbildung. [Costs and benefits of company-based apprenticeships]*. Bonn: Federal Institute for Vocational Education and Training. BiBB research report; No 2.1.203.

Pritchett, L. (2001). Where has all the education gone? *World Bank economic review*, Vol. 15, No 3, pp. 367-391.

Psacharopoulos, G.; Patrinos, H.A. (2004). Returns to investment in education: a further update. *Education economics* Vol. 12, No 2, pp. 111-134.

Quintini, G. (2014). *The effects of vocational education on adult skills and wages: what can we learn from PIAAC?* OECD, Directorate for Employment, Labour and Social Affairs.

Riley, R.; Robinson, C. (2011). *UK economic performance: how far do intangibles count?* Innodrive working paper; No 14.

Rocco, T.S.; Thijssen, J.G.L. (2006). *Older workers, new directions: employment and development in an aging labour market*. Miami, FL: Florida International University, Center for Labour Research and Studies.

Roosmaa, E.L.; Saar, E. (2012). Participation in non-formal learning in EU-15 and EU-8 countries: demand and supply side factors. *International journal of lifelong education*, Vol. 31, N 4, pp. 477-501. http://dx.doi.org/10.1080/02601370.2012.689376

Rovny, A.E. (2014). The capacity of social policies to combat poverty among new social risk groups. *Journal of European social policy*, Vol. 24, No 5, pp. 405-423.

Sabates, R. (2008). Education attainment and juvenile crime. *British journal of criminology*, Vol. 48, pp. 395-409.

Sakellariou, C. (2009). Endogeneity, computers, language skills and wages among university graduates in Vietnam. *Applied economics*, Vol. 41, pp. 653-663.

Schuller, T. et al. (2004). *The benefits of learning: the impact of education on health, family life and social capital.* New York: Routledge Falmer.

Sianesi, B.; Van Reenen, J. (2000). *The returns to education: a review of the macro-economic literature*. A report to the DfEE.

Siedler, T. (2010). Schooling and citizenship in a young democracy: evidence from post-war Germany. *Scandinavian journal of economics*, Vol. 112, No 2, pp. 315-338.

Silles, M.A. (2009). The causal effect of education on health: evidence from the United Kingdom. *Economics of education review*, Vol. 28, No 1, pp. 122-128.

Smits, W.; Zwick, T. (2004). Why do business service firms employ fewer apprentices? A comparison between Germany and the Netherlands. *International journal of manpower*, Vol. 25, No 1, pp. 36-54.

Spasojevic, J. (2010). Effects of education on adult health in Sweden: results from a natural experiment. In: Slottje, D.; Tchernis, R. (eds). *Current issues in health economics*. Emerald Group Publishing, pp. 179-199, Chapter 9. Contributions to economic analysis series, No 290. http://www.emeraldinsight.com/doi/pdfplus/10.1108/S0573-8555%282010%290000290012

Statistics Canada (2005). *Building on our competencies: Canadian results of the international adult literacy and skills survey*. Ottawa: Statistics Canada.

Steedman, H., McIntosh, S. (2001). Measuring low skills in Europe: how useful is the ISCED framework? *Oxford economic papers*, Vol. 53, No 3, pp. 564-581.

Tyler, J.H. (2004). Basic skills and the earnings of dropouts. *Economics of education review*, Vol. 23, No 3, pp. 221-235.

Van Kippersluis, H. et al. (2011). Long run returns to education: does schooling lead to an extended old age? *Journal of human resources*, Vol. 46, No 4, pp. 695-721.

Vignoles, A. et al. (2004). The labour market impact of adult education and training: a cohort analysis. *Scottish journal of political economy*, Vol. 51, No 2, pp. 266-280.

Vignoles, A. et al. (2010). The value of basic skills in the British labour market. *Oxford economic papers*, Vol. 63, pp. 27-48.

Williams, R. (2012). Using the margins command to estimate and interpret adjusted predictions and marginal effects. *Stata journal*, Vol. 12, No 2, pp. 308-331.

Willms, J.D.; Murray, T.S. (2007). *Gaining and losing literacy skills over the lifecourse*. Ottawa: Statistics Canada.

Wilson. R.; Briscoe, G. (2004). The impact of human capital on economic growth: a review. In: Cedefop et al. (eds). *Impact of education and training: third report on vocational training research in Europe: background report*. Luxembourg: Publications Office. Cedefop Reference series; No 54, pp. 9-70. http://www.cedefop.europa.eu/EN/Files/3036_en.pdf

Woessmann, L. (2014). *The economic case for education*. EENEE analytical report; No 20.

ANNEXES

ANNEX 1.

Low skills definitions used in this report: by chapter

Table A1. **Low skill definition used for Chapter 2 and Chapter 3**

Formal education (Eurostat LFS)		
Qualification level	**Description**	**ISCED-2011**
Low-qualified	Up to lower secondary education	(0-2)
Medium-qualified	Upper secondary and post-secondary non-tertiary education	(3, 4)
High-qualified	Tertiary education	(5-8)
Information processing (or cognitive) skills (OECD PIAAC)		
Skills level (cognitive)	**Description**	**OECD-PIAAC 2011**
Low skills in literacy or numeracy	Proficiency score less than 226 points	(below 1 or level 1)
Low skills in problem solving	Proficiency score less than 241 points	(below level 1)
Job/occupation skill level		
Occupation category	**Description**	**ISCO- 08**
Highly skilled	Managers; professionals, technicians and associate professionals	(groups 1-3)
Semi-skilled non-manual	Clerical support workers; service and sales workers	(groups 4-5)
Semi-skilled manual	Skilled agricultural, forestry and fishery workers; craft and related trades workers; plant and machine operators, and assemblers	(groups 6-8)
Low-skilled	Elementary occupations	(group 9)

Due to data limitation, in Section 2.3 (future demand and supply scenarios for low-skilled adults), low-skilled are referred only using the narrow ISCED definition (ISCED 0-2).

Table A2. **Low skill definition used for Chapter 5, the cost of low skills**

Formal education (Eurostat LFS)		
Qualification level	**Description**	**ISCED-2011**
Low-qualified	Up to lower secondary education	(0-2)
Medium-qualified	Upper secondary and post-secondary non-tertiary education	(3, 4)
High-qualified	Tertiary education	(5-8)
Skills obsolescence		
	Description	
	People with educational attainment at ISCED 3 or above, who work in either elementary occupations (S1, ISCO major group 9) or in elementary occupations, low-skilled employment, craft and related trades workers or in skilled employment in agriculture (S2, major groups 6-9 in ISCO-08)	
Job/occupation skill level		
Occupation category	**Description**	**ISCO- 08**
Highly skilled	Managers; professionals, technicians and associate professionals	(groups 1-3)
Semi-skilled non-manual	Clerical support workers; service and sales workers	(groups 4-5)
Semi-skilled manual	Skilled agricultural, forestry and fishery workers; craft and related trades workers; plant and machine operators, and assemblers	(groups 6-8)
Low-skilled	Elementary occupations	(group 9)

ANNEX 2.

Cluster analysis

Methodological approach

The cluster analysis was based on an original dataset of policy indicators for 27 Member States over the 2003-13 period. The main sources of data are Eurostat and OECD (Table A3). Croatia was not included in the analysis, since data were not available for the most of the policy indicators considered.

To cluster Member States we have considered the 2003-07 average (pre-crisis period) for the following policy indicators:

(a) labour market policies (LMP) expenditure, distinguishing between active and passive measures (as % of GDP);

(b) education system in terms of (i) public expenditure on education (as % of GDP) and (ii) adult lifelong learning (participation of people aged 25 to 64 years old in formal and non-formal education and training in the last four weeks);

(c) market regulation (both product and labour markets, including unions – as representation may be higher for low-skilled adults – and minimum wages);

(d) taxation on second earner, since empirical literature has shown that this is a key factor in deciding to participate in the labour market;

(e) work-life balance policies in terms of (i) public expenditure in maternity and paternal leave as a percentage of GDP, and (ii) formal childcare (coverage rate for children aged 0-2 years).

We used a hierarchical cluster technique, with the method of complete linkage, also known as farthest neighbour clustering, which tends to find compact clusters of approximately equal diameters.

Table A3. **Description of variables used in the cluster analysis**

Variable	Description	Source
LMP expenditure		
LMP expenditure as % of GDP	% of expenditure in each type of measure and support; The indicator is also available for overall LMP, total measures LMP (category 2-7); and total supports LMP (category 8-9).	Eurostat, LM policy database
Education system		
Expenditure on education as % of GDP	Public expenditure on overall education (all ISCED) as % of GDP.	Eurostat database
Lifelong learning	Participation rate of 25 to 64 years old people in formal and non-formal education and training in the last four weeks	Eurostat database
Market regulation		
Product market regulation (PMR)	Integrated indicator which measures the degree to which policies promote or inhibit competition in areas of the product market where competition is viable. Higher values of PMR are assigned to those countries with more pervasive state regulation.	OECD database
Employment protection legislation (EPL)	A measure of all types of employment protection, whether grounded primarily in legislation, court rulings, collectively bargained conditions of employment or customary practice. The indicator ranges from 0 to 6, with higher scores representing stricter regulation.	OECD database
Union density (UD)	UD (0-100) = net union membership as a proportion of all wage and salary earners in employment; quadratic form used in regressions	Visser, J. (2013), ICTWSS database, Version 4.0
Adjusted union coverage	Adjusted union coverage (0-100) = employees covered by wage bargaining agreements as a % of all wage and salary earners in employment with the right to bargaining, adjusted for the possibility that some sectors or occupations are excluded from the right to bargain	Visser, J. (2013), ICTWSS database, Version 4.0
Minimum wages	Proportion of minimum relative to median monthly wages of full-time workers.	Visser, J. (2013), ICTWSS database, Version 4.0
Family-related taxation		
Tax rate on second earner	*Taxation on second earner* = $1 - \frac{(Net\ income)_A - (Net\ income)_B}{(Gross\ income)_A - (Gross\ income)_B}$ where *A* denotes married couples with no children and only one earner (100% or average wage), and *B* refers to two-earner married couples with no children (67% of average wage).	OECD database
Work-life balance policies		
Parental leave (% GDP)	Public expenditure in maternity and paternal leave as % of GDP	OECD database
Formal child care (0-2)	Children aged less than 3 years cared for (by formal arrangements other than by the family) 30 hours or more a week, as a proportion of all children in the same age group.	Eurostat database

ANNEX 3.

Characteristics, determinants and risks of being low-skilled among adults in the EU

Methodological approach

To assess the relationships between the level of cognitive skills and the characteristics and family background of individuals, as well as other factors influencing the accumulation or maintenance of skills, we estimated a multivariate econometric model, using an OLS regression of proficiency scores in literacy and numeracy (separately) on several factors possibly influencing cognitive skills level, controlling for country fixed effects. The model specification is:

$$Y_i = \alpha + \beta P_i + \gamma E_i + \delta T_i + \rho C_i + \vartheta U_i + \theta W_i + \varphi X_i + \varepsilon_i \qquad \text{[equation 1]}$$

Where:

- *Y* is the proficiency score in numeracy (or literacy) measured on a 500-point scale;
- *P* is a vector of variables reporting personal and family background characteristics: gender, age, perceived general health, migrant background, parental education, number of books available at home ([110]). Family background characteristics influences both schooling and cognitive skills and serves as a proxy to innate learning abilities;
- *E* is a vector of dummy variables on the highest level of education attained (low, medium and high). In the empirical literature, the achieved level of education is found to be the most important factor affecting skills levels;
- *T* is a dummy variable indicating if the individual has participated to any formal or non-formal education or training course during the 12 months preceding participation in the survey. It seeks to capture the fact that people do not only learn during initial education, but also later in life;
- *C* is a dummy variable indicating whether or not the individual has computer experience;

([110]) This is a widely used measure of cultural capital used in international surveys (e.g. PISA) (OECD, 2011).

- *U* identifies a set of dummy variables related to the frequency of use of cognitive skills (reading, writing and numeracy) at home ([111]): engagement in literacy and numeracy practices and the use of ICTs at work and in everyday life is one way adults enhance or maintain their skills (OECD, 2013c);
- *W* is a set of dummy variables reporting the work situation of the individual distinguishing according to the duration of not being in employment: never worked in life; experiencing a very long, long and short unemployment or inactivity spell. Inactivity and unemployment may reduce the use of skills with a detrimental effect on information processing skills;
- *X* are country fixed effects to control for institutional features and policies.

This general specification was applied to perform OLS regressions on numeracy and on literacy proficiency scores on the PIAAC full set of adults aged 25 to 65, excluding retired people, students, permanently disabled people and individuals in compulsory military or community service.

Along with the pooled regressions, a set of categorical regressions have been estimated to assess differences in the relationships with cognitive skills related to age, level of education and employment status.

For the employment status of participants, the OLS regression has been estimated on a sample of workers with a different specification model to capture

([111]) The PIAAC dataset contains indices to describe the use of information processing skills at work and at home. These indices were created from multiple questions included in the background questionnaire and cover several information processing skills: numeracy (calculating prices, costs or budgets; use of fractions, decimals or percentages; use of calculators; preparing graphs or tables; algebra or formulas; use of advanced math or statistics); reading (reading documents: directions, instructions, letters, memos, emails, articles, books, manuals, bills, invoices, diagrams, maps); writing (writing documents: letters, memos, emails, articles, reports, forms), ICT skills (using Internet, spreadsheets, word processors, programming languages; conducting transactions online; participating in online discussions); problem solving (facing hard problems: at least 30 minutes of thinking to find a solution). Each skill index has been produced by using the item response theory (IRT) and provides a measure of how often the tasks making up the index were carried out by a participant. Internationally, participants were grouped into quintiles, which give an indication of how often they perform these tasks. For instance, participants who fall in the lowest 20% on the index internationally will tend to perform some or all of the tasks infrequently, while participants who fall in the more than 80% group will frequently perform many of the tasks. Respondents who answered ‘never’ to all questions in the index appear in an ‘all zero response’ category. For more details on how the indices were created see the OECD reader companion (OECD, 2013c) and the PIAAC technical report (OECD, 2013b).

the effect of work experience and to control for job-related characteristics. The model specification is:

$$Y_i = \alpha + \theta J_i + \omega Z_i + \beta P_i + \gamma E_i + \delta T_i + \rho C_i + \vartheta U_i + \varphi X_i + \varepsilon_i \qquad \text{[equation 2]}$$

where

- *Y* is the proficiency score in numeracy (or literacy) measured on a 500-point scale;
- *J* is a set of variables related to the job held (occupation, type of contract and hours of work) and the employer (firm size, sector);
- *Z* is a vector reporting a scalar of the years of paid work during one's lifetime and its squared term.

The other regressors are the same as equation 1, apart from the variables relating to training in the previous 12 months which, in this specification, distinguish between job-related training and non-job-related training.

This model specification was estimated on a sample of dependent workers aged 25 to 65; the sample is restricted to employees with one job only and excludes workers employed in non-profit organisations, in the armed forces, and skilled agricultural, forestry and fishery workers.

To present in a synthetic way the contribution of group of variables (personal characteristics, family background, highest level of education attained, participation in training, use of cognitive skills at home, work experience and unemployment) in explaining the scores in cognitive skills we conducted a variance decomposition analysis. This allows assessment of how much of the observed variance in the outcome variable of the OLS regression (R^2) – the score in cognitive skills – is explained by the dependent variables. Like the OECD (2014) we used Fields' (2004) regression-based decomposition technique, which performs an exact decomposition of the outcome variable variance into the variance attributable to each explanatory variable and the residual. Fields' approach consists in decomposing the explained portion of the regression (R-squared) into weights for each of the factors (for more details see Fields, 2004 and OECD, 2014).

To assess how the risk of being low-skilled in numeracy ([112]) changes in relation to the personal background and other factors associated with the acquisition, maintenance and development of this skill, we performed a probabilistic regression using the following specification:

([112]) In this part of the analysis we concentrate, and present results, only on numeracy skills, since literacy and numeracy proficiency scores are highly correlated (the correlation coefficient being 0.86 in our sample) and produce similar results.

$$Z_i = \alpha + \beta P_i + \gamma E_i + \delta T_i + \rho C_i + \vartheta U_i + \theta W_i + \varphi X_i + \varepsilon_i \qquad \text{[equation 3]}$$

where

- *Z* is a variable taking value 1 for individuals scoring at or below proficiency level 1 (i.e. scores less than 226 points) ([113]) in numeracy, and 0 otherwise.

Explanatory variables are the same as those used in equation 1 and relate to personal and family background characteristics, highest level of education attained and training in the previous 12 months, computer experience, frequency of use of cognitive skills at home, work experience and unemployment spells and country fixed effects.

The probit regression was calculated on the PIAAC full set of adults aged 25 to 65, excluding retired people, students, permanently disabled people and individuals in compulsory military or community service.

Predicted (or expected) probabilities for hypothetical or prototypical cases were calculated using Stata 'margins' command. Expected probabilities have been estimated using average adjusted predictions and adjusted predictions at representative values (Williams, 2012).

([113]) For more details see Box 2.

ANNEX 4.

Effects of low skills on employability

Methodological approach

To analyse the effects of low-skills on employability we performed two distinct analyses.

The first is a logistic regression on PIAAC data to assess the effect on the employment status of different types of skills (formal education, training, cognitive skills, computer experience), controlling for the socio-demographic characteristics of individuals, and for economic and institutional factors. The model specification is:

$$Y_i = \alpha + \beta P_i + \gamma E_i + \delta T_i + \rho C_i + \varphi X_i + \varepsilon_i \qquad \text{[equation 4]}$$

where

- *Y* is a variable taking value 1 employed people and 0 for unemployed or inactive people;
- *P* is a vector of variables reporting personal and family characteristics: gender, age, perceived general health, migrant background, parental education, having children and an interaction variable for women with children ([114]);
- *E* is a vector of dummy variables on the highest level of education attained (low, medium and high);
- *T* is a dummy variable indicating if the individual has obtained a proficiency score in numeracy below level 1 of OECD classification (lower than 226 points), low-skilled in numeracy;
- *C* is a dummy variable indicating whether or not the individual has computer experience;
- *X* are country fixed effects to control for institutional features and policies.

This specification has been used to perform a logistic regression on a sample of adults aged 25 to 65 surveyed by PIAAC. The sample does not include retired people, students, permanently disabled people and individuals in compulsory military or community service.

([114]) Since, in contrast with men, women with children present a lower participation to the labour market.

Predicted (or expected) probabilities for hypothetical or prototypical cases were calculated using Stata 'margins' command. Expected probabilities were estimated using average adjusted predictions and adjusted predictions at representative values (see Williams, 2012).

The second analysis uses a multinomial logit econometric specification to investigate the determinants of transitions across labour market statuses.

Multinomial logit is based on a nominal multi-response model where the dependent variable has more than two categories.

We consider as dependent variable the transitions from a low-skilled job to four possible outcomes:

(a) transition to a high-skilled or semi-skilled manual or non-manual jobs (HSJ/SSJ/SSMJ), that we select as reference state j^* ;
(b) permanence in a low-skilled job (LSJ);
(c) movement to unemployment (U);
(d) movement to inactivity (N).

As covariates we have used:

(a) level of education (low, medium and high) as proxy of skills;
(b) personal and household variables such as gender (a dummy for female), marital status, age, a variable indicating the number of children aged four years and below (and an interaction term between female and the number of children), household size (in terms of persons), a dummy (bad health) indicating if the perceived health of the individual is bad or very bad;
(c) other job related variables such as years of work experience, the type of contract/employment (dependent worker with a permanent contract, or with a fixed-term contract or self-employed) and a dummy with value 1 if the individual has had an unemployment spell between the initial labour market status and the current one.

This specification was adopted for the three-year transition using the 2011 longitudinal EU-SILC dataset, on a sample of people aged 25 to 65 in 2011.

The conditional individual transition probabilities can be defined as:

$$P_{ij,t(h)} = \Pr\left(X_{t,h} = j \middle| X_{t-1,h} = i, z_{t,h}\right) \qquad \text{[equation 5]}$$

where $X_{t,h}$ is the labour market state of individual h at time t, and $z_{t,h}$ is a vector of covariates.

The multinomial logit model is specified as follows:

$$p_{ij,t(h)} = \frac{\exp[g_i(z_{t,h})]}{\sum_{j=1}^{k} \exp[g_i(z_{t,h})]} \qquad \text{[equation 6]}$$

where

$$g_j(z_{t,h}) = \log\left[\frac{\Pr(X_{t,h} = j | X_{t-1,h} = i, z_{t,h})}{\Pr(X_{t,h} = j^* | X_{t-1,h} = i, z_{t,h})}\right]$$
$$= \beta_{j0} + \beta_{j1} z_{1h} + \cdots + \beta_{jp} Z_{p,h} \qquad \text{[equation 7]}$$

with $g_{j^*}(z_{t,h}) = 0$.

We do not take permanence in the initial labour market status as the reference category ($j^* \neq i$), since we are interested in the determinants of permanence in a low-skilled job.

The coefficients of multinomial models are generally not directly interpretable. Instead, the marginal effects of the explanatory variables are given by the following equation ([115]):

$$\frac{\partial \Pr(X_{t,h}=j)}{\partial z_m} = \Pr(X_{t,h} = j | Z) \times [\beta_m^j - \sum_{j=1}^{K} \beta_m^j \Pr(X_{t,h} = j | Z)] \qquad \text{[equation 8]}$$

the marginal effect of a change in the *mth* regressor on the probability that alternative *j* is the outcome.

It is also helpful to transform the model coefficient in the odds ratio or relative risk ratio, because, with interaction term, marginal effects cannot be computed. The relative-risk ratio of choosing alternative *j* rather than the reference category *j** is given by:

$$\frac{\Pr(X_{t,h}=j)}{\Pr(X_{t,h}=j*)} = \exp(z'_m \beta^j) \qquad \text{[equation 9]}$$

the proportionate change in the probability of occurrence of outcome *j* rather than the reference category *j** for one unit change of explanatory variables.

([115]) As a reference for this multinomial logit framework and interpretation of the marginal effects see Bukowski and Lewandowski (2005) and Cameron and Trivedi (2010).

ANNEX 5.

Cost of low skills: empirical specification for the macroeconomic approach

Starting with the standard version of a 'neoclassical' growth model, we assume production output *Y* to result from a production function *F*, depending on a level parameter of productivity *A*, capital *K* and labour *L* and a given production technology, for example Cobb Douglas, such as:

$$Y = F(K,L) = A \cdot K^{\alpha} \cdot L^{\beta} \qquad \text{[equation 10]}$$

Following the basic assumption of a neoclassical production function, this function increases from the origin with decreasing returns. The marginal products – the change of output based on an increase of a unit in either one factor of production – can be obtained by the partial of the production function by the relevant factor;

$$Y = \frac{\partial F(K,L)}{\partial L} = \beta \cdot A \cdot K^{\alpha} \cdot L^{\beta-1} = \beta \cdot \frac{A \cdot K^{\alpha} \cdot L^{\beta}}{L} = \beta \cdot \frac{Y}{L}$$

$$Y = \frac{\partial F(K,L)}{\partial K} = \alpha \cdot A \cdot K^{\alpha-1} \cdot L^{\beta} = \alpha \cdot \frac{Y}{K} \qquad \text{[equation 11]}$$

Under standard neoclassical assumptions, these marginal products exhaust the production result and correspond to wages and the costs of capital. Assuming, in the case of Cobb Douglas, that $\alpha + \beta = 1$ output per capita can be related to a per capita capital stock and a production technology as follows:

$$\frac{Y}{L} = \frac{A \cdot K^{\alpha} \cdot L^{\beta}}{L} = \frac{A \cdot K^{\alpha} \cdot L^{1-\alpha}}{L} = A \cdot \left(\frac{K}{L}\right)^{\alpha} = A \cdot k^{\alpha} = f(k) \qquad \text{[equation 12]}$$

This proposes a per capita representation of the production output, with a per capita capital stock as the sole factor of production. Exogenous variables to this relationship are the rate of depreciation δ, the savings rate *s*, the rate of population growth *n* all affecting the intensity and the rate of the technological change *g* affecting the level parameter *A*. The comparative statics of this model suggest that – provided other parameters remain unchanged – an increase in the

savings rate would increase the per capita capital stock, the per capita output and the overall output in the economy. However, without an exogenous change to technological progress, long-term growth as well as the per capita output would result in a steady state and convergence to a steady state per capita stock *k**.

$$k^* = \left[s/(n+g+\delta)\right]^{1/(1-\alpha)} \qquad \text{[equation 13]}$$

In contrast, a positive productivity increase by some magnitude would, in the long-term, increase output by more than this quantity as there would be further effects via increased savings from the higher output.

A log specification of the production function to show growth over time *t* relative to a base level in period 0 incorporating this convergence property shows the main properties of the standard neoclassical growth model.

$$\ln\left(\frac{Y}{L}\right)_t = \ln A_0 + g_t + \frac{\alpha}{1-\alpha}\ln(s) - \frac{\alpha}{1-\alpha}\ln(n+g+\delta) \qquad \text{[equation 14]}$$

As described in Mankiw et al. (1992, p. 410), the assumption that the factors of production are rewarded based on their marginal products makes it possible to derive both the sign and the magnitude of changes in savings and population growth. The empirical specification of such a model, such as to test the prediction of the Solow growth model using a dynamic panel data model for a total number of i countries and t time periods observed is straightforward, by simply adding a further error term to this and estimating OLS.

The augmented growth model following Mankiw et al. (1992) includes measures for skills/human capital in the economy in the model, which are theoretically suggesting a positive impact on production out (Mankiw et al., 1992, p. 418). In empirical tests, this can be the logarithm of the secondary-school enrolment rate (enr_{it}). We follow this basic set-up and specify our human capital augmented growth model by including the percentage shares of people of the population of aged 25 to 65, who achieved at ISCED 3-4 and an equivalent variable for the proportion of people with ISCED 5-8 attainment.

In addition to differential levels in human capital, we include further variables to account for differences in growth caused by country-specific labour market participation patterns. This is especially relevant in the context of Europe, where employment and working time differs markedly, with higher working time in the formerly communist Central and Eastern Member States and lower working time in the continental economies of the West (in particular, Germany, France and the Netherlands).

Investing in skills pays off: the economic and social cost of low-skilled adults in the EU

This Cedefop study seeks to provide a comprehensive and robust evidence base on low-skilled adults in the European Union. It analyses trends in low skills among adults as well as characteristics, determinants and risks of being low-skilled. The study also provides an estimation of the individual and social value in monetary terms of a faster increase in the general level of skills in Member States compared to the current trend. Fully appreciating the benefits of updating the skills of individuals through adult and lifelong learning is essential to strengthening the rationale for public intervention in this area and to designing and implementing effective policies tailored to this particular target group.

5560 EN - TI-BC-17-002-EN-N - doi:10.2801/23250

European Centre for the Development of Vocational Training

Europe 123, 570 01 Thessaloniki (Pylea), GREECE
Postal address: PO Box 22427, 551 02 Thessaloniki, GREECE
Tel. +30 2310490111, Fax +30 2310490020
E-mail: info@cedefop.europa.eu
www.cedefop.europa.eu

Publications Office