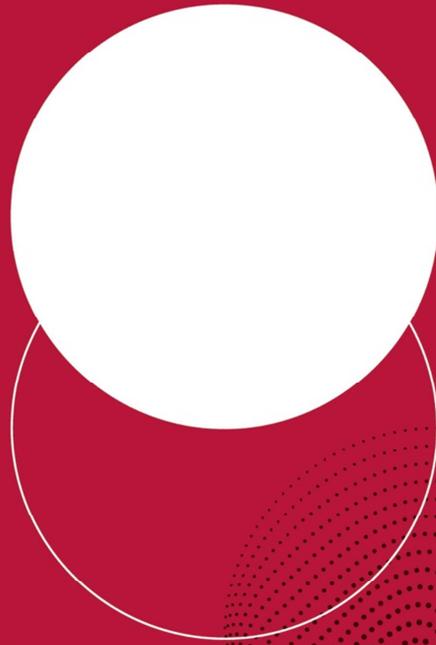




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MEASURING SKILLS MISMATCHES REVISITED - INTRODUCING SECTORAL APPROACH

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Abstract

Appropriate measuring of skills mismatches is necessary to create an adequate policy response to this problem. We review the up-to-date advancement, in particular in large scale international surveys: Survey of Skills (PIAAC) co-ordinated by the OECD and European skills and jobs survey (ESJ) conducted by the CEDEFOP. Analysis of the data shows that there are not only national, but also sectoral and occupational differences in the scale of the skills mismatch in Europe. We identified two main weaknesses of existing research framework in measuring skills mismatches: subjectivity of answers leading to incomparability of results among different data sets and heterogeneity in particular in sectoral and occupational characteristics, that appear to be more important than cross-national differences. We propose a potential methodological advancement in measuring skills based on defining core knowledge, skills and competencies at the sectoral level with the use of sectoral qualifications frameworks. We assess the usefulness of this approach in measuring the level of skills mismatch.

Keywords: skills mismatch, skills need, sectoral qualifications frameworks

JEL: J20, J24, J62, J68

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Table of contents

Abstract	2
Introduction.....	4
1. Skills mismatch in the literature: definitions and measurement	4
2. Skills mismatch in the EU countries	7
2.1. Description of datasets.....	7
2.2. Skills needs by sector and occupation.....	9
2.3. Incidence of skills mismatch by sector and occupation	12
3. Multinomial logit of skills mismatch.....	13
3.1. Skills mismatch and sector (NACE classification).....	13
3.2. Skills mismatch and occupation (ISCO classification)	17
3.3. Skills mismatch and other characteristics.....	21
4. Measuring skills match revisited: towards more objective skills measurement	22
5. Conclusions.....	26
References.....	27
Annex. Supporting tables and figures.....	30

Introduction

Skills mismatches become one of the major challenges for the public policy on the labour market. Lack of the proper match of skills, regardless if it is overskilling or underskilling, leads to inefficiencies on the labour market that should be limited, through appropriately designed public policies.

Our aim is to broaden the evidence on the incidence of the skills mismatch in Europe by adding the sectoral perspective and contribute to the advancement in the methodology of measuring the skills mismatch. We follow the existing literature approach to measuring skills mismatches in the European countries, with special reference to the differences on the level of economic sectors and occupations. The sector perspective in understanding skills mismatches is important, as in many countries the skills policies are designed with the participation of the sectoral skills councils. Many tools and instruments addressing the skills gaps are also developed at the sectoral level. Finally, we propose advancement in measuring skills match in Europe, based on the progress in the development of national qualifications frameworks.

The paper is structured as follows. First, we present the literature review related to measuring skills mismatch, identifying up-to date evidence on the skills mismatch from the sectoral and occupational perspective. Second, we assess the sectoral and occupational differences in the level of skills match in the European countries using two large-scale international surveys: survey of skills (PIAAC) (OECD 2013) and European skills and jobs (ESJ) (CEDEFOP 2015). To assess the effect of different characteristics, including the sector of employment, we estimate multinomial logistic regressions to explain skills mismatch in general assessment and by different types of skills identified in the ESJ survey. We provide a critical assessment to the approaches in measurement of the skills match, based on the review of the literature as well as the model results. Finally, we propose further advancement in the measurement of skills match at sectoral level in the future research in this area.

1. Skills mismatch in the literature: definitions and measurement

When measuring skills mismatch we refer to the concept of skills. Acemoglu and Autor (2011) define skill as “a worker’s endowment of capabilities for performing various tasks”, where task is understood as “a unit of work activity that produces output (goods and services)”. This is a broad definition, that is also found in the OECD (OECD 2012). Correct match of skills of workers to the job requirements leads to the efficient use of the existing labour force potential.

If the level of skills of individual is different (either lower or higher) than the level of skills required for her job, skills mismatch occurs. According to Sala (2011) the skills mismatch in the labour market describes the fact that levels or kinds of skills of individuals are inadequate in view of particular job requirements. (OECD 2014) defines that skills mismatch arises when workers have a level of skills that is higher or lower than that required by their job.

There are the following types of mismatches that can be found on the labour market:

- Qualification mismatch that occurs, when the level of qualification of the worker is different than that require by the job;
- Field of study match, when the field of education of individual is different than the economic sector of her job.

Another approach is proposed by Sloane (2014), who divides mismatches into two groups: horizontal and vertical. The horizontal mismatch is understood similarly to field of study match of OECD's classification. Within vertical mismatch, Sloane (2014) proposes three main categories of workers:

1. Overeducated workers, whose level of *education* is higher than required;
2. Overqualified, if the level of *qualification* is higher;
3. Overskilled, if the mismatch concerns the level of *skills*.

In this paper, we use the term "skills mismatch", as it is usually used in the literature in this subject.

OECD (2011) underlines, that skills mismatch is often a result of the differences in skills among individuals with the same level of qualification or education and it is a more complex phenomenon than the education mismatch. This is the reason, why the literature on skills mismatch is growing.

The methods that can be applied to measure and analyse the skills mismatches are similar to the ones used in measuring educational mismatch. Leuven and Oosterbeek (2011) list three main approaches to measuring education mismatch:

1. Job titles method – where the requirements for a specific occupation (according to job title) are identified by sectoral experts.
2. Workers self-assessment method, where the job requirements are of the opinion of a worker.
3. Realised matches method – where the match is understood as a difference of the individual's level of education and the mean or (more often) mode level of education among the workers in the same occupation.

Theoretical assumptions of the measurement of skills mismatch have been widely debated for example by Handel (2003), McGuinness and Ortiz (2014) and Verhaest and Omeij (2006). In particular McGuinness and Ortiz (2014) point out to the need of using employers as informants about the skills mismatch. However, surveying employers is usually more difficult than surveying individuals, due to lower response rates in employers' surveys.

The majority of studies in the subject use the workers' self-assessment. As stated in the (OECD 2011), the main disadvantage of the remaining two approaches is that they are based on the interpretation of occupational titles. The basis for the estimations in both cases are classifications of jobs (usually ISCO classification or its national counterparts). In such case, the employers and employees have problems with identifying the exact code of the occupation, in particular (but not exclusively), because the job titles significantly vary among the companies. In the case of realised matches method, achieving statistically significant results with the use of 4-digit occupational codes require very large datasets, which is expensive. The expert identification of job requirements for all the occupations would be also expensive, given the large variety of occupations and jobs.

However, there are also several deficiencies of the self-assessment approach, discussed in the literature. The self-assessment is a subjective measure and employees may be overly optimistic in their skills assessment as well as skills required at the workplace. As a result, the incidence of the skills mismatch may be susceptible to a bias arising from a different perception of skill levels and requirements (Støren and Wiers- Jenssen 2010).

The extent of skills mismatch, according to different survey varies, which is due to differences in the terminological and methodological approaches. The skills mismatch in OECD countries, based on the outcomes of the Survey of Skills (PIAAC) reaches the level of 60% of workforce (OECD 2014). Adalet McGowan and Andrews (2015) assess, that the percentage of workers with skills mismatch varies from 18 to 34%, applying different approach to analysing PIAAC data. The results of the ESJ survey (CEDEFOP 2015) show that this percentage in EU-28 countries exceeds 40%, with vast majority of workers being over-skilled.

There are also different characteristics of individuals and labour markets that affect the skills mismatch. These can be individual characteristics, those related to the occupation or sector of employment as well as the features of the local, regional or national labour markets.

The individual characteristics that affect skills mismatch at the country level include level of education, race and sex, which is shown by Schmidt i Strauss (1975), for the US data. Kiker, Santos, and de Oliveira (1997) in the case Portuguese workers show that socio-economic characteristics such as education, tenure, work experience and sex affect overeducation. Their evidence indicates also that overeducation may result from a trade-off between education and other forms of human capital. More recently, Dolton and Silles (2002b) show that skills mismatch varies by individual characteristics such as sex, education, occupation, sector, company size, work experience, mobility and family commitments. Chiswick and Miller (2009) based on the US data show differences in overeducation incidence between native born and foreign born workers.

Differences in the incidence of mismatch by occupations are also in the ESJ survey CEDEFOP (2015) shows that the incidence of overqualification is higher among individuals employed in elementary and skilled agricultural jobs, while it also disproportionally affects plant and machine operators and assemblers and market sales workers. On the other hand, adult workers in professional and managerial occupations are the least likely to report that they are overqualified for their jobs.

There is relatively little evidence in the literature that focuses on the sectoral differences in the skills match. Large study of Consoli and Rentocchini (2015) showed that the differences in skills needs and utilisation among economic sectors in United States are of huge importance and may significantly affect the incidence and policy responses to skills mismatches. In her overview of the skills mismatch Quintini (2011: 25) finds out that some of the results obtained from micro-econometric studies of the determinants of over-qualification provide some insights on the factors that influence the incidence of skill mismatch at the aggregate level. This refers, among others, to workers in the commerce sector (Dolton i Silles 2002a) that are more likely to be overeducated, while in the case of industry and public companies the incidence of overeducation is smaller.

Sector differences are also reported by Bevan and Cowling (2007), who use European Working Conditions Survey to assess the skills mismatch on the sectoral level in the UK. The highest levels of underskilling are seen in the following sectors: transport and communication, manufacturing, hotels and catering and finance, while the overskilling is noted in the retail sector. Also CEDEFOP (2010) studies reveal that some sectors face skills shortages, in others the level of skills that are possessed by workers is higher than expected. Effective skills-jobs matching is primarily affected by problems of incomplete information and transaction costs on both of employers and employees side, which may differ by sectors. The results of the ESJ survey (CEDEFOP 2015) show that relative to those employed in the manufacturing sector, individuals working in wholesale and retail trade, accommodation or food services, transportation and storage, arts and entertainment, and also in ICT services are more likely to have higher qualifications relative to the ones needed by their jobs.

International large scale surveys, such as PIAAC or ESJ allow comparing the incidence of skills mismatch by countries. The country differences are studied among others by (Adalet McGowan and Andrews 2015; CEDEFOP 2015). According to their assessment, country differences in skill mismatch are associated with differences in the policy environment. Skill mismatch is lower in countries with well-designed framework conditions that promote efficient reallocation of the workforce, greater flexibility in wage negotiations and higher participation in lifelong learning as well as better quality of management. Some policies, such as employment protection legislation that affect the youth, can also have adverse implications for their lifetime labour market outcomes given persistence in skill mismatch (Adalet McGowan i Andrews 2015). The results of the CEDEFOP study also reveal that countries differ with regards to the structure of the qualifications of the workforce and job requirements (CEDEFOP 2015).

2. Skills mismatch in the EU countries

2.1. Description of datasets

In the paper, we aim to broaden the understanding on the skills mismatch at the sectoral and occupational level, using two recent large-scale international surveys that allow assessing skills mismatch on larger samples¹.

The first dataset comes from the Survey of Adult Skills conducted and developed within the Programme for the International Assessment of Adult Competencies (PIAAC), coordinated by the OECD. We use the results of the first round of the survey conducted in 2011-12 that covers 30 countries, including 17 EU member states². The total sample of EU countries are 104 409 people, including 67 667 that were employed at the moment of survey. The second dataset is taken from the European Skills and Jobs (ESJ) Survey that was conducted by Cedefop in 2014. In the survey 49 000 adult employees (aged 24 to 65) across all 28 Member States were asked how their skills and qualifications match the needs of their jobs.

Workers in both surveys responded to individual questionnaires, that included questions on the level of their skills compared to their perception of the skills that are needed at their workplace.

In the PIAAC survey, there were two questions regarding self-assessment of own skills and skills required in a job:

- Do you feel that you have the skills to cope with more demanding duties than those you are required to perform in your current job?
- Do you feel that you need further training in order to cope well with your present duties?

Those, who responded positively to the former were classified as over-skilled, those, who responded positively to the latter were classified as under-skilled. If respondents replied “yes” to both questions, they were classified as matched.

¹ Other large scale surveys, that are used in literature on educational and skills mismatches are: Labour Force Survey (e.g. Wincenciak 2016), REFLEX Survey (Salahodjaev 2015) or Structure of Earnings Survey (Kampelmann i Rycx 2012).

² AT, BE, CY, CZ, DK, EE, FI, FR, DE, IE, IT, NE, PL, SK, ES, SE, UK.

The ESJ survey included a series of items that focus on identification of skills needs and skills match by respondents. The ESJ survey covered different bundles of fundamental and transversal skills (see Table 1).

Table 1. Bundles of skills used in the ESJ survey

Skills	Definitions
Fundamental	
Basic literacy	Reading manuals, procedures, letters or memos.
Advanced literacy	Writing long documents such as long reports, handbooks, articles or books.
Basic numeracy	Calculations using decimals, percentages or fractions, understanding tables and graphs.
Advanced numeracy	Calculations using advanced mathematical or statistical procedures.
Basic ICT	Using a PC, tablet or mobile device for email, internet browsing.
Moderate ICT	Word-processing, using or creating documents and/or spreadsheets.
Advanced ICT	Developing software, applications or programming; use computer syntax or statistical analysis packages.
Transversal	
Communication skills	Sharing information with co-workers/clients. Teaching and instructing people. Making speeches or presentations.
Teamwork skills	Cooperating and interacting with co-workers. Dealing and negotiating with people.
Customer handling skills	Selling a product/service. Dealing with people. Counselling, advising or caring for customers or clients.
Problem solving skills	Thinking of solutions to problems. Spotting and working out the cause of problems.
Learning skills	Learning and applying new methods and techniques in your job. Adapting to new technology, equipment or materials. Engaging in own learning.
Planning and organisational skills	Setting up plans and managing duties according to plans. Planning the activities of others. Delegating tasks. Organising own or other's work time.
Technical skills	Specialist knowledge needed to perform job duties. Knowledge of particular products or services. Ability of operating specialised technical equipment.

Source: (CEDEFOP 2015).

In the case of literacy, numeracy and ICT skills, respondents in the ESJ were asked to assess the highest level of skills required at their job. In case of the other skills, respondents were assessing the level of skills on the scale from 0 to 10.³ In our analysis we propose the following classification of responses: less important (from 0 to 6), important (from 7 to 9), essential (10).

Then, respondents assessed their skills match to the level required at their job, based on the following question:

"Please use a scale of 0 to 10 where 0 means your level of skill is a lot lower than required, 5 means your level of skill is matched to what is required and 10 means your level of skill is a lot higher than required."

In the paper, we assess that respondents are underskilled if their response is from 0 to 4, matched if the response is between 5 and 8 and overskilled if their response is 9 or 10.

2.2. Skills needs by sector and occupation

Both PIAAC and ESJ allow identifying the level of needs for selected skills at job places of the respondents. Literacy, numeracy and ICT skills needs are assessed in both surveys. In the PIAAC, the assessment is based on the frequency of the use of the selected skills at work. In the ESJ, this is based on the assessment of the level of skills required for the job.

In many sectors the skills mix that seems to be most important includes both knowledge and skills that are developed mainly through the education system, as well as skills which are usually developed in the course of the working life. Sectors that require highest knowledge and use of literacy, numeracy and IT skills include: professional, scientific or technical services; information technology or communication services; financial, insurance or real estate services and services related to education and health. On the other hand, lowest literacy skills are reported in agriculture and accommodation, catering or food services. IT skills are also needed in construction sector, while they are less needed in the education and health sector.

Bundles of transversal skills are valued on average more than fundamental ones, according to the ESJ. The skills that are valued most are advanced ICT skills, those that related to social competences such as communication and teamwork and problem solving.

The importance of skills is also different at the sector level (Table 2). Workers in accommodation, catering and food services point out to the high importance of many of fundamental and transversal skills bundles. Those working in financial, insurance or real estate services indicate high importance of technological, learning and problem solving skills. Other sectors where the need for skills, both fundamental and transversal ones are higher are services related to education and health, information technology or communication services, professional, scientific or technical services. The need of using skills (both fundamental and transversal ones) is smaller in sectors of supply of gas, electricity, mining or quarrying and supply, management or treatment of

³ The respondents replied to the following question: "On a scale from 0 to 10, where 0 means not at all important, 5 means moderately important and 10 means essential, how important are the following for doing your job".

water and steam. Both types of skills are also less important in agriculture, transportation services or among those, who did not select any specific sector⁴.

Table 2. Importance of fundamental and transversal bundles of skills by NACE sector

	The most important	The least important
basic literacy	Cultural industries (arts, entertainment or recreation)	Agriculture, horticulture, forestry or fishing
advanced literacy	Accommodation, catering or food services	Supply, management or treatment of water or steam
basic numeracy	Accommodation, catering or food services	Agriculture, horticulture, forestry or fishing
advanced numeracy	Social and personal services	Cultural industries (arts, entertainment or recreation)
basic ICT	Information technology or communication services	Supply of gas or electricity, mining or quarrying
moderate ICT	Accommodation, catering or food services	Construction or building
advanced ICT	Construction or building	Supply of gas or electricity, mining or quarrying
technology	Financial, insurance or real estate services	Social and personal services
communication	Accommodation, catering or food services	Supply, management or treatment of water or steam
teamwork	Accommodation, catering or food services	Supply, management or treatment of water or steam
customers	Accommodation, catering or food services	Supply of gas or electricity, mining or quarrying
problem solving	Financial, insurance or real estate services	Supply of gas or electricity, mining or quarrying
learning	Financial, insurance or real estate services	Supply of gas or electricity, mining or quarrying
planning	Cultural industries (arts, entertainment or recreation)	Supply of gas or electricity, mining or quarrying

Source: Authors' analysis of the ESJ data.

The sectoral differences in the composition of skills needs by sectors are important when analysing skills mismatch. For example, workers employed in retail and sales sector may indicate that they have higher than required skills to perform their job, but if they were employed in the information technology and communication services sector, their skills would not be sufficient.

⁴

Table 5 in the Annex shows more detailed results.

The need for skills and the importance of different skills also vary by occupation. The advanced ICT use among plant and machine operators and assemblers and advanced numeracy in the case of workers using such skills in elementary occupations score the highest rank among fundamental skills (Table 3). However, this can indicate that understanding of what is meant by advanced ICT skills may also differ between occupations. For example, the advanced numeracy needs can be understood differently by people performing elementary occupations, as a result, they indicate importance of such skills at their job places.

The importance assigned to transversal skills is higher compared to fundamental skills also at occupation level. The differences are the most striking in the case of the skilled agricultural and fishery workers, where the skills related to customer handling and planning are assessed as very needed, while most of the fundamental skills are less needed (Table 6 in the Annex).

Table 3. Importance of fundamental and transversal bundles of skills by NACE sector

	The most needed	The least needed
basic literacy	Service workers and shop and market sales workers	Skilled agricultural and fishery workers
advanced literacy	Legislators, senior officials and managers	Skilled agricultural and fishery workers
basic numeracy	Service workers and shop and market sales workers	Skilled agricultural and fishery workers
advanced numeracy	Elementary occupations	Skilled agricultural and fishery workers
basic ICT	Service workers and shop and market sales workers	Skilled agricultural and fishery workers
moderate ICT	Clerks	Skilled agricultural and fishery workers
advanced ICT	Plant and machine operators and assemblers	Elementary occupations
technology	Craft and related trades workers	Elementary occupations
communication	Skilled agricultural and fishery workers	Craft and related trades workers
teamwork	Skilled agricultural and fishery workers	Professionals
customers	Skilled agricultural and fishery workers	Craft and related trades workers
problem solving	Legislators, senior officials and managers	Professionals
learning	Skilled agricultural and fishery workers	Technicians and associate professionals
planning	Skilled agricultural and fishery workers	Professionals

Source: Authors' analysis of the ESJ data.

Different level of skills needs and importance at sector and occupation levels mean that these are important factors in analysing the skills mismatch. The assessment of the skills mismatch is also relative given the different perception of the level of skills required.

2.3. Incidence of skills mismatch by sector and occupation

According to the proposed above approach to measure the skills mismatch, results of both surveys indicate that the incidence of lack of match of skills to the requirements on the job is quite large, which is in line with other findings in the literature.

In the case of PIAAC, around one third of workers report that their skills are correctly matched to the job, 43.55% indicate that they have higher skills than required and 23.11% are underskilled. Results of ESJ show much better match, with 54.8% of employed, who indicate that they are matched to their job, 39.8% overskilled and 5.4% underskilled.

Our results show that the skills match differs by sector, in general terms as well as for selected fundamental and transversal skills. Sectors in which workers tend to report higher than average overall overskilling are: accommodation, catering and food services, retail and sales, transportation or storage, cultural services. The highest skills is found in construction or building, supply of gas or electricity, mining and quarrying and services relating to education and health (see Figure 8 and Figure 9 in the annex). The lowest share of workers that believe that their skills are correctly matched in almost all types fundamental and transversal skills identified in the ESJ is seen in the case retail and sales, accommodation, catering and food services, administration and support services, supply of gas and electricity and manufacturing (Table 7 and Table 8 in the annex). It should be underlined that in many of these sectors the importance of possessing such skills is lower. By the same token, higher than average overskilling is noted in the retail and sales and accommodation and catering. Among sectors with high importance of skills, overskilling is seen in the ICT sector as well as financial, insurance or real estate services.

In some sectors, workers indicate that they are overskilled, when the need for skills seems to be less essential. In other sectors overskilling is reported in the high level of skills needs. The highest level of overskilling is reported in the case of jobs with the following skills needs: basic literacy, advanced ICT, teamwork, problem solving and communication. The latter three types of skills are typical soft skills that are ranking among those that are mostly sought by employers.

The two dimensions: assessment of skills needs and skills match should to be put together to understand the level of skills that are possessed by workers. The overskilling in basic literacy is reported in sectors, where such level of literacy is most frequently required (accommodation, retail, transportation), but also construction, where we see more demand for advanced literacy. ICT skills at advanced level are expected mainly in ICT as well as professional serviced. Overskilling in advanced ICT skills is seen in sectors with lower need for such skills (cultural, construction, education or health). Similarly, communication skills are important and essential in financial services and ICT, retail, cultural services with overskilling reported frequently. On the other hand, higher than required level of these skills is observed in accommodation and catering, where they are less required. Teamwork skills are reported at higher than required level in sectors with high demand for such skills: financial services and ICT, but also where the demand is lower: accommodation, catering and retail and sales.

The relative incidence of skills match by occupations is similar in the PIAAC and ESJ. In the low skilled occupations (elementary occupations, plant and machine operators and assemblers, clerks, service workers and shop and market sales workers) have the highest incidence of general skills mismatch (overskilling) is

highest, while it is lower among professionals, technicians and associate professionals as well as legislators, senior officials and managers. Legislators, senior officials and managers as well as service workers and shop and market sales workers are the two occupations that report higher than average level of overskilling in the range of both fundamental and transversal skills.

3. Multinomial logit of skills mismatch

In order to assess the determinants of underskilling and overskilling we estimate multinomial logistic regression models (Hosmer, Lemeshow, i Sturdivant 2013), which is an extension of the traditional binomial logistic regression that was first introduced by (Mc Fadden 1974). This type of analytical approach was used to analyse the educational and skills mismatch, among others, by (Chiswick i Miller 2009; Grilli i Rampichini 2007; Kiker i in. 1997; Schmidt i Strauss 1975).

The covariates include the following groups:

- (i) individual and workplace characteristics, such as age, sex, educational attainment as well as size of the company,
- (ii) occupation in the ISCO classification,
- (iii) sector of employment in the NACE classification,
- (iv) country variable.

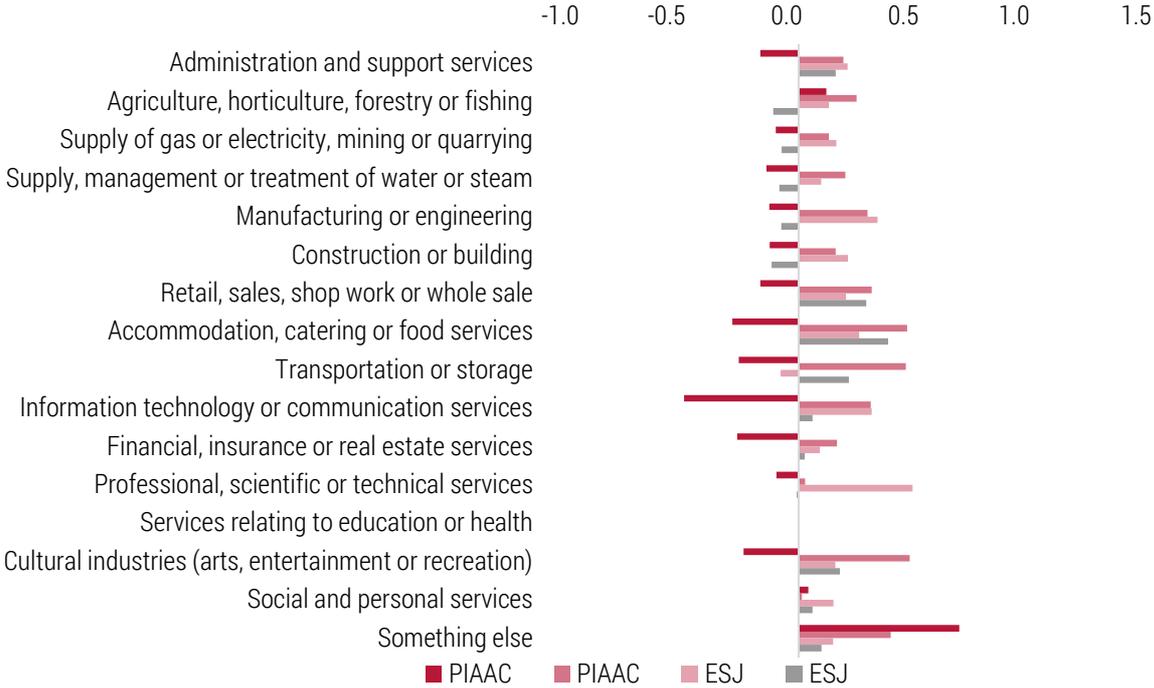
The models are estimated using the maximum likelihood estimator.

Separate multinomial models, based on overall skills match both in the PIAAC and ESJ survey have been estimated using similar or the same covariates (to the extent it is possible given differences in the specification of the variables in the two surveys). This allows verifying robustness of our results. We also estimated the models for each type of fundamental and transversal skills that are identified in the ESJ survey. The comparison of the estimated coefficients for different types of skills allows to draw conclusions on the probability of different skills mismatch due to sector and occupational differences. The tables with results (in the annex) show the estimates of the probability of the underskilling compared to the correctly matched workers (US/CM) and overskilling compared to the correctly matched workers (OS/CM). Table 11 presents estimates for the general skills mismatch for both PIAAC and ESJ data sets. Table 12 shows the results for the fundamental skills and Table 13 includes estimates for the transversal skills. In all models, the reference industry were *services relating to education and health* and the reference occupation was *a professional*.

3.1. Skills mismatch and sector (NACE classification)

There are significant differences in the skills mismatch at the sectoral level. (Figure 1). The incidence of overskilling (compared to the correctly matched) is highest in accommodation, catering and food services; transportation or storage; retail, sales, shop work or whole sale. Smaller, but still significant differences are also noted in cultural industries as well as administration and support services in the case of both PIAAC and ESJ surveys. The estimates of underskilling give different predictions, depending on the dataset. The same direction noted only in the case of transportation or storage (lower incidence of underskilling) and agriculture, horticulture, forestry or fishing (higher incidence of underskilling).

Figure 1. Multinomial logit estimates of general skills match for sector covariates (NACE), PIAAC and ESJ



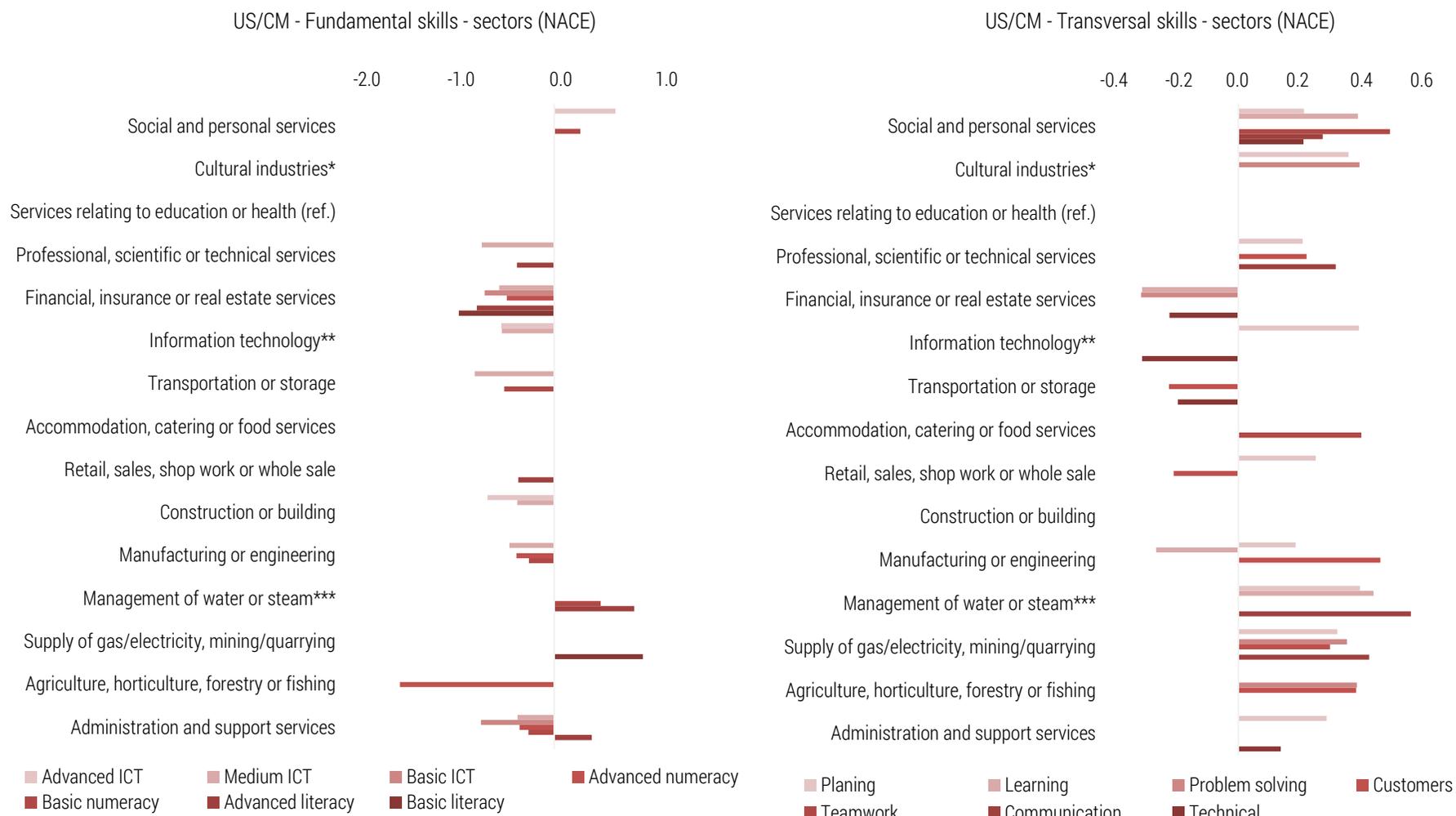
Note: Bars are shown only for the statistically significant estimates ($p < 0.1$), reference category: services relating to education and health.

Source: Authors' analysis of the PIAAC and ESJ data.

The lower incidence of underskilling (Figure 2) in some fundamental skills, compared to the workers employed in the sector of services relating to education and health is seen in administration and support services, manufacturing or engineering financial, insurance or real estate services. In supply of gas or electricity mining or quarrying, supply, management or treatment of water or steam we see higher incidence of underskilling, respectively, in basic literary and basic and advanced numeracy. Those working in social and personal services are more likely to be underskilled in basic numeracy and advanced ICT. Underskilling in the area of transversal skills is more likely to be observed in the supply of gas or electricity mining or quarrying, supply, management or treatment of water or steam as well as social and personal services and professional, scientific or technical services, while it is less likely to be seen in transportation or storage (technical and customer skills), financial, insurance and real estate services (technical, customers and learning services).

The models results also confirm the higher incidence of overskilling (Figure 3) both in relation to selected fundamental and transversal skills, particularly in the retail, sales, shop work and whole sale, accommodation, catering and food services, transportation or storage, information technology or communication services. On the other hand, the probability of overskilling is lower in the case of supply of gas, electricity, mining and quarrying, supply, management or treatment of water or steam (communication and teamwork), manufacturing or engineering and construction or building. In very few cases we see that the direction of the incidence of mismatch is different for selected skills. Workers in professional, scientific or technical services are more likely to be overskilled in basic numeracy and technical skills, while less likely to be overskilled in advanced numeracy, communication, teamwork and customer skills. Those in cultural industries have higher probability of overskilling in basic literacy, while lower in advanced numeracy.

Figure 2. Multinomial logit estimates of probability of underskilling compared to skills match for sector (NACE) covariates, fundamental and transversal skills

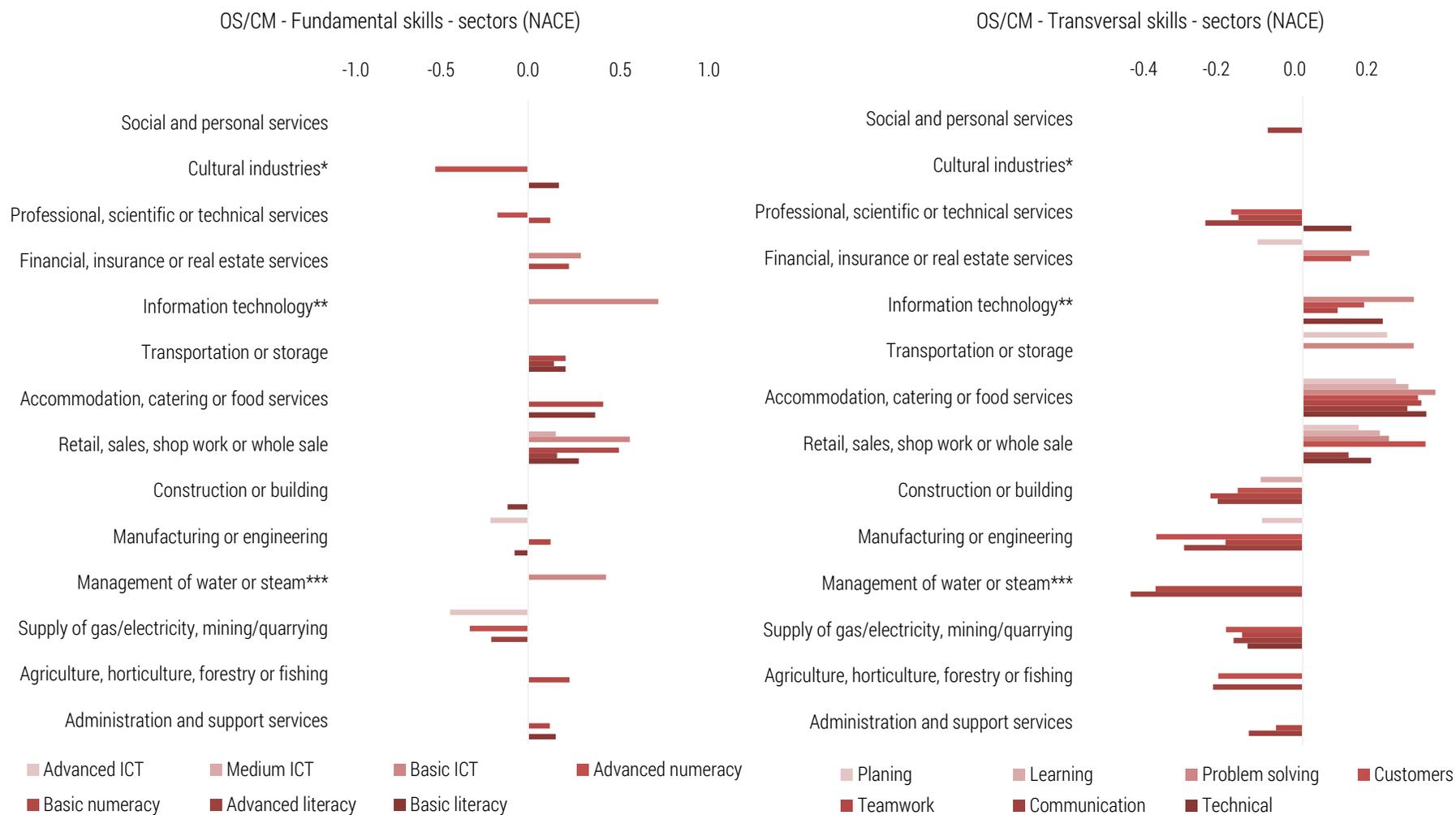


*Cultural industries includes arts, entertainment or recreation, **Information technology or communication services, ***Supply, management or treatment of water or steam.

Note: Bars are shown only for the statistically significant estimates ($p < 0.1$) reference category: services relating to education and health.

Source: Authors' analysis of the ESJ data.

Figure 3. Multinomial logit estimates of probability of overskilling compared to skills match for sector (NACE) covariates, fundamental and transversal skills



Cultural industries includes arts, entertainment or recreation, **Information technology or communication services, *Supply, management or treatment of water or steam. Note: Bars are shown only for the statistically significant estimates ($p < 0.1$), reference category: services relating to education and health. Source: Authors' analysis of the ESJ data.*

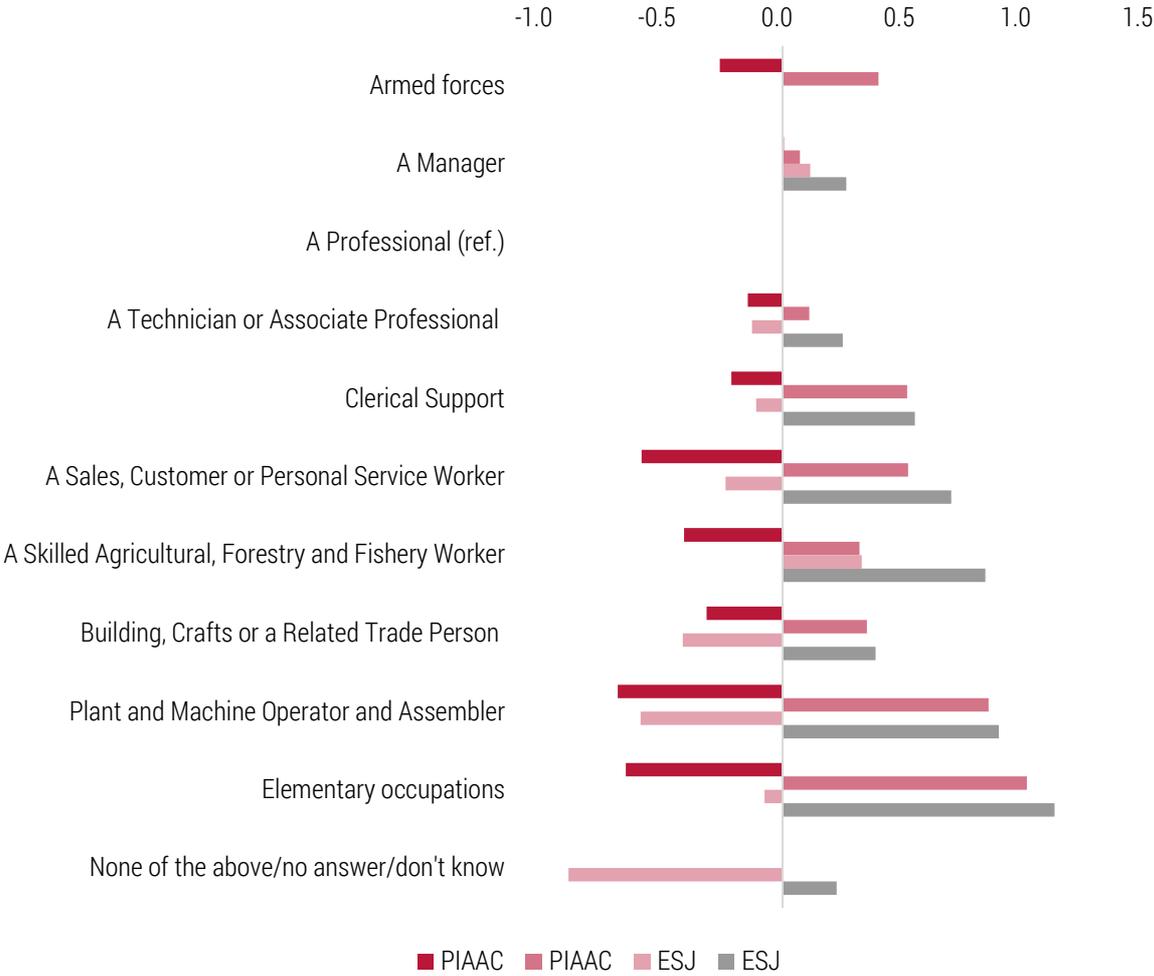
3.2. Skills mismatch and occupation (ISCO classification)

The incidence of underskilling and overskilling, compared to the correctly matched workers depends on the occupation (Figure 4). Compared to professionals, we can see that the incidence of underskilling is lower in occupations that require lower skills levels. By the same token, the incidence of overskilling is higher for occupations with lower skills levels. These results indicate that the level of skills among European workers is higher than the actual need for skills, particularly in the low-skilled occupations and low-skilled sectors. This may lead to divergent outcomes. First, there can be a skill loss related to the unused skills that would be forgotten by workers. Second, there is potential to have a higher productivity of workers employed in occupations that are associated with lower skill levels, which are frequently seen the services sectors.

We see a more divergent picture, when we take a closer look at the bundles of fundamental and transversal skills. Compared to professionals, managers, technicians or associate professionals, sales, customer or personal service workers and building, crafts or related trade persons have lower incidence of being underskilled in literacy (Figure 5). In the case of numeracy, we see that the incidence of underskill is higher for managers, skilled agricultural, forestry and fishery workers, building, crafts or related trade persons, plant and machine operators and assemblers and those in elementary occupations. The latter three groups of occupations also have higher incidence of underskilling in moderate or advanced ICT. For transversal skills, we see that managers, technicians or associate professionals have in general lower incidence of underskilling, while those in elementary occupations, plant and machine operators and assemblers as well as those working as building, crafts or a related trade persons have higher probabilities of being underskilled.

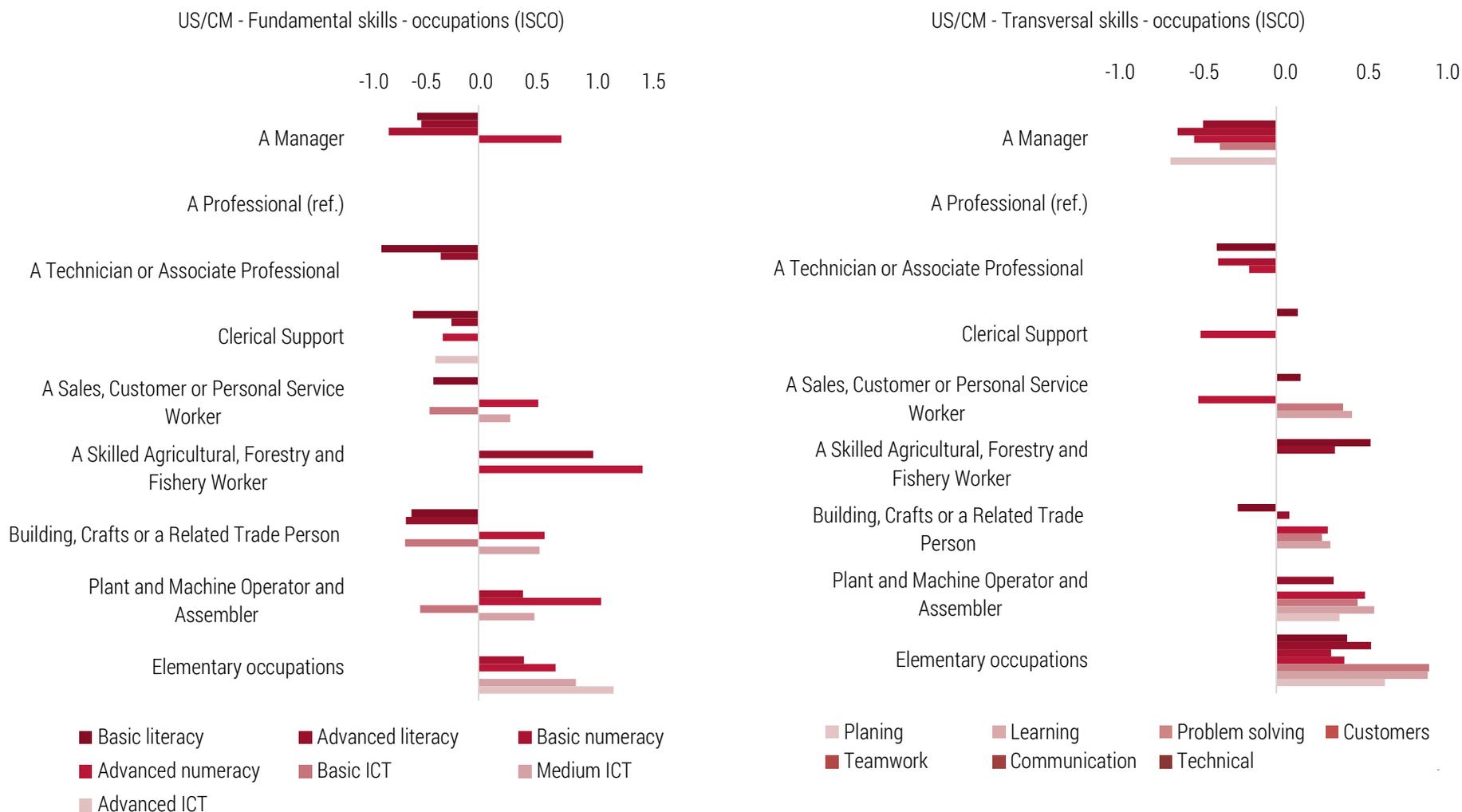
There is a higher probability of overskilling on low skills occupations for basic literacy, basic numeracy and basic ICT (Figure 6). Managers, compared to professionals, report also higher incidence of overskilling in advanced numeracy and advanced literacy. Clerical support workers, plant and machine operators and those in elementary occupations report lower incidence of overskilling in the case of transversal skills (compared to professionals), while those in who work as sales, customer or personal service workers tend to be more overskilled (compared to reference category) in the case of technical, communication, teamwork and customers skills.

Figure 4. Multinomial logit estimates of general skills match for occupation (ISCO) covariates , PIAAC and ESJ



Note: Bars are shown only for the statistically significant estimates ($p < 0.1$).
 Source: Authors' analysis of the PIAAC and ESJ data.

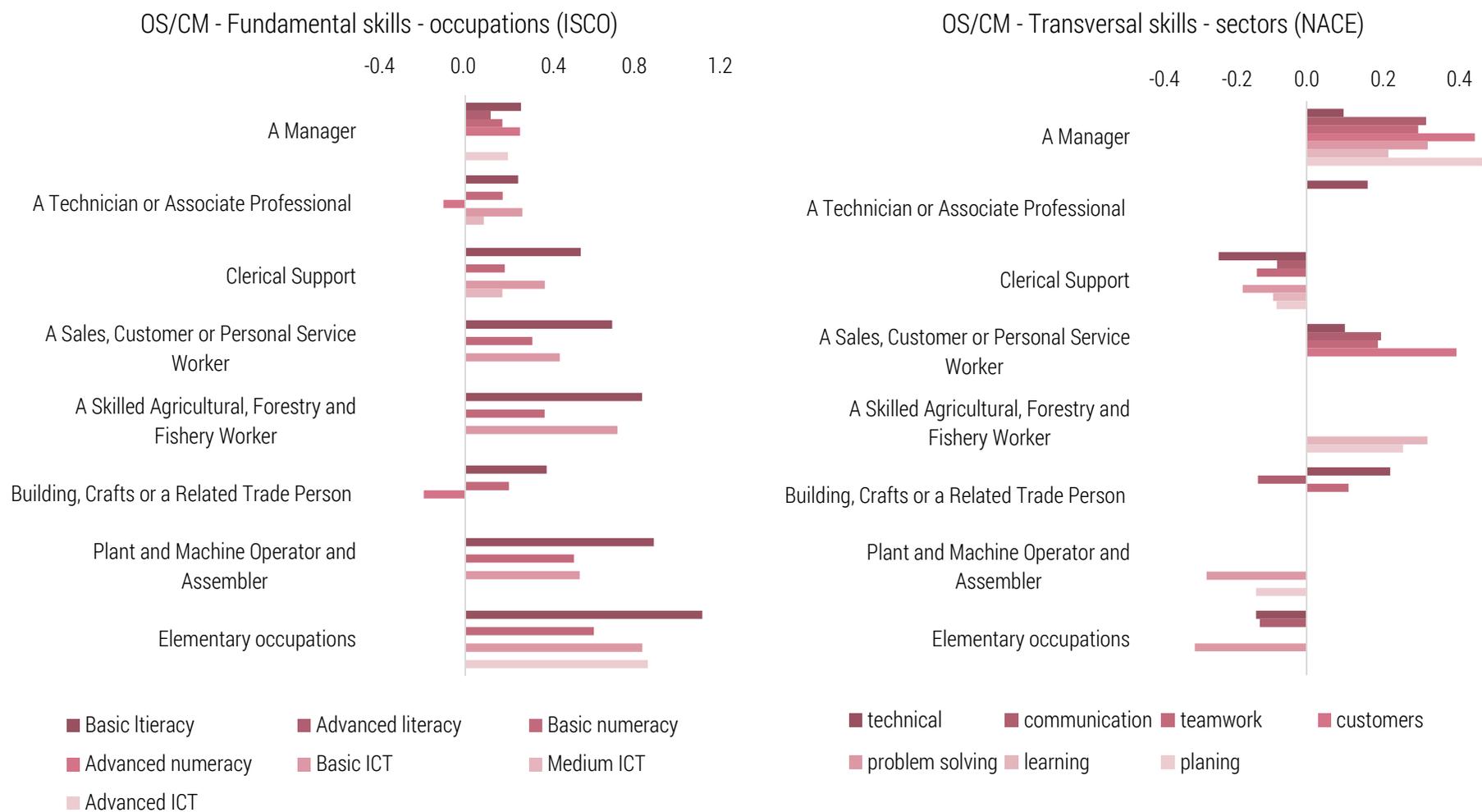
Figure 5. Multinomial logit estimates of probability of underskilling compared to skills match for occupation (ISCO) covariates, fundamental and transversal skills



Note: Bars are shown only for the statistically significant estimates ($p < 0.1$).

Source: Authors' analysis of the ESJ data.

Figure 6. Multinomial logit estimates of probability of overskilling compared to skills match for occupation (NACE) covariates, fundamental and transversal skills



Note: Bars are shown only for the statistically significant estimates ($p < 0.1$).

Source: Authors' analysis of the ESJ data.

3.3. Skills mismatch and other characteristics

The model allows assessing the impact of the individual characteristics on the skills mismatch. We analyse the following characteristics: age, sex, education, firm size, country of employment.

Sex appear to be not statistically significant variable in case of general skills. In the case of fundamental skills, we see that females have lower incidence of overskilling in numeracy and ICT. There are also mixed results for the transversal skills. Women report higher incidence of overskilling in “soft” skills such as communication, teamwork, customers as well as learning and planning, while they have lower probability of being overskilled in problem solving.

Age variable brings contradictory results for PIAAC and ESJ datasets. According to PIAAC results, probability of mismatch (both under- and overskilling) is higher with the age and lower according to ESJ. Results are also different for bundles of fundamental and transversal skills.

As expected, compared to those with higher education level, those with lower educational attainment have higher probability of being underskilled and lower probability of being overskilled for most of the analysis skills.

Comparing to the medium sized companies (in the ESJ survey based model), workers in small and large companies have lower probability of being underskilled in terms of general skills (though, results on overskilling are not statistically significant). In micro companies, relative to the reference group (medium), we see the lower incidence of underskilling in skills related to advanced numeracy and customers and higher incidence in medium ICT and teamwork. The probability of higher overskill is seen in basic numeracy and customers, while lower probability of overskill relates to the basic ICT. Small companies tend to have more underskilled workers in basic literacy and ICT and less in the area of communication and customers. There is less overskill in the basic ICT, while there are more overskilled workers in the areas of basic numeracy, communication, teamwork and customers. Large companies have less underskilled workers in advanced literacy, technical and communication skills and more in those jobs that require medium ICT skills. This type of companies also seems to experience higher incidence of overskill in 6 out of 7 identified transversal skills.

Our results also confirm the country differences in the case of both underskilling and overskilling. The results of the assessment of country differences for the general skills match show different results in the case of PIAAC and ESJ datasets, however there are fewer countries that were covered by the PIAAC survey, which may affect the obtained results. In our models, we set the German workers as the reference. Both models indicate that there is a handful of countries, where the incidence of underskilling is higher than in Germany (11 out of 15 in the PIAAC survey and 14 out of 28 in the case of the ESJ survey). Lower incidence of underskilling is indicated in one country according to PIAAC (Slovakia) and two countries in the ESJ (Portugal and Croatia). The incidence of overskilling is higher, compared to Germany, in 14 out of 15 countries according to PIAAC (with one statistically insignificant) and in only 2 according to ESJ (with 21 with lower incidence).

The UK, Sweden, the Netherlands, Belgium, Portugal have significantly lower incidence of underskilling for groups of fundamental and transversal skills. In some countries (i.e. Malta, Luxemburg, Latvia, Cyprus and Lithuania) this lower incidence covers selected transversal skills. In fewer countries: Czech Republic, Greece, Poland, Austria) we observed higher incidence of underskilling in the ESJ survey. In majority of the countries, the incidence of overskilling is lower, compared to Germany for both fundamental and transversal skills

(France, the UK, Sweden, the Netherlands, Denmark, Spain, Belgium, Finland, Portugal, Estonia, Luxembourg), in much fewer countries we observe statistically higher probability of overskilling.

4. Measuring skills match revisited: towards more objective skills measurement

In analysing the skills match we need to take into account the workplace characteristics, including the sector of employment and occupation, not only country differences. The importance of some specific skills and competence is different in different sectors, therefore they influence the results of the measuring the skills mismatches. Furthermore, those differences persist regardless the source (PIAAC or ESJ), so those two factors overlap and more significantly affect results..

Comparison of results of the mismatch assessment based on the PIAAC and ESJ surveys show that measuring skills match is subjective. The outcomes vary depending on the way how the questions are asked, even if their semantic meaning is the same. There are two main sources of the such subjectivity. First, the skill level for a given job is assessed by the respondents may diverge from the real one. Second, the assessment of their individual's skills in relation to the job requirement may be overestimated – as we see, workers tend to report that their skills are higher than need for the job. As a result, it is difficult to formulate policy recommendations on the potential public interventions to improve the level of skills match and utilise the potential of the labour force.

It is difficult to eliminate the error in the subjective measurement of own skills compared to the benchmark of the selected job in the measurement, if we use the typical survey approach. We believe that it is possible to advance the approach related to defining the level of skills needs for a given sector, as in job titles approach. One of the potential ways of using information from employers is to define the skills requirements based on the needs expressed by employers as a more objective and less relative benchmark.

Our proposal of the further advancement in measuring skills mismatches is the use of the level descriptors in the qualifications frameworks. This includes in particular the sectoral qualifications frameworks, that include the descriptors of knowledge, skills and competences (that can be named skills in the Acemoglu and Autor (2011) approach) at different levels, corresponding to different types of occupations. These descriptors reflect the skills needs of a given sector.

Our departing point are the skills that are specified in the European and national qualifications frameworks. Qualifications framework is the tool aimed at comparing the qualifications awarded in a given qualifications system. It is composed of a number of level descriptors, that help users to identify what is the level of a particular qualification. There are several types of qualifications frameworks.

At the most general level there are qualifications frameworks developed at the level of world's regions (Tuck 2007), that serve as a “meta-framework”, i.e. help to compare NQFs in different countries. The most common one is the European Qualifications Framework, established on the basis of Recommendation of The European Parliament and of The Council of 23 April 2008 on the establishment of the European Qualifications Framework for lifelong learning (European Parliament

and Council of the European Union 2008; hence EQF Recommendation). By 2016, 28 countries presented referencing reports showing how national frameworks relate to the EQF.

The national qualifications frameworks (NQFs) that aims to arrange the qualifications systems on the national level. The EQF Recommendation defines 'national qualifications framework' as:

"means an instrument for the classification of qualifications according to a set of criteria for specified levels of learning achieved, which aims to integrate and coordinate national qualifications subsystems and improve the transparency, access, progression and quality of qualifications in relation to the labour market and civil society."

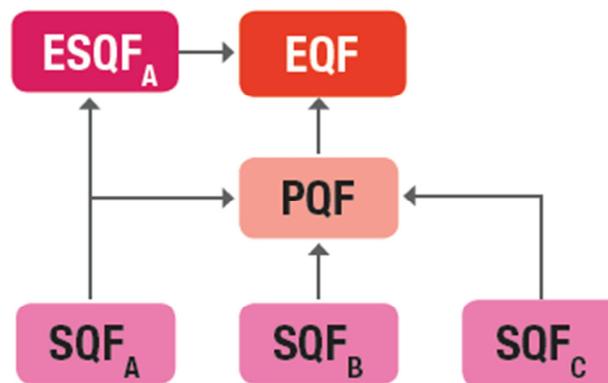
The number of NQFs around the world is currently estimated to excess 100. For an overview of a recent developments regarding national qualifications frameworks in Europe see (Cedefop 2014, 2015). For some insights on the developments of NQFs outside Europe see Allais (2010).

There are three main aspects that constitute qualifications frameworks (that concerns in particular but not exclusively the European ones):

1. Qualifications frameworks are usually open to different types of qualifications – unlike most of other classifications (e.g. ISCED) they can serve as a reference point for formal, non-formal, VET qualifications etc.
2. Qualifications frameworks are effects based – they describe the *learning outcomes* and do not specify, how they should be obtained (e.g. there are no defined credit points).
3. Qualifications frameworks aim at describing all the types of competences, both "hard" and "soft". They are usually divided to three categories: Knowledge, Skills and Competence. In some cases, there is a fourth category: attitude.

Sectoral qualifications frameworks are qualifications frameworks designed in order to meet the specific needs of a given sector. They are usually (though not always) composed in a similar way as the national qualifications frameworks, however they are written in the sector-specific language and do underline the competences that are crucial from the perspective of a given sector. E.g. sectors like health care tend to put an accent on social competences and attitudes, whereas industries sometimes focus almost explicitly on skills. There are two types of sectoral qualifications frameworks: international sectoral qualifications frameworks, that help to compare sector-specific qualifications between the countries and are usually referenced to EQF and national level SQFs, that are linked with and referenced to particular NQF. The relationships between different types of qualifications frameworks are illustrated in Figure 7.

Figure 7. Relationships between qualification frameworks: European, national, sectoral and international sectoral



Source: (Szymczak, Trochymiak, i Żurawski 2015).

Auzinger et al. (2016) offer the useful (though not complete) review of the International SQFs in Europe, that helps to see the differences among the sectors. The representative example of International SQF is Sectoral Qualifications Framework for Border Guarding, established by Frontex, that helps to compare qualifications of border guards in all the EU countries (Frontex 2013).

An example of SQFs designed on the national level are five SQFs in Poland (in banking, IT, tourism, telecommunication and sports sectors). Unlike the International SQFs, those are strictly built on a national context and are referred directly to Polish NQF, but also emphasize the sectoral differences. Unlike the NQFs that are considered more as an academic tool, the SQFs are developed with an active participations of sector stakeholders in particular, the representatives of employers and other labour market participants (Szymczak i in. 2015).

The comparison between level descriptors of European Qualifications Framework and sectoral qualifications frameworks is presented in Table 4. There are two examples of SQFs used: international SQF for border guarding and national (Polish) SQF for banking sector. The category of skills is used, for both SQFs only one, representative aspect was chosen.

Given the proliferation of the national qualifications frameworks, they can be potentially used also in the context of the skills measurement. The level descriptors, defined in the EQF and sectoral frameworks can be mapped to the selected occupations, allowing for a more objective benchmark for the assessment of the skills match. Furthermore, as sectoral skills descriptors are defined with the participation of employers – their preferences are expressed in the formulation of such requirements. This process is similar to the approach used in the job titles method.

Table 4. Level descriptors of European Qualifications and selected sectoral qualifications frameworks

European Qualifications Framework	Sectoral Qualifications Framework for Border Guarding	Sectoral Qualifications Framework for banking
Level 4: a range of cognitive and practical skills required to generate solutions to specific problems in a field of work or study	Level 4: Is able to demonstrate border surveillance tactics and techniques to gather information, prevent and detect illegal border crossing, cross-border criminality and irregularity	Level 4: Is able to collect and apply in work economic data, including data on financial markets and on the sector of enterprises and households
Level 5: a comprehensive range of cognitive and practical skills required to develop creative solutions to abstract problems	Level 5: selectively apply surveillance tactics and techniques to proactively survey the borders and gather information, maximising prevention and detection of illegal border crossing, cross border criminality and irregularity	Level 5: Is able to analyse a complex set of indicators, including sectoral ones, and use the results of analysis to develop an offer for a customer or synthetic reports for internal use in the bank
Level 6: advanced skills, demonstrating mastery and innovation, required to solve complex and unpredictable problems in a specialised field of work or study	Level 6: Is able to critically evaluate the tactics and implementation of operational procedures for border checking	Level 6: able to analyse forecasts for relevant economic variables, including sectoral data, present them in a synthetic form and use them to build/restructure customers' portfolios or to manage the bank well

Source: Authors' analysis.

Development of sectoral frameworks can combine both sectoral approach that could allow comparing occupational skills of people employed at similar occupations in different sectors, with a benchmark which is needed in the assessment of skills needs.

Use of sector-specific level descriptors allows to develop new approach to developing questionnaires related to the assessment of the skills match. At sector level, respondents could be directed to the set of questions based on the sectoral descriptions of job requirements, that could be the basis of the assessment of skill match.⁵ This could help to reduce the bias of the questionnaires related to the assessment of the level of skills required for a certain job.

It should be noted that such approach would not exclude all the subjectivity in the measuring skills mismatches. It would be still the method based on self-reported statements by employees, who are often willing to overestimate their actual level of skills.

There is also another aspect, that increases the potential usefulness of Sectoral Qualifications Frameworks, that are understood in a similar way to Frontex and Polish examples. It was assumed, that all the SQFs should be referenced to NQF or to EQF. Therefore (and given the fact, that all the European NQFs are or are planned to be referenced to EQF), it is possible to make easy inter-sectoral comparisons of the level of skills. This is a

⁵ Such approach is planned to be tested in Poland, as a part of the activities related to monitoring of the development of the implementation of the Polish Qualifications Framework, in a survey designed and conducted by the Educational Research Institute, planned for 2017.

value added of SQFs that is absent in alternative sectoral tools (e.g. sectoral competence profiles), that also help to understand sectoral context, but fail to be comparable with other tools.

5. Conclusions

The aim of the paper was to present and analyse the up-to-date approach of international measurement skills match. Skills mismatch appears to be an important challenge for the efficiency of the labour markets. There is a need to develop policy responses to address it. Therefore, it is very important to adequately measure the occurrence and the incidence of the skills match, taking into account different socio-economic characteristics.

The sector and occupation difference should be taken into account in analyses of the skills mismatch, as well as policy responses. Based on the two international large-scale surveys we assessed that there are significant differences in the level of skills used and skill (mis)match among different sectors of economic activity and occupations. In particular, in service sectors, such as retail, accommodation, financial and IT services the extend of overskilling seems to be higher, in particular in the area of transversal skills. The workers employed in the low-skilled occupations also tend to believe that they have higher skills than needed for these jobs. Their job contents could be modified, including more demanding tasks and improving productivity levels.

We also show that there are significant differences at the sector level on the assessment of the importance and level of skills needed. Our analysis confirms one of the main weaknesses of traditional approach to this subject, discussed in the literature, that the extent of the skill mismatch is dependent on subjective opinions of respondents. As a result, there is an additional bias at the level of cross-sectoral comparisons.

We also show, that different surveys may bring significantly different results. There are several sources of the observed differences: (i) the way questions are formulated affects the understanding of its meaning by the respondents; (ii) respondents can have different understanding of the actual level of skills required for their job, that is the benchmark is biased by the workers' perception; (iii) respondents can overestimate their own skills compared to their perceived benchmark. Due to the relative simplicity of the research tools and the cost of collecting the data, many of these biases are unavoidable in the large-scale quantitative surveys of workers.

In order to respond to both of those obstacles, we propose the approach incorporating sectoral qualifications framework. Qualifications frameworks are built on level descriptors of qualifications, that help to objectively assess both the level of workers' skills and job requirements in much more strict way than traditional questionnaires. Furthermore, sectoral frameworks are the extensions of "regular" qualifications frameworks, that underline the sectoral context, what may diminish the second weaknesses of questionnaires used to date.

Further development of the sectoral dialogue on the European and national levels focusing on the skills needs can support better skills match in the future, enhancing efficiency of the labour markets at the sectoral level. To date, there are only the few sectors, that developed the sectoral qualifications frameworks on the European or national levels. Therefore, such a survey would be possible only in a limited number of sectors. If the number of SQFs will grow in a near future, that limitation could be less binding.

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Annex. Supporting tables and figures

Table 5. Mean level of skills needs by type of skills and sector (NACE), ESJ

	Fundamental skills							Transversal skills						
	basic literacy	advanced literacy	basic numeracy	advanced numeracy	basic ICT	moderate ICT	advanced ICT	technology	communication	teamwork	customers	problem solving	learning	planning
Administration and support services	8.16	8.18	8.15	8.16	7.87	8.15	8.44	8.04	8.25	8.31	8.6	8.45	8.25	8.32
Agriculture, horticulture, forestry or fishing	7.6	7.89	7.55	8.11	7.39	7.97	7.88	8.19	8.1	8.6	8.64	7.99	8.17	8.59
Supply of gas or electricity, mining or quarrying	7.73	7.51	7.82	7.59	7.13	8.25	7.62	8.39	8.33	8.16	7.58	8.04	8.13	7.98
Supply, management or treatment of water or steam	7.8	7.41	7.84	7.69	8.11	7.96	7.89	7.79	7.62	7.65	8.09	8.33	8.16	8.4
Manufacturing or engineering	8.15	7.8	8.03	7.91	7.73	8.12	8.22	8.1	7.97	8.33	7.9	8.42	8.34	8.06
Construction or building	7.77	7.87	7.72	7.85	7.32	7.86	9.05	8.33	8.2	8.45	8.02	8.45	8.44	8.36
Retail, sales, shop work or whole sale	8.23	7.98	8.19	8.05	8.11	8.01	8.32	7.93	8.49	8.63	8.52	8.63	8.47	8.28
Accommodation, catering or food services	8.14	8.7	8.4	8.06	8	8.42	8.61	8.11	9	8.92	8.87	8.78	8.55	8.42
Transportation or storage	8.54	7.69	8.1	7.6	7.72	8.22	7.83	8.4	8.5	8.51	8.35	8.63	8.37	8.51
Information technology or communication services	8.39	8	8.05	8.2	8.53	8.1	8.2	8.35	8.31	8.42	8.27	8.56	8.36	8.26
Financial, insurance or real estate services	8.76	7.93	8.38	7.89	8.53	8.3	8.02	8.44	8.78	8.68	8.71	8.87	8.79	8.59
Professional, scientific or technical services	8.3	7.94	8.08	7.67	8.25	8.16	8.02	8.12	8.01	8.38	7.9	8.41	8.53	8.14
Services relating to education or health	8.3	8.09	7.79	8.17	7.65	7.97	8.48	8.04	8.65	8.54	8.27	8.49	8.34	8.29
Cultural industries (arts, entertainment or recreation)	8.87	7.81	7.67	7.54	8.21	8.13	8.06	7.96	8.56	8.6	8.67	8.54	8.46	8.83
Social and personal services	8.43	8.06	7.88	8.23	7.9	7.91	7.84	7.74	8.39	8.48	8.51	8.4	8.31	8.27
Something else	8.07	7.8	7.89	7.95	9.3	7.72	9.3	8.59	8.87	9.32	8.15	9.1	9.02	8.89

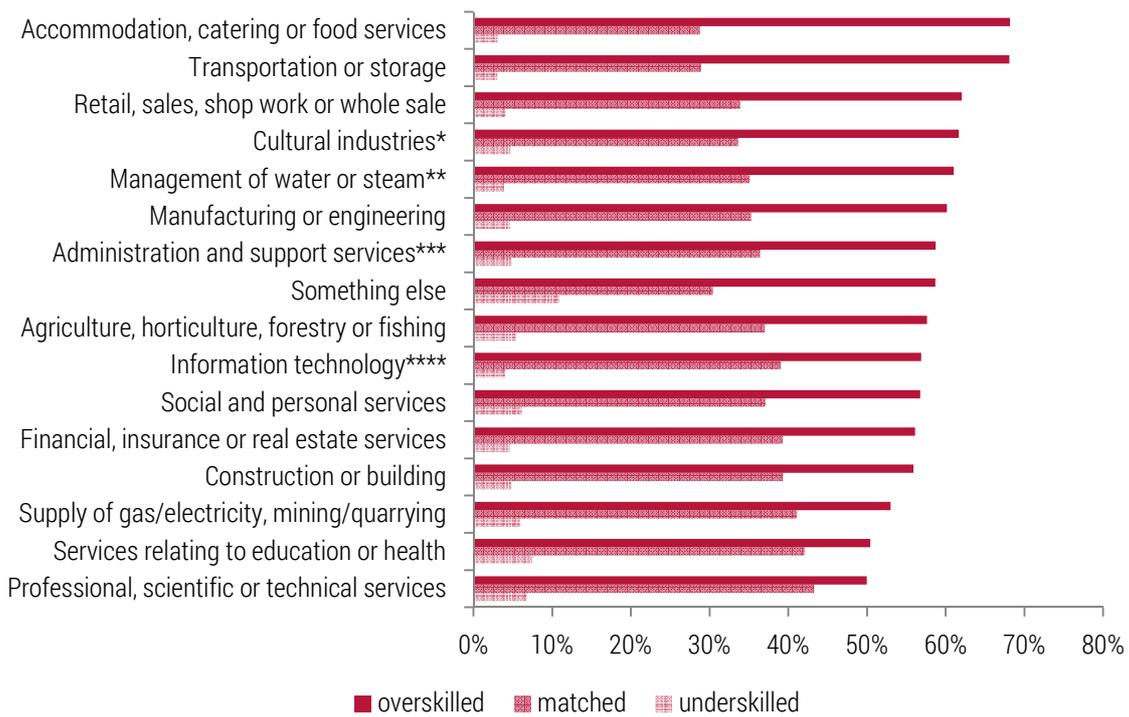
Source: Authors' calculations.

Table 6. Mean level of skills needs by type of skills and occupation (ISCO), ESJ

	Fundamental skills							Transversal skills						
	basic literacy	advanced literacy	basic numeracy	advanced numeracy	basic ICT	moderate ICT	advanced ICT	technology	communication	teamwork	customers	problem solving	learning	planning
Legislators, senior officials and managers	8.17	8.20	8.14	8.01	7.57	8.06	8.28	8.02	8.60	8.47	8.24	8.80	8.41	8.54
Professionals	8.07	8.05	7.94	8.12	7.71	7.99	8.07	8.05	8.32	8.31	8.05	8.36	8.29	8.13
Technicians and associate professionals	8.31	7.75	7.95	7.79	7.78	8.07	8.25	8.27	8.15	8.40	8.12	8.52	8.28	8.27
Clerks	8.33	8.01	7.96	8.03	8.11	8.26	8.60	8.02	8.38	8.40	8.42	8.40	8.57	8.36
Service workers and shop and market sales workers	8.44	8.03	8.25	7.68	8.29	7.93	8.40	8.01	8.79	8.82	8.94	8.66	8.35	8.33
Skilled agricultural and fishery workers	7.55	7.23	7.28	7.49	6.96	7.33	7.63	8.52	8.79	9.07	9.19	8.73	9.01	9.48
Craft and related trades workers	7.88	7.79	7.89	7.81	7.18	7.98	8.03	8.53	8.05	8.66	8.04	8.54	8.48	8.21
Plant and machine operators and assemblers	8.12	7.78	8.12	7.98	7.72	7.98	9.25	8.32	8.27	8.50	8.23	8.55	8.41	8.42
Elementary occupations	8.33	7.89	7.91	8.50	7.92	8.00	7.40	7.96	8.16	8.47	8.18	8.61	8.28	8.30
None of the above	8.56	8.48	8.01	7.81	9.07	8.33	8.08	7.89	8.22	9.09	8.60	9.11	9.46	8.85

Source: Authors' calculations.

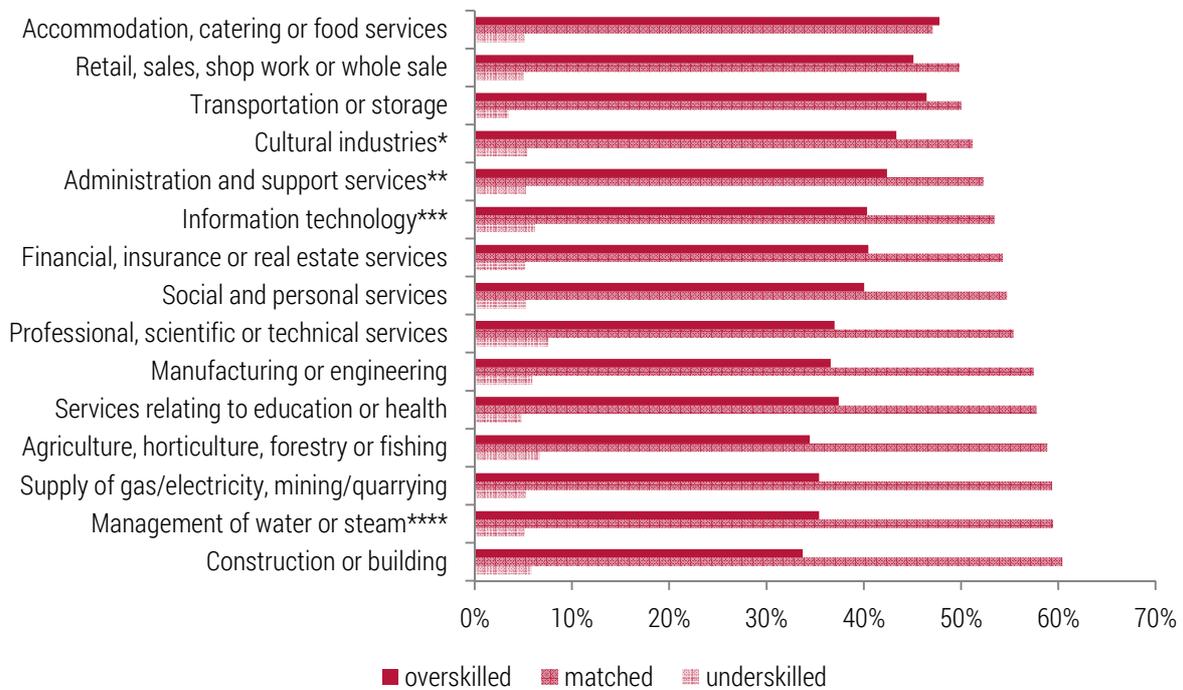
Figure 8. General skills match by economic sectors (NACE), PIAAC



*Cultural industries includes arts, entertainment or recreation, **Supply, management or treatment of water or steam, ***Including public administration and defence, ****Information technology or communication services.

Source: Authors' calculations.

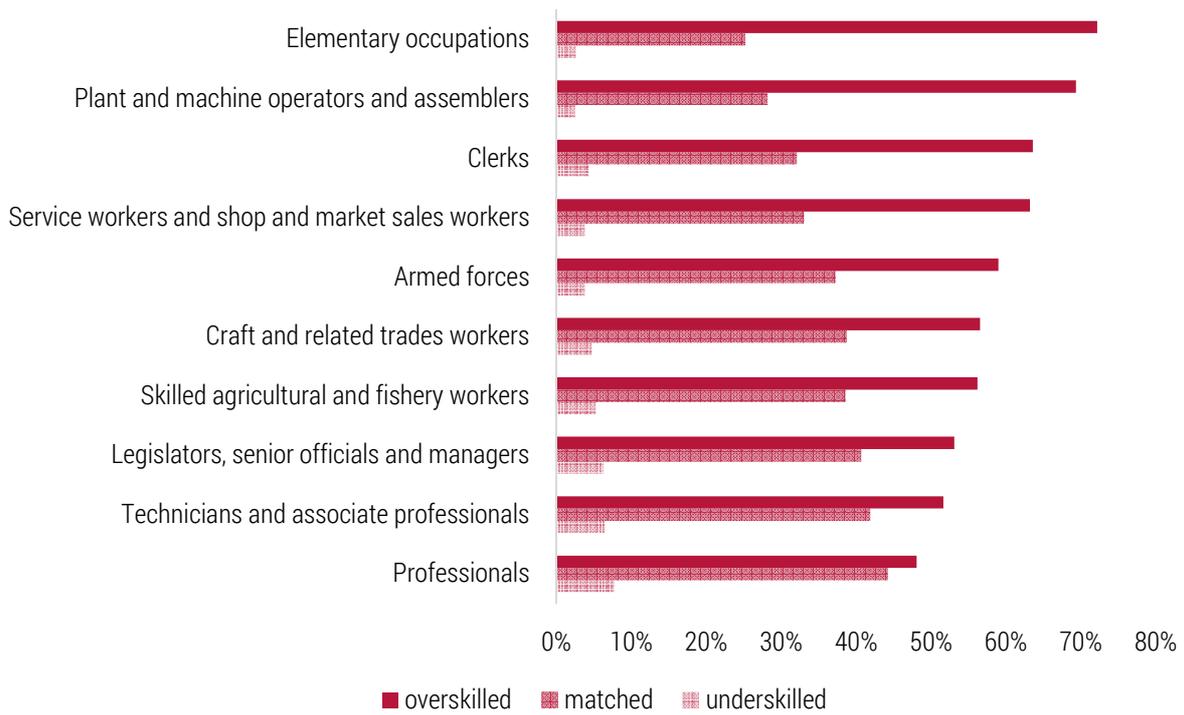
Figure 9. General skills match by economic sectors (NACE), ESJ



*Cultural industries includes arts, entertainment or recreation, **Including public administration and defence, ***Information technology or communication services, ****Supply, management or treatment of water or steam.

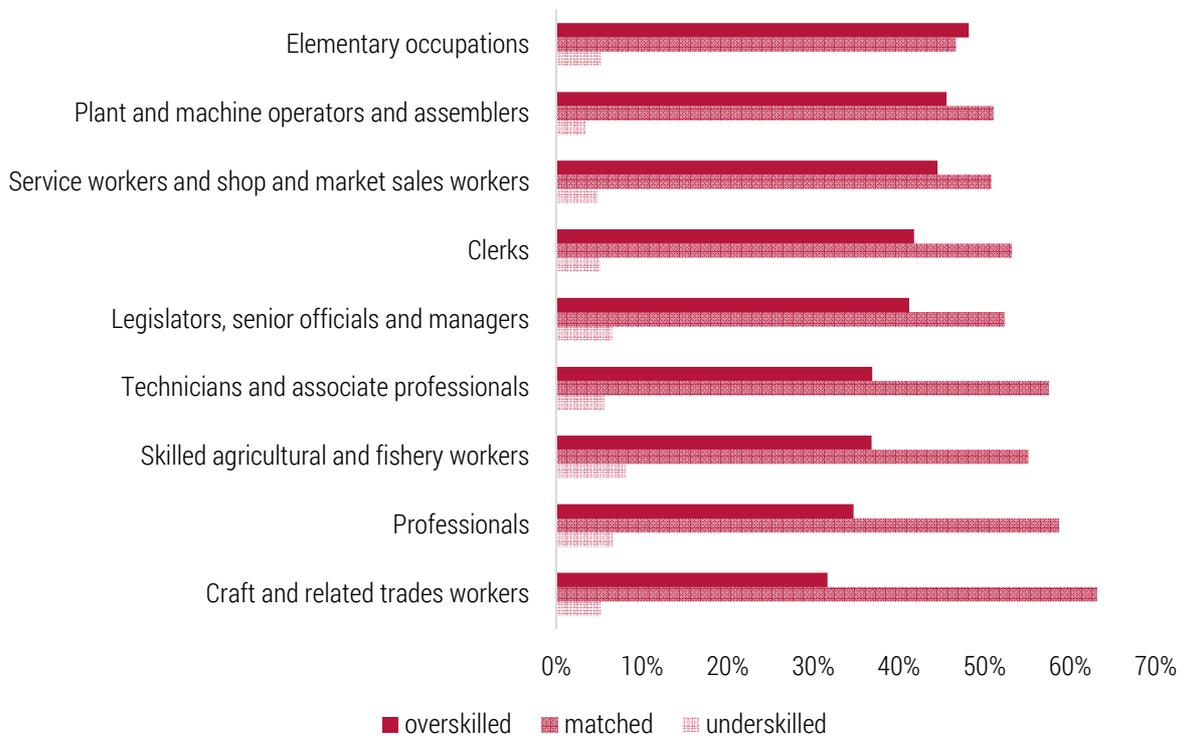
Source: Authors' calculations.

Figure 10. General skills match by occupation (ISCO), PIAAC



Source: Authors' calculations.

Figure 11. General skills match by occupation (ISCO), ESJ



Source: Authors' calculations.

Table 7. Skills match by type of skill and sector (NACE)

Skills matched	Fundamental skills							Transversal skills						
	basic literacy	advanced literacy	basic numeracy	advanced numeracy	basic ICT	moderate ICT	advanced ICT	technology	communication	teamwork	customers	problem solving	learning	planning
Total	0.45	0.59	0.60	0.59	0.60	0.61	0.54	0.60	0.57	0.56	0.57	0.57	0.59	0.58
Administration and support services, including public administration and defence	0.45	0.58	0.61	0.58	0.61	0.62	0.52	0.61	0.59	0.57	0.57	0.58	0.59	0.58
Agriculture, horticulture, forestry or fishing	0.38	0.60	0.59	0.60	0.58	0.60	0.54	0.59	0.59	0.57	0.59	0.58	0.58	0.56
Supply of gas or electricity, mining or quarrying	0.40	0.64	0.62	0.65	0.62	0.62	0.60	0.61	0.57	0.57	0.59	0.56	0.60	0.57
Supply, management or treatment of water or steam	0.38	0.58	0.61	0.62	0.56	0.62	0.55	0.57	0.62	0.61	0.59	0.56	0.59	0.59
Manufacturing or engineering	0.43	0.60	0.61	0.60	0.61	0.61	0.55	0.60	0.61	0.58	0.60	0.58	0.60	0.59
Construction or building	0.37	0.59	0.62	0.59	0.63	0.63	0.52	0.61	0.60	0.60	0.61	0.59	0.61	0.60
Retail, sales, shop work or whole sale	0.51	0.56	0.52	0.55	0.51	0.57	0.52	0.58	0.51	0.52	0.48	0.54	0.54	0.55
Accommodation, catering or food services	0.50	0.59	0.55	0.58	0.58	0.62	0.55	0.57	0.49	0.47	0.49	0.52	0.54	0.54
Transportation or storage	0.49	0.58	0.59	0.59	0.63	0.62	0.54	0.61	0.58	0.57	0.57	0.55	0.59	0.55
Information technology or communication services	0.50	0.60	0.62	0.61	0.45	0.58	0.54	0.58	0.55	0.55	0.55	0.52	0.57	0.57
Financial, insurance or real estate services	0.45	0.60	0.59	0.58	0.58	0.62	0.53	0.62	0.56	0.56	0.56	0.56	0.60	0.61
Professional, scientific or technical services	0.44	0.61	0.60	0.63	0.66	0.63	0.54	0.59	0.61	0.60	0.61	0.58	0.58	0.59
Services relating to education or health	0.45	0.58	0.63	0.58	0.65	0.62	0.51	0.63	0.55	0.56	0.58	0.59	0.59	0.58
Cultural industries (arts, entertainment or recreation)	0.49	0.55	0.60	0.69	0.61	0.62	0.53	0.62	0.58	0.59	0.56	0.58	0.59	0.59
Social and personal services	0.43	0.61	0.63	0.58	0.64	0.62	0.51	0.63	0.56	0.55	0.55	0.59	0.61	0.58
Something else	0.35	0.56	0.69	0.53	0.66	0.61	0.60	0.62	0.62	0.62	0.57	0.56	0.60	0.57

Source: Authors' analysis.

Table 8. Overskilling by type of skill and sector (NACE)

Overskilling	Fundamental skills							Transversal skills						
	basic literacy	advanced literacy	basic numeracy	advanced numeracy	basic ICT	moderate ICT	advanced ICT	technology	communication	teamwork	customers	problem solving	learning	planning
Total	0.45	0.38	0.37	0.37	0.35	0.36	0.43	0.34	0.39	0.41	0.36	0.40	0.38	0.38
Administration and support services, including public administration and defence	0.45	0.38	0.36	0.39	0.36	0.36	0.43	0.32	0.38	0.40	0.37	0.39	0.37	0.37
Agriculture, horticulture, forestry or fishing	0.38	0.38	0.36	0.39	0.34	0.37	0.43	0.34	0.36	0.40	0.29	0.37	0.37	0.39
Supply of gas or electricity, mining or quarrying	0.40	0.33	0.34	0.32	0.33	0.34	0.34	0.34	0.37	0.40	0.31	0.40	0.38	0.38
Supply, management or treatment of water or steam	0.38	0.35	0.33	0.33	0.39	0.35	0.40	0.37	0.31	0.35	0.32	0.40	0.36	0.35
Manufacturing or engineering	0.43	0.37	0.36	0.37	0.33	0.36	0.41	0.36	0.34	0.39	0.27	0.39	0.38	0.36
Construction or building	0.37	0.37	0.34	0.37	0.30	0.35	0.46	0.35	0.35	0.37	0.32	0.38	0.37	0.36
Retail, sales, shop work or whole sale	0.51	0.41	0.45	0.41	0.44	0.39	0.43	0.36	0.45	0.45	0.48	0.43	0.42	0.41
Accommodation, catering or food services	0.50	0.36	0.42	0.36	0.35	0.34	0.37	0.38	0.47	0.49	0.47	0.44	0.42	0.41
Transportation or storage	0.49	0.39	0.39	0.37	0.33	0.36	0.42	0.35	0.38	0.40	0.36	0.43	0.37	0.39
Information technology or communication services	0.50	0.37	0.35	0.36	0.51	0.40	0.43	0.39	0.42	0.43	0.38	0.46	0.41	0.39
Financial, insurance or real estate services	0.45	0.39	0.39	0.40	0.39	0.36	0.43	0.33	0.41	0.42	0.39	0.42	0.38	0.36
Professional, scientific or technical services	0.44	0.38	0.37	0.34	0.29	0.36	0.42	0.37	0.35	0.37	0.31	0.41	0.40	0.37
Services relating to education or health	0.45	0.39	0.33	0.38	0.31	0.35	0.44	0.32	0.42	0.42	0.36	0.39	0.39	0.39
Cultural industries (arts, entertainment or recreation)	0.49	0.42	0.36	0.28	0.34	0.35	0.44	0.31	0.38	0.38	0.37	0.38	0.38	0.36
Social and personal services	0.43	0.36	0.32	0.36	0.30	0.35	0.38	0.29	0.39	0.41	0.38	0.38	0.34	0.37
Something else	0.35	0.39	0.29	0.45	0.31	0.37	0.40	0.33	0.33	0.33	0.35	0.42	0.37	0.38

Source: Authors' analysis.

Table 9. Skills match by type of skill and occupation (ISCO)

Skills matched	Fundamental skills							Transversal skills						
	basic literacy	advanced literacy	basic numeracy	advanced numeracy	basic ICT	moderate ICT	advanced ICT	technology	communication	teamwork	customers	problem solving	learning	planning
Total	0.53	0.59	0.60	0.59	0.60	0.61	0.54	0.60	0.57	0.56	0.57	0.57	0.59	0.58
Legislators, senior officials and managers	0.52	0.57	0.58	0.53	0.60	0.61	0.50	0.58	0.52	0.52	0.52	0.48	0.55	0.49
Professionals	0.53	0.58	0.62	0.59	0.65	0.62	0.55	0.61	0.58	0.57	0.60	0.57	0.58	0.58
Technicians and associate professionals	0.54	0.61	0.61	0.62	0.62	0.61	0.53	0.58	0.59	0.58	0.59	0.56	0.59	0.58
Clerks	0.54	0.59	0.62	0.60	0.60	0.60	0.56	0.65	0.59	0.59	0.59	0.59	0.60	0.59
Service workers and shop and market sales workers	0.49	0.57	0.57	0.56	0.57	0.61	0.55	0.59	0.52	0.51	0.48	0.55	0.57	0.57
Skilled agricultural and fishery workers	0.64	0.60	0.60	0.67	0.56	0.66	0.61	0.53	0.57	0.57	0.61	0.55	0.54	0.54
Craft and related trades workers	0.63	0.63	0.63	0.63	0.65	0.64	0.51	0.55	0.61	0.55	0.58	0.56	0.59	0.60
Plant and machine operators and assemblers	0.51	0.62	0.56	0.57	0.59	0.62	0.58	0.60	0.59	0.57	0.56	0.60	0.61	0.61
Elementary occupations	0.47	0.62	0.55	0.60	0.54	0.66	0.35	0.62	0.59	0.56	0.55	0.61	0.59	0.58

Source: Authors' analysis.

Table 10. Overskilling by type of skill and occupation (ISCO)

Overskilling	Fundamental skills							Transversal skills						
	basic literacy	advanced literacy	basic numeracy	advanced numeracy	basic ICT	moderate ICT	advanced ICT	technology	communication	teamwork	customers	problem solving	learning	planning
Total	0.45	0.38	0.37	0.37	0.35	0.36	0.43	0.34	0.39	0.41	0.36	0.40	0.38	0.38
Legislators, senior officials and managers	0.46	0.42	0.40	0.43	0.31	0.36	0.46	0.37	0.46	0.47	0.44	0.50	0.43	0.49
Professionals	0.44	0.39	0.35	0.38	0.29	0.36	0.41	0.33	0.39	0.40	0.32	0.41	0.40	0.38
Technicians and associate professionals	0.45	0.37	0.35	0.35	0.33	0.36	0.44	0.39	0.38	0.40	0.33	0.42	0.38	0.38
Clerks	0.45	0.38	0.35	0.38	0.36	0.37	0.41	0.29	0.38	0.38	0.36	0.38	0.38	0.37
Service workers and shop and market sales workers	0.49	0.38	0.40	0.39	0.38	0.35	0.38	0.35	0.45	0.46	0.48	0.42	0.39	0.38
Skilled agricultural and fishery workers	0.35	0.32	0.35	0.26	0.36	0.32	0.39	0.40	0.37	0.40	0.25	0.40	0.42	0.43
Craft and related trades workers	0.34	0.34	0.33	0.32	0.29	0.32	0.45	0.41	0.33	0.41	0.29	0.41	0.38	0.35
Plant and machine operators and assemblers	0.47	0.31	0.40	0.35	0.36	0.34	0.38	0.35	0.35	0.39	0.28	0.36	0.35	0.32
Elementary occupations	0.50	0.32	0.41	0.33	0.42	0.28	0.50	0.28	0.33	0.38	0.32	0.32	0.34	0.32

Source: Authors' analysis.

Table 11. Multinomial logit estimates of general skills match, PIAAC and ESJ

	PIAAC		ESJ	
	US/CM	OS/CM	US/CM	OS/CM
Female	-0.003	-0.001*	0.032	-0.185***
Age	0.282***	0.070***	-0.016***	-0.002**
Primary	0.479***	-0.251***	0.326**	-0.995***
Secondary	0.283***	-0.131***	0.182**	-0.910***
Secondary plus	0.241***	0.039*	0.012	-0.423***
<i>Higher (ref.)</i>				
Armed forces	-0.249	0.385***		
A Manager	0.007	0.071*	0.113	0.256***
<i>A Professional (ref.)</i>				
A Technician or Associate Professional	-0.138**	0.109***	-0.121*	0.242***
Clerical Support	-0.203**	0.500***	-0.104	0.530***
A Sales, Customer or Personal Service Worker	-0.562***	0.503***	-0.226**	0.675***
A Skilled Agricultural, Forestry and Fishery Worker	-0.392**	0.309***	0.319	0.812***
Building, Crafts or a Related Trade Person	-0.302***	0.339***	-0.397***	0.374***
Plant and Machine Operator and Assembler	-0.658***	0.825***	-0.566***	0.866***
Elementary occupations	-0.625***	0.978***	-0.071	1.089***
None of the above/no answer/don't know			-0.855	0.217
Administration and support services	-0.161**	0.186***	0.204**	0.154***
Agriculture, horticulture, forestry or fishing	0.115	0.242***	0.125	-0.108
Supply of gas or electricity, mining or quarrying	-0.097	0.125	0.156	-0.073
Supply, management or treatment of water or steam	-0.136	0.195*	0.094	-0.082
Manufacturing or engineering	-0.123	0.287***	0.329***	-0.074*
Construction or building	-0.122	0.153***	0.204**	-0.114**
Retail, sales, shop work or whole sale	-0.162**	0.305***	0.197**	0.282***
Accommodation, catering or food services	-0.278**	0.452***	0.252*	0.373***
Transportation or storage	-0.252*	0.447***	-0.076	0.209***
Information technology or communication services	-0.481***	0.300***	0.304***	0.057
Financial, insurance or real estate services	-0.258**	0.158***	0.088	0.024
Professional, scientific or technical services	-0.094	0.026	0.475***	-0.010
Services relating to education or health				
Cultural industries (arts, entertainment or recreation)	-0.231	0.463***	0.153	0.171**
Social and personal services	0.039	0.013	0.144	0.057
Something else	0.671	0.384	0.143	0.095
Firm size: micro	na	na	0.001	-0.013
Firm size: small	na	na	-0.165***	0.045
Firm size: large	na	na	-0.154**	0.029

	PIAAC		ESJ	
	US/CM	OS/CM	US/CM	OS/CM
AT	-0.159	0.176***	0.216	0.413***
BE	0.768***	0.652***	0.218	-0.497***
BG	na	na	0.233	-0.822***
CY	0.031	0.452***	0.388	-0.226
CZ	0.955***	0.112**	0.606***	-0.404***
<i>DE (ref.)</i>				
DK	na	na	0.295	-0.253***
EE	0.986***	0.763***	1.107***	-1.070***
ES	0.173	0.370***	-0.030	-0.178***
FI	1.362***	0.499***	0.972***	-0.092
FR	0.944***	0.441***	0.188**	-0.452***
EL	na	na	0.569***	0.110
HR	na	na	-1.645***	-0.290**
HU		na	0.373***	-0.333***
IE	0.368***	0.927***	0.620***	-0.049
IT	0.531***	0.430***	-0.166*	-0.396***
LT	na	na	0.726***	-1.207***
LU	na	na	-0.712	-0.733**
LV	na	na	0.675***	-1.150***
MT	na	na	0.445	-1.071***
NL	0.772***	0.942***	0.241**	-0.305***
PL	0.268**	-0.020	0.326***	-0.293***
PT	na	na	-0.500***	-0.732***
RO	na	na	0.106	-0.996***
SE	1.156***	0.565***	0.500***	-0.281***
SI	na	na	0.083	-0.385**
SK	-0.332**	0.720***	0.672***	-0.184*
UK	0.619***	1.087***	0.253***	0.275***
Constant	-2.488***	-0.523***	-1.821***	-0.108*
Number of observations	61 094		47 993	

Note: .01 - ***; .05 - **; .1 - *; na – not available

Source: Authors' analysis.

Table 12. Multinomial logit estimates of skills match, fundamental skills, ESJ

	Basic literacy		Advanced literacy		Basic numeracy		Advanced numeracy		Basic ICT		Moderate ICT		Advanced ICT	
	US/CM	OS/CM	US/CM	OS/CM	US/CM	OS/CM	US/CM	OS/CM	US/CM	OS/CM	US/CM	OS/CM	US/CM	OS/CM
Female	-0.336***	0.225***	-0.168*	0.110***	-0.084	-0.064**	0.652***	-0.068*	-0.170	-0.063	0.180**	-0.121***	0.376***	-0.169***
Age	-0.023***	0.002	-0.021***	0.013***	-0.013***	0.008***	-0.004	0.012***	0.000	-0.017***	0.001	-0.007***	-0.011*	0.012***
Primary	0.459*	-1.434***	1.822***	-0.108	0.833***	-1.585***	0.907**	-0.463**	0.706**	-0.943***	0.879***	-0.949***	1.915***	-0.649
Secondary	-0.076	-0.813***	0.941***	-0.630***	0.013	-0.689***	0.680***	-0.358***	0.591***	-0.660***	0.414***	-0.355***	0.631**	-0.318**
Secondary plus <i>Higher (ref.)</i>	-0.194	-0.421***	0.499***	-0.254***	-0.120	-0.381***	0.243**	-0.223***	0.275*	-0.352***	-0.090	-0.110***	0.321**	-0.039
A Manager <i>A Professional (ref.)</i>	-0.542*	0.115	-0.506***	0.116**	-0.797***	0.170***	0.743***	0.251***	0.305	0.155	0.049	0.058	0.059	0.195**
A Technician or Associate Professional	-0.863***	0.154**	-0.335**	-0.051	0.094	0.172***	-0.036	-0.101*	-0.300	0.262***	0.031	0.085*	-0.205	0.049
Clerical Support	-0.582***	0.130**	-0.239*	-0.023	0.073	0.181***	-0.316*	0.010	-0.196	0.366***	-0.051	0.170***	-0.381*	-0.059
A Sales, Customer or Personal Service Worker	-0.399*	0.369***	0.088	0.063	-0.098	0.308***	0.535***	0.125	-0.434**	0.434***	0.287*	0.015	-0.016	-0.047
A Skilled Agricultural, Forestry and Fishery Worker	-0.389	0.178	1.027*	-0.112	0.440	0.364**	1.466**	-0.545	0.434	0.700**	-0.362	-0.144	-13.405	-0.550
Building, Crafts or a Related Trade Person	-0.594**	0.086	-0.646**	-0.101	-0.085	0.200***	0.593**	-0.191*	-0.653**	0.189	0.548**	-0.121	-0.047	0.133
Plant and Machine Operator and Assembler	-0.252	0.512***	0.317	-0.157	0.400**	0.499***	1.097***	-0.002	-0.518**	0.526***	0.502**	-0.047	-0.395	-0.223
Elementary occupations	0.147	0.667***	0.349	-0.086	0.409**	0.590***	0.690*	-0.017	-0.430	0.814***	0.871***	-0.194	1.207**	0.839***
None of the above/no answer/don't know	-0.531	0.284	-0.369	0.356	1.295*	0.434	-12.179	-0.398	-2.687	-0.337	-1.294	-0.055	-14.732	-2.291
Administration and support services	0.227	0.155**	0.377***	0.029	-0.260*	0.120**	-0.351*	0.019	-0.740***	0.157	-0.370***	-0.046	0.093	-0.044
Agriculture, horticulture, forestry or fishing	-0.326	0.068	-0.797	0.044	-0.105	0.230*	-1.555**	0.129	0.058	0.088	-0.283	0.102	-0.617	0.049
Supply of gas or electricity, mining or quarrying	0.891***	0.029	0.069	-0.204*	-0.028	0.041	-0.476	-0.324**	-0.086	0.122	-0.223	-0.107	0.133	-0.433**
Supply, management or treatment of water or steam	-0.089	-0.152	0.804***	-0.050	0.466*	-0.006	-0.146	-0.174	-0.048	0.433*	-0.302	-0.079	-0.194	-0.276

	Basic literacy		Advanced literacy		Basic numeracy		Advanced numeracy		Basic ICT		Moderate ICT		Advanced ICT	
	US/CM	OS/CM	US/CM	OS/CM	US/CM	OS/CM	US/CM	OS/CM	US/CM	OS/CM	US/CM	OS/CM	US/CM	OS/CM
Manufacturing or engineering	0.148	0.076	-0.089	-0.002	-0.257*	0.125**	-0.381**	-0.032	0.215	0.046	-0.452***	0.010	-0.216	-0.209**
Construction or building	0.338	-0.043	0.121	-0.002	0.109	0.105	-0.200	0.000	0.211	0.072	-0.375**	-0.100	-0.674*	0.031
Retail, sales, shop work or whole sale	0.288	0.315***	-0.363*	0.161**	0.044	0.505***	-0.379	0.142	0.141	0.565***	-0.129	0.154***	-0.123	-0.058
Accommodation, catering or food services	0.227	0.383***	0.430	-0.007	0.054	0.418***	0.229	-0.045	0.197	0.197	-0.164	-0.050	0.585	-0.262
Transportation or storage	-0.113	0.298***	-0.276	0.144*	-0.505***	0.208***	-0.455	-0.020	-0.253	-0.027	-0.803***	0.023	-0.087	-0.109
Information technology or communication services	-0.452	0.322***	-0.202	-0.013	-0.237	0.090	-0.076	-0.101	0.040	0.723***	-0.528**	0.104	-0.534**	-0.096
Financial, insurance or real estate services	-0.961**	-0.007	-0.781***	0.016	-0.334	0.227***	-0.479*	0.063	-0.701*	0.294**	-0.554***	-0.052	-0.235	-0.027
Professional, scientific or technical services	-0.025	0.014	-0.377*	-0.045	-0.240	0.123*	0.034	-0.170**	-0.000	-0.102	-0.730***	-0.047	-0.040	-0.119
<i>Services relating to education or health (ref.)</i>														
Cultural industries (arts, entertainment or recreation)	-1.315	0.152	0.047	0.158	0.222	0.073	-0.528	-0.515***	-0.108	0.058	-0.321	-0.058	-0.708	0.013
Social and personal services	0.070	-0.010	-0.196	-0.088	0.260*	-0.027	0.009	-0.027	0.313	-0.056	-0.252	-0.012	0.616*	-0.165
Something else	-0.088	-0.057	0.679*	0.123	-0.361	-0.007	-0.924	0.298	-0.214	0.064	-0.542	0.060	-4.840	-0.399
Firm size: micro	-0.005	-0.003	-0.105	-0.008	0.153	0.146***	-0.514***	-0.098	0.215	-0.188**	0.291**	0.039	0.007	-0.016
Firm size: small	0.344**	-0.013	-0.184	-0.037	0.165	0.092**	-0.054	-0.055	0.430***	-0.190***	0.082	0.064	0.003	0.070
Firm size: large	-0.006	-0.046	-0.211*	-0.036	-0.081	0.056	0.125	-0.044	0.131	0.004	0.255*	0.045	-0.168	0.075
<i>DE (ref.)</i>														
FR	-0.033	-0.113**	-0.915***	-0.275***	-0.481***	-0.027	0.074	-0.348***	-0.430**	-0.307***	-0.494***	-0.220***	-0.409*	-0.341***
UK	-0.620**	0.429***	-1.031***	-0.389***	-0.301**	0.398***	-0.568***	-0.309***	-0.979***	-0.029	-0.610***	-0.097**	-0.479**	-0.461***
SE	-0.686*	-0.230**	-0.378	-1.139***	-0.018	-0.184**	0.497*	-0.793***	-1.032**	0.054	-0.573**	-0.136	0.600*	-0.946***
IT	-0.472*	-0.107*	-0.553***	-0.122**	-0.422***	-0.155***	-0.148	0.061	-1.926***	-0.109	-0.518***	-0.071	-1.268***	0.092
GR	0.231	0.095	0.622*	0.178	-0.211	0.513***	0.567	0.351**	0.236	0.225	0.007	0.468***	-0.412	0.377**
CZ	0.620**	-0.159	0.704***	-0.689***	0.161	0.071	0.280	-0.431***	-0.109	0.040	0.095	-0.083	0.107	-0.156

	Basic literacy		Advanced literacy		Basic numeracy		Advanced numeracy		Basic ICT		Moderate ICT		Advanced ICT	
	US/CM	OS/CM	US/CM	OS/CM	US/CM	OS/CM	US/CM	OS/CM	US/CM	OS/CM	US/CM	OS/CM	US/CM	OS/CM
PL	-0.151	0.334***	0.030	0.012	-0.108	0.414***	0.299	0.249***	0.125	0.145	-0.337*	0.289***	0.080	-0.056
NL	-0.951**	-0.526***	-0.768***	-0.524***	-0.486**	-0.335***	-0.926***	-0.568***	-1.044***	-0.699***	-1.093***	-0.519***	-0.322	-0.479***
DK	-0.718	-0.156	-0.193	-0.587***	-0.285	-0.339***	-0.173	-0.361*	-0.123	-0.403*	-0.262	-0.393***	0.272	-0.418*
HU	-0.855	0.189*	-0.318	0.011	-0.484	0.433***	-0.504	0.113	-0.225	-0.015	-0.534*	-0.084	-0.220	-0.354**
ES	0.437**	-0.406***	-0.399**	-0.216***	-0.200	-0.136**	-0.228	-0.154*	-0.203	-0.207**	-0.964***	-0.180***	-0.563*	-0.105
AT	0.708**	0.122	0.185	0.096	0.013	0.178*	0.779***	0.040	-0.830	0.442**	0.267	-0.059	0.259	-0.333**
BE	-1.134**	0.029	-1.744***	-0.236**	-0.581**	0.244***	-0.486	-0.271**	-0.291	-0.162	-0.604**	-0.157	-0.179	-0.377**
IE	0.473	0.192	-0.083	-0.308**	-0.038	0.308**	0.320	-0.248	0.480	-0.199	-0.817	0.095	0.333	-0.343
SK	0.345	0.084	0.237	-0.211	0.040	0.330***	0.523	-0.052	-0.423	0.133	-0.444	0.108	0.870*	0.030
FI	-0.666	-0.127	0.091	-0.466***	0.061	-0.021	0.150	-0.406**	0.018	0.029	0.018	-0.049	-0.099	-0.496**
PT	-1.080***	-0.828***	-0.593	-0.631***	-0.830***	-0.405***	-0.196	-0.360**	-0.544*	-0.548***	-0.668**	-0.283**	0.044	-0.273
EE	-0.920	-0.784***	0.566	-0.880**	-0.193	-0.417*	0.870	-0.552	-0.332	-0.285	0.286	-0.581**	0.713	-0.932
RO	-0.124	-0.416***	-0.053	0.156*	-0.091	-0.017	-0.043	0.127	0.032	-0.138	-1.804***	0.190**	-0.700	0.527***
LT	-0.420	-0.825***	-0.593	-0.204	-0.696	-0.178	-0.848	0.140	-0.261	-0.693***	-0.161	-0.314	-0.214	-0.193
CY	-1.101	0.051	0.218	0.408	0.161	0.550*	0.707	0.622	-0.529	0.348	0.172	0.183	-13.751	0.323
SI	0.040	0.060	-0.355	-0.045	0.060	0.256	-0.398	0.322	-0.361	-0.016	-0.286	0.352*	-0.282	-0.542*
BG	0.209	-0.500***	0.220	-0.159	0.481**	-0.231**	-0.196	0.098	0.209	-0.442**	-0.601	-0.014	-0.180	0.019
LV	-0.305	0.242	-0.413	-0.547**	-0.540	0.056	0.696	-0.028	-0.057	-0.215	-0.474	-0.484**	-0.528	-0.503
LU	-0.375	-1.773***	-1.669	-1.196***	-0.190	-0.527	-2.495	-0.678*	-0.473	-1.037	-0.449	-1.280**	-14.301	-1.243*
MT	-0.183	0.103	-1.282	0.145	-1.806	-0.102	-1.113	-0.241	-2.143	-1.224	-0.848	-0.778	-0.475	0.107
HR	-0.461	0.006	-0.544	-0.054	-0.123	0.243	0.299	-0.263	0.242	0.104	0.388	0.058	0.270	-0.208
Constant	-1.749***	-0.259**	-1.804***	-0.677***	-2.157***	-1.006***	-3.009***	-0.631***	-2.373***	0.258*	-2.787***	-0.125	-1.986***	-0.452***
Number of observations	19,867		23,463		28,029		13,644		9,094		25,101		7,319	

Note: .01 - ***; .05 - **; .1 - *.

Source: Authors' analysis.

Table 13. Multinomial logit estimates of skills match, transversal skills, ESJ

	Technical		Communication		Teamwork		Customers		Problem solving		Learning		Planning	
	US/CM	OS/CM	US/CM	OS/CM	US/CM	OS/CM	US/CM	OS/CM	US/CM	OS/CM	US/CM	OS/CM	US/CM	OS/CM
Female	0.338***	-0.260***	-0.045	0.164***	-0.226***	0.132***	-0.009	0.138***	0.088	-0.074***	0.103*	0.088***	0.037	0.108***
Age	0.003	0.010***	-0.008***	0.013***	0.002	0.009***	-0.001	0.011***	-0.005*	0.013***	0.003	-0.000	-0.004	0.008***
Primary	0.763***	-0.503***	0.955***	-0.372***	0.844***	-0.253***	0.796***	-0.166*	0.725***	-0.239***	1.133***	-0.544***	0.972***	-0.529***
Secondary	0.199**	-0.182***	0.415***	-0.180***	0.453***	-0.065*	0.285***	0.032	0.284***	-0.165***	0.489***	-0.305***	0.565***	-0.307***
Secondary plus	-0.092*	-0.007	0.018	-0.046*	-0.007	0.022	0.058	0.052**	-0.097	-0.039	0.091	-0.173***	0.094	-0.111***
<i>Higher (ref.)</i>														
A Manager	-0.032	0.097**	-0.439***	0.310***	-0.593***	0.290***	-0.492***	0.437***	-0.338*	0.314***	-0.056	0.212***	-0.635***	0.457***
<i>A Professional (ref.)</i>														
A Technician or Associate Professional	-0.356***	0.159***	-0.111	-0.014	-0.348***	-0.007	-0.163**	0.008	-0.099	-0.012	0.019	-0.013	-0.034	0.025
Clerical Support	0.130*	-0.228***	-0.092	-0.076**	-0.158	-0.129***	-0.455***	-0.002	0.156	-0.165***	0.005	-0.086**	-0.099	-0.077**
A Sales, Customer or Personal Service Worker	0.147*	0.100**	-0.103	0.194***	-0.150	0.185***	-0.468***	0.389***	0.402***	0.033	0.456***	0.038	0.048	0.024
A Skilled Agricultural, Forestry and Fishery Worker	0.568**	0.229	0.353	0.136	-0.227	0.080	0.221	-0.228	0.452	0.025	0.369	0.314**	-0.518	0.251*
Building, Crafts or a Related Trade Person	-0.231*	0.218***	0.079	-0.126**	-0.042	0.109**	0.311***	-0.090	0.275*	-0.043	0.326**	0.078	0.114	0.016
Plant and Machine Operator and Assembler	0.061	-0.002	0.346***	-0.001	-0.019	0.003	0.534***	-0.087	0.490***	-0.258***	0.589***	-0.049	0.382***	-0.130**
Elementary occupations	0.427***	-0.130**	0.571***	-0.121**	0.331**	-0.003	0.411***	-0.018	0.920***	-0.289***	0.911***	-0.002	0.653***	-0.047
None of the above/no answer/don't know	0.900**	-0.140	-0.585	0.114	0.016	0.716***	0.129	-0.258	0.421	-0.217	-0.534	-0.118	0.773*	-0.391
Administration and support services	0.137*	0.031	0.094	-0.129***	0.024	-0.064*	0.059	0.013	0.159	0.061	0.168	-0.010	0.286***	-0.018
Agriculture, horticulture, forestry or fishing	0.015	-0.020	0.091	-0.214**	-0.231	-0.102	0.382**	-0.201*	0.385*	-0.066	0.211	-0.118	0.232	0.020
Supply of gas or electricity, mining or quarrying	-0.063	-0.132*	0.424**	-0.164**	-0.099	-0.144*	0.297**	-0.182**	0.353*	-0.008	-0.083	-0.124	0.321*	-0.042
Supply, management or treatment of water or steam	0.069	0.135	0.560***	-0.409***	0.284	-0.350***	0.131	-0.171	0.339	0.030	0.439*	-0.093	0.395*	-0.100
Manufacturing or engineering	-0.068	0.032	0.160	-0.282***	0.004	-0.184***	0.461***	-0.348***	-0.126	-0.007	-0.268**	-0.055	0.186*	-0.097**

	Technical		Communication		Teamwork		Customers		Problem solving		Learning		Planning	
	US/CM	OS/CM	US/CM	OS/CM	US/CM	OS/CM	US/CM	OS/CM	US/CM	OS/CM	US/CM	OS/CM	US/CM	OS/CM
Construction or building	-0.122	-0.008	0.191	-0.202***	-0.201	-0.219***	-0.038	-0.155***	0.099	-0.022	-0.218	-0.100**	-0.099	-0.081
Retail, sales, shop work or whole sale	0.072	0.163***	0.165	0.109**	0.089	0.063	-0.211**	0.292***	-0.029	0.205***	-0.047	0.184***	0.251**	0.133***
Accommodation, catering or food services	-0.213	0.294***	0.048	0.249***	0.399**	0.282***	-0.248	0.274***	0.193	0.315***	0.026	0.251***	0.246	0.222***
Transportation or storage	-0.197*	0.056	-0.147	-0.053	-0.166	-0.028	-0.227**	0.053	-0.083	0.264***	-0.015	0.054	0.175	0.201***
Information technology or communication services	-0.313***	0.190***	0.204	0.064	-0.140	0.083*	0.145	0.146***	-0.119	0.264***	-0.017	0.076	0.392***	0.017
Financial, insurance or real estate services	-0.225*	0.077	0.032	0.017	-0.094	0.050	-0.176	0.115**	-0.317*	0.158***	-0.313*	0.020	0.134	-0.107**
Professional, scientific or technical services	-0.115	0.116**	0.316***	-0.232***	0.028	-0.153***	0.221**	-0.170***	-0.229	0.040	-0.052	0.018	0.208*	-0.073
<i>Services relating to education or health (ref.)</i>														
Cultural industries (arts, entertainment or recreation)	0.111	-0.006	0.194	-0.123	0.159	-0.125	0.167	0.045	0.394*	0.032	0.183	0.015	0.358**	-0.076
Social and personal services	0.211**	-0.048	0.273**	-0.083*	0.492***	-0.035	0.154	0.024	0.126	0.019	0.388***	-0.079	0.213*	-0.000
Something else	0.146	-0.038	0.182	-0.250***	0.270	-0.301***	0.126	0.041	-0.274	0.207**	-0.036	-0.047	0.296	0.064
Firm size: micro	0.009	0.016	-0.024	0.009	0.162*	-0.009	-0.322***	0.084**	-0.115	0.003	0.061	-0.033	0.059	-0.001
Firm size: small	-0.047	0.024	-0.239***	0.049*	-0.072	0.063**	-0.227***	0.070**	-0.132	0.045	-0.029	0.046	-0.078	0.023
Firm size: large	-0.111*	0.152***	-0.156**	0.080**	0.134	0.163***	0.055	0.062*	-0.088	0.092***	-0.053	0.071**	0.026	0.011
<i>DE (ref.)</i>														
FR	-0.634***	-0.140***	0.175**	-0.567***	-0.003	-0.478***	0.800***	-0.684***	-0.117	-0.481***	0.069	-0.480***	0.020	-0.397***
UK	-0.392***	-0.099***	-0.588***	-0.289***	-0.466***	-0.345***	-0.326***	-0.269***	-0.655***	-0.192***	-0.316***	-0.348***	-0.462***	-0.247***
SE	-0.167	-0.496***	-0.158	-0.593***	-0.612***	-0.474***	-0.222	-0.411***	-0.522**	-0.324***	-0.499**	-0.460***	-0.490***	-0.358***
IT	-0.867***	0.415***	-0.391***	-0.007	-0.092	-0.033	0.097	-0.054	-0.523***	0.262***	-0.311**	0.271***	-0.579***	0.228***
GR	-0.003	0.251***	-0.188	0.227***	0.114	0.165*	0.624***	-0.027	0.215	0.122	0.445**	0.074	0.099	0.003
CZ	-0.029	-0.096	0.167	-0.018	0.163	-0.094	0.525***	-0.058	-0.061	0.021	0.099	0.050	0.250*	-0.215***
PL	-0.078	0.152***	0.218**	-0.029	0.336***	-0.004	0.366***	-0.068	0.028	0.044	0.249**	0.149***	0.255***	-0.119***
NL	-0.168	-0.736***	-0.055	-0.581***	-0.356**	-0.695***	-0.494***	-0.479***	-0.805***	-0.323***	0.414***	-0.932***	0.167	-0.702***
DK	-0.089	-0.507***	-0.223	-0.641***	-0.148	-0.789***	-0.116	-0.759***	-0.288	-0.527***	-0.042	-0.583***	0.032	-0.548***

	Technical		Communication		Teamwork		Customers		Problem solving		Learning		Planning	
	US/CM	OS/CM	US/CM	OS/CM	US/CM	OS/CM	US/CM	OS/CM	US/CM	OS/CM	US/CM	OS/CM	US/CM	OS/CM
HU	-0.607***	0.375***	-0.149	0.055	-0.282	0.033	0.203	-0.137*	-0.648**	0.181***	-0.179	-0.096	0.031	-0.210***
ES	-0.494***	0.008	0.096	-0.361***	0.186*	-0.372***	0.283***	-0.313***	-0.075	-0.250***	0.005	-0.237***	-0.113	-0.365***
AT	0.210	-0.192**	0.320**	-0.176**	0.132	-0.280***	0.321**	-0.245***	0.495***	-0.035	-0.097	-0.040	0.146	-0.121
BE	-0.596***	-0.176**	0.055	-0.360***	-0.162	-0.449***	0.295**	-0.422***	-0.461**	-0.269***	-0.419*	-0.516***	-0.549***	-0.344***
IE	0.001	0.011	0.194	-0.149	0.073	-0.185*	0.396*	-0.079	0.176	-0.060	0.157	-0.206*	-0.098	-0.230**
SK	-0.206	0.121	0.295	0.271***	0.393	0.156*	0.523***	0.335***	0.042	0.220**	-0.043	0.291***	0.219	-0.059
FI	-0.272	-0.245**	0.219	-0.406***	0.110	-0.572***	-0.067	-0.367***	-0.028	-0.299***	0.076	-0.528***	-0.209	-0.567***
PT	-1.325***	-0.211***	-0.806***	-0.401***	-0.746***	-0.384***	0.216	-0.576***	-0.689***	-0.408***	-0.903***	-0.363***	-1.072***	-0.416***
EE	-0.302	-0.549***	-0.225	-0.820***	0.028	-0.832***	0.093	-1.042***	0.173	-0.840***	0.215	-0.774***	0.292	-0.971***
RO	-0.344***	0.329***	-0.233	0.496***	-0.316	0.498***	0.270**	0.332***	-0.215	0.430***	0.054	0.344***	-0.291*	0.289***
LT	-0.770**	0.166	-1.094**	0.109	-0.194	-0.095	0.233	-0.145	0.167	-0.131	0.168	-0.294**	0.141	-0.386***
CY	-1.016	0.173	-0.022	0.554**	-0.642	0.341	0.131	0.259	-0.396	0.233	-0.575	0.132	-0.238	0.051
SI	-0.381	0.167	-0.615	0.154	-0.155	0.166	0.035	0.183	-0.623	0.274*	-0.106	0.378***	-0.675	0.185
BG	-0.512***	0.067	-0.064	-0.071	-0.448	0.244***	0.695***	0.158*	-0.190	0.043	0.430**	-0.157*	-0.176	-0.108
LV	-0.718*	-0.033	-0.383	-0.153	-0.375	-0.040	-0.172	-0.110	-0.760	-0.306**	-0.439	-0.293*	-0.148	-0.420***
LU	-0.281	-0.690**	-1.659	-1.050***	-0.554	-1.287***	-0.533	-1.101***	-0.609	-1.277***	-0.637	-1.213***	-1.503	-1.359***
MT	-0.447	-0.441	-1.138	-0.073	-0.448	0.066	-0.529	-0.237	-0.844	-0.026	-1.072	0.107	-0.755	-0.134
HR	-0.286	0.263**	-0.226	0.379***	0.271	0.295**	0.732***	0.192	-0.407	0.490***	0.102	0.293**	-0.575	0.353***
Constant	-2.369***	-0.986***	-2.367***	-0.769***	-2.873***	-0.642***	-2.198***	-0.943***	-2.828***	-0.829***	-3.516***	-0.229***	-2.719***	-0.600***
Number of observations	46,029		46,492		46,639		43,201		46,638		46,752		46,016	

Note: .01 - ***; .05 - **; .1 - *.

Source: Authors' analysis.



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