Measuring skills mismatches revisited - introducing sectoral approach[1]

Agnieszka Chłoń-Domińczak[2]
Andrzej Żurawski[3]

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Abstract

The aim of the paper is to present the development of survey-based assessment of skills mismatch. In recent years, several international and national studies are conducted to measure the level of skills and educational mismatches. 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.

We support our analysis and approach with quantitative assessment using the PIAAC and ESJ data, including the assessment of skills needs by sector of employment and occupation and the self-reported skill match to the identified needs. We find out that skills needs are different across sectors, which affects the assessment of skills mismatch. Skill mismatch is most frequently reported in the case of basic literacy, communication and teamwork skills.

We identify potential methodological advancement in measuring skills based on defining core knowledge, skills and competencies at the sectoral level. This is done, for example with the development of sectoral qualifications framework or through skills definitions in the ESCO portal. We assess the usefulness of this approach in measuring the level of skills mismatch.

Key words: skills mismatch, skills need, sectoral qualifications frameworks

[1] Ph.D., Warsaw School of Economics and Educational Research Institute.
[2] Warsaw School of Economics and Educational Research Institute, contact: a.chlon-dominczak@ibe.edu.pl.
[3] Educational Research Institute, contact: a.zurawski@ibe.edu.pl.

Introduction

This paper is aimed at exploring the existing approach to measuring skills mismatch at the level of economic sectors. Most commonly, skills mismatch is defined in terms of excess or shortage of skills and/or qualifications held by the individual in relation to the job requirements . We argue that sectoral perspective should be more visible in analysing the skills mismatch. Some sectors face skills shortages, in others the level of skills that are possessed by workers is higher than expected (CEDEFOP 2010).

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. However, there is relatively little evidence in the literature that focuses on the sectoral differences in the skills match. 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 and Silles 2002) that are more likely to be overeducated, while in the case of industry 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. In our paper we aim to fill the gap in the skills match analysis from the sectoral perspective, with the following objectives.

First, we identify 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). Then, we provide a critical assessment to the approaches in measurement of the skills match. Finally, we propose further advancement in the measurement of skills match at sectoral level.

Data and method

In recent years two large-scale international surveys took place: survey include items that allow assessing skills mismatch on larger samples. That includes the PIAAC survey of the OECD and ESJ survey that was conducted by CEDEFOP. Both of the surveys are based on the individual questionnaires. Workers are responding to questions that are related to the level of their skills compared to their perception of the skills that are needed at their workplace.

In the PIAAC survey (The Programme for the International Assessment of Adult Competencies) was conducted by OECD in 30 countries, out of them 17 are EU member states[4]. Total sample of EU countries are 104 409, 67 667 out of them were employed at the moment of 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

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

Those, who responded positively to the former were classified as over-skilled, those, who responded positively to the latter were classified as under-skilled. Please note, respondents replied "yes" to both questions, even though they exclude each other. Such respondents were classified as matched.

The European skills and jobs survey includes a series of items that focus on identification of skills needs and skills match by respondents. This includes not only the overall level of skills, but also skills in the areas of: literacy, numeracy, ICT skills as well as technical, communication, teamwork, foreign language, customers-related, problem solving, learning and planning skills.

In the case of literacy, numeracy and ICT skills, respondents were asked to assess the highest level of skills required at their job. In the case of the other skills, respondents were assessing the level of skills on the scale from 0 to 10.[5] 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 our analysis 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.

In the analysis we first look at the composition of skills needs by types of skills identified in the PIAAC and ESJ surveys by sector (using NACE classification) and occupation (using ISCO classification). Then, we look at the incidence of skills mismatch by sector and occupations, based on the frequencies distribution.

In order to assess the determinants of underskilling and overskilling we estimate models for different types of skills. The dependent variable Y_i takes one of the three possible outcomes (j=0,1,2), representing the underskilled, those with matched skills and overskilled respectively. We use the multinomial logistic framework (Greene 2012; Hosmer et al. 2013) and estimate the probabilities of over-and underskilling relative to the skills match probability and calculate the log-odds relative to the baseline, which we assume to be a linear function of the predictors. The covariates include individual and workplace characteristics, such as age, sex, educational attainment, occupation, sector of employment, size of the company, we also control for the group of countries (EU15 and new member states). The model is estimated using the maximum likelihood estimator.

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. This is based, however, on subjective assessments of those who are performing these tasks.

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

[5] They 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"

is based on the assessment of the level of skills required for the job. The use of literacy, numeracy and ICT skills by NACE sector, reported in the PIAAC survey is shown in Figure 1 and importance of these skills at work by sector in the ESJ survey is shown in Figure 2. These results confirm that the skills use varies by sectors. Sectors that require highest knowledge and use of literacy skills include: professional, scientific of 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. The top sectors are similar in the case of numeracy and IT skills, additionally we see an increased need for such skills in the construction sector, while they are less needed in the education and health sector.

Figure 3 presents the level of skills needs in the case of three types of specific skills surveyed in the ESJ: communication, teamwork and problem solving skills[6]. Again, we see that those sectors where the selected skills are financial, insurance or real estate services; services related to education and health, information technology or communication services, professional, scientific or technical services. These skills are less needed in agriculture, transportation services or among those, who did not select any specific sector.

Summarising, there are important differences in the level and composition of skills needs when we look at the sectoral perspective. These differences should be kept in mind, 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.

This means that measuring of the skills match, using the approach proposed in the two surveys, is relative to the reported level of the skill need at the given job, that differs by economic sector and also by the occupation (the analysis of the skills need by occupation will be added in the final version of the paper).

Skills mismatch by sector and occupation

According to the proposed method of calculating skills mismatch, both surveys indicate that the incidence of lack of match of skills to the requirements on the job is quite large. In the case of PIAAC, around one third of workers report that their skills are well matched to the job. 43.55% indicate that they have higher skills than required and 23.11 % are underskilled. In the ESJ, 54.8% of employed indicate that they are matched to their job, 39.8% believe that they are overskilled and 5.4% report underskilling .

Our results show that the skills match differs by sector. According to the ESJ, sectors in which workers tend to report higher than average overskilling are retail and sales, accommodation, catering and food services and information technologies and communication. The largest skills match is found in construction, water, gas and electricity supply as well as manufacturing.

The ESJ data allows also comparing the level of skills match by different types of skills. Comparison of the level of skill match by selected skills is shown in Table 1 and the share of overskilled by skill type and sector is shown in Table 2. The lowest incidence in almost all selected skills, compared to the average for a given skill is noted in the following sectors: retail

[6] These skills were selected as ones where there is the highest level of overskilling reported in the survey.

and sales, accommodation, catering and food services, administration and support services, supply of gas and electricity and manufacturing. Many of these sectors have relatively low skills expectations. By the same token, higher than average overskilling is noted in the retail and sales and accommodation and catering. Among sectors with high level of skills requirement, overskilling is seen in the ITC sector as well as financial, insurance or real estate services .

We also see that 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.

When we compare the assessment of skills needs and the level of overskilling reported by workers, we see that these two dimensions need to be put together to understand the level of skills that are possessed by workers (Table 2).

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 IT 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.

For the more accurate assessment of determinants of the underskilling and overskilling at sector and occupational levels, we use the multinominal logistic regression. We run regression models separately for each skill identified in PIAAC and ESJ surveys. Results are presented in Table 3 (PIACC skills mismatch) and Tables 4-7 (ESJ skills mismatch). Estimated average marginal effects for the ESJ skills match: general, communication, teamwork and problem solving are shown in Figures 8-11.

When we control for the selected characteristics, such as age, gender, educational attainment, country of origin or company size (in ESJ) we see that sectors of employment matter, both in the case of underskilling and overskilling. Results based on the PIAAC indicate that underskilling is less likely and at the same time overskilling is more likely in administration and support services, retail and sales, accommodation and catering, ICT and financial and insurance sectors (reference sector is education and health). As one can note, this covers both sectors with lower and higher skills needs. Results of regressions that use the ESJ data provide a more diverse picture. For example, in retail and sales there is a higher risk of having skills below required in general assessment (this is when we control for other factors) as well as in planning. Less underskilling is seen in advance literacy and numeracy, language and customer handling skills. In the case of ICT sector, the underskilling is less likely in the case of ICT skills, technical and language skills and more likely in the case of teamwork and planning skills. In the case of social and personal services we note significantly higher risk of underskilling in 10 out of 16 skill items that we verify.

The model results also confirm that overskilling is more likely to be observed in the following sectors: administration and support services, retail and sales; accommodation and catering, transportation and cultural industries. More than required skills in communication are less reported in administration, agriculture, supply of gas and electricity, supply of water, manufacturing, construction, professional services, cultural industries and more likely in retail and sales, accommodation and catering and ICT, which may indicate that in those sectors where communication is a core skill, such level of skills is frequently at relatively high level. Similar picture also emerges when we look at the results of assessment of overskilling in the teamwork skills. Overskilling in problem solving skills is also reported in retail and sales, accommodation and catering, transportation and storage, ICT and financial and insurance services. Again, these represent both sectors, where such skills are less needed as well as more needed.

Measuring skills match revisited: towards more objective skills measurement.

Results of the PIAAC and ESJ surveys show that measuring skills match is subjective and depends on sector and occupation. The skills mismatch is a concept based on relative assessment. The benchmark in such assessment differs across sectors and occupations. Therefore, the incidence of overskilling cannot be easily compared. The criticism of the current approach to skills measurement in the literature points out to several deficiencies. First, employees may be overly optimistic in their skills assessment as well as skills requirement at the workplace. Theoretical assumptions of the measurement of skills mismatch have been widely debated for example by Handel (2003), McGuinness and Ortiz (2014) and Verhaest and Omey (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 costly and much more difficult than surveying individuals. 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.

One of the possible advancement in the measurement of skills level by sector is to use the level descriptors developed in qualifications frameworks. Qualifications frameworks are currently developed in more than 100 countries. In the EU there is a European Qualifications Framework (EQF) that provides a common reference point for national qualifications frameworks. In many sectors (such as financial services, border guards, sports) special sectoral frameworks are developed to link sector qualifications and skills needs to the levels of qualifications frameworks.

The level descriptors referring to the knowledge, skills and competences, 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 requirements are defined with the participation of employers – their preferences are expressed in the formulation of such requirements. Example of such approach is shown in the table below.

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

European Qualifications Framework	Sectoral Qualifications Framework - 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 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: 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: 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

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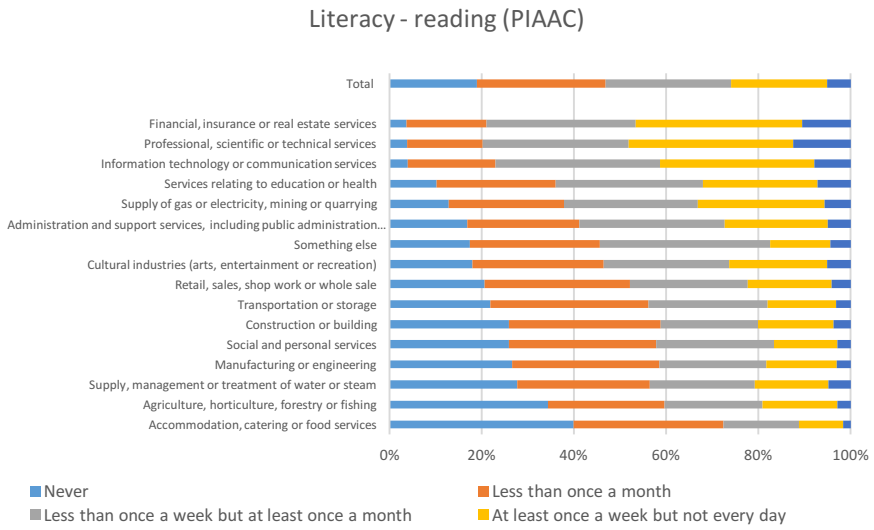
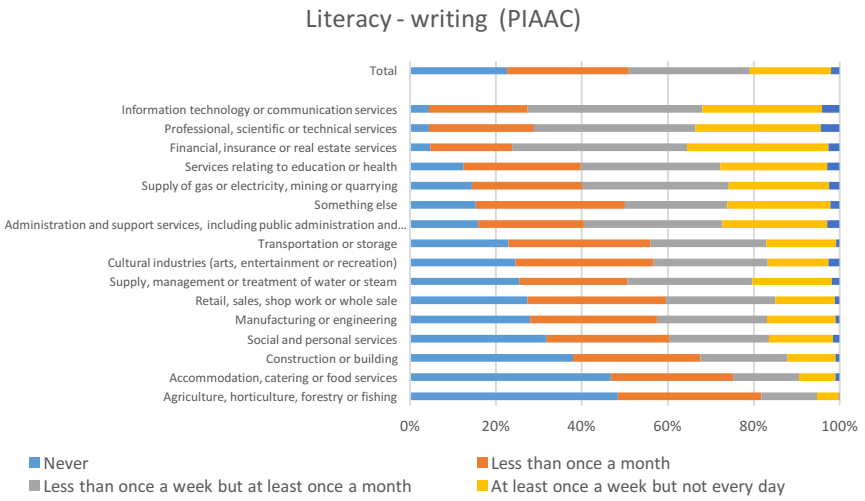
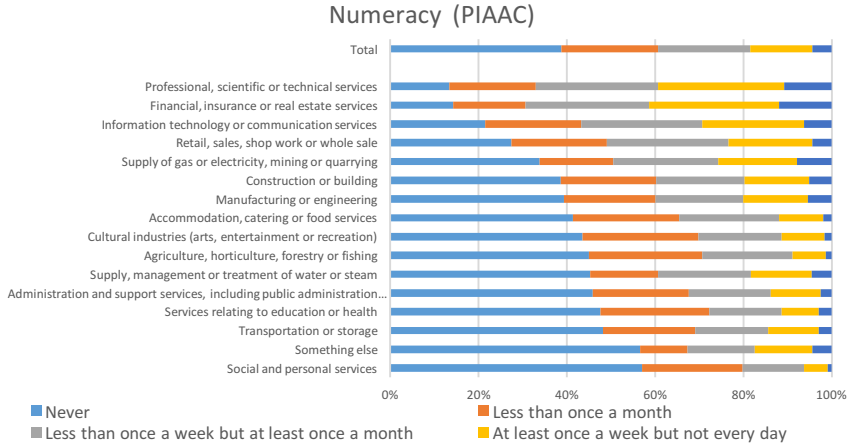
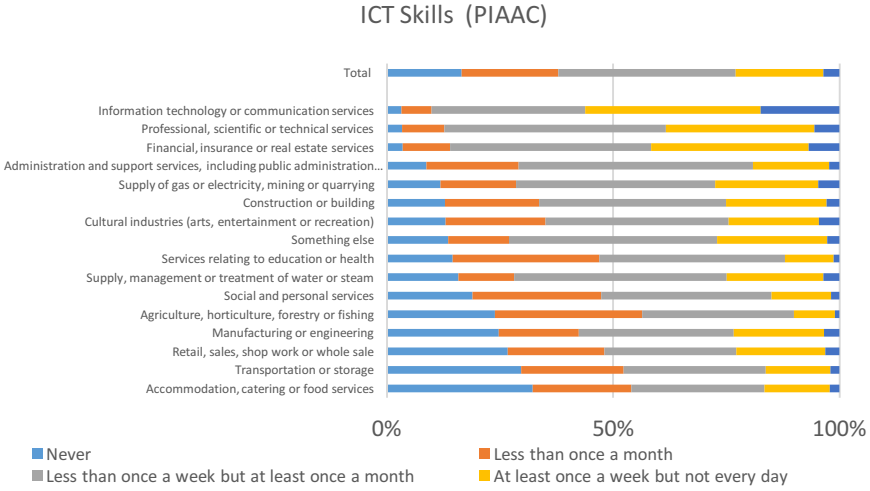
Figure 1. Use of literacy, numeracy and ICT skills by NACE sector, PIAAC



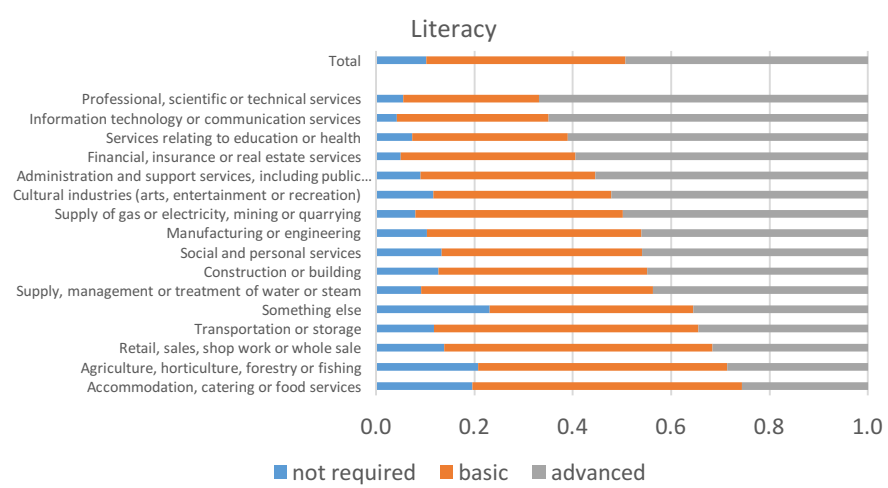


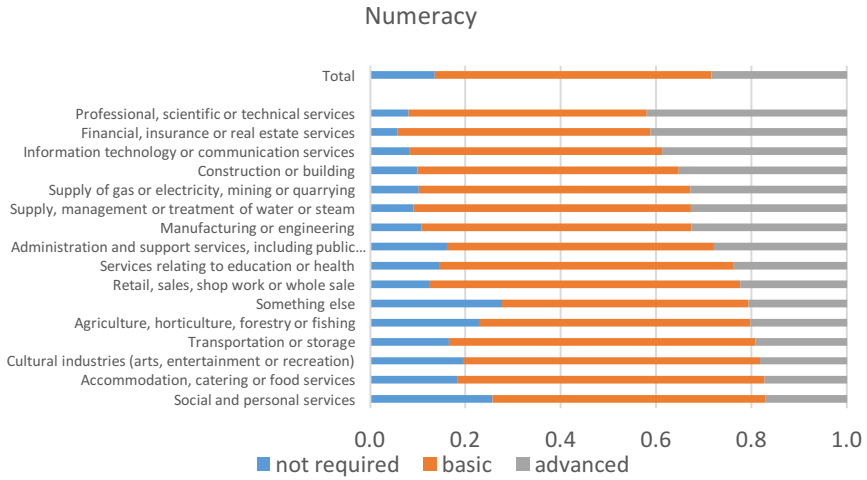


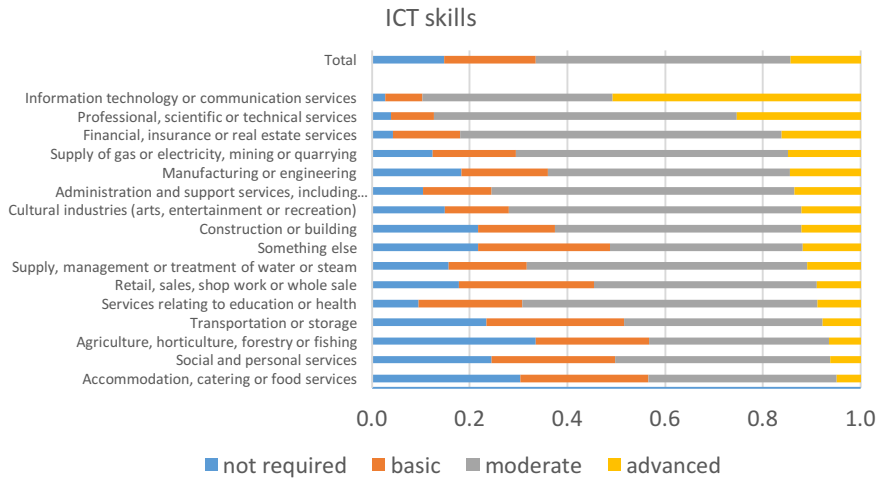


Source: Authors' calculations

Figure 2. Importance of literacy, numeracy and ICT skills by sector, ESJ

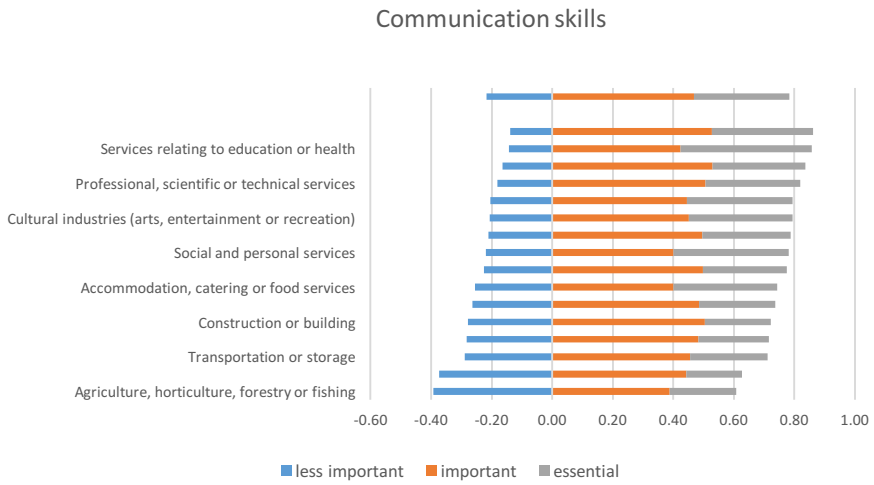


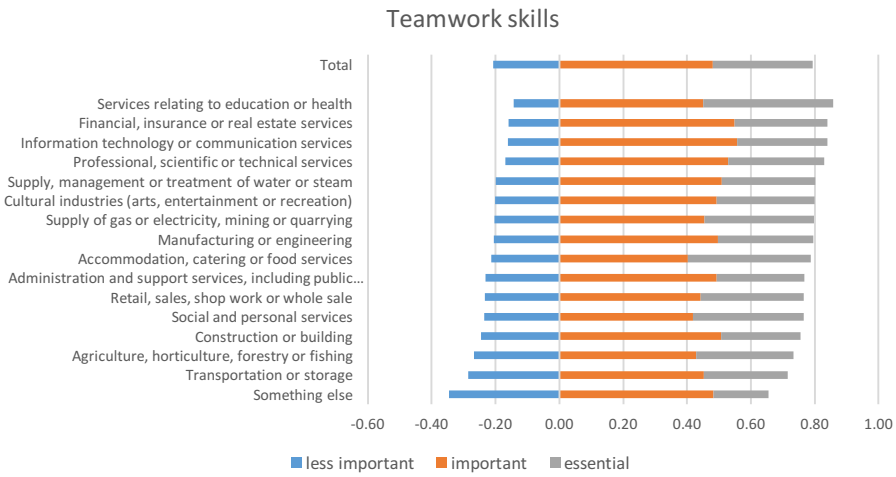


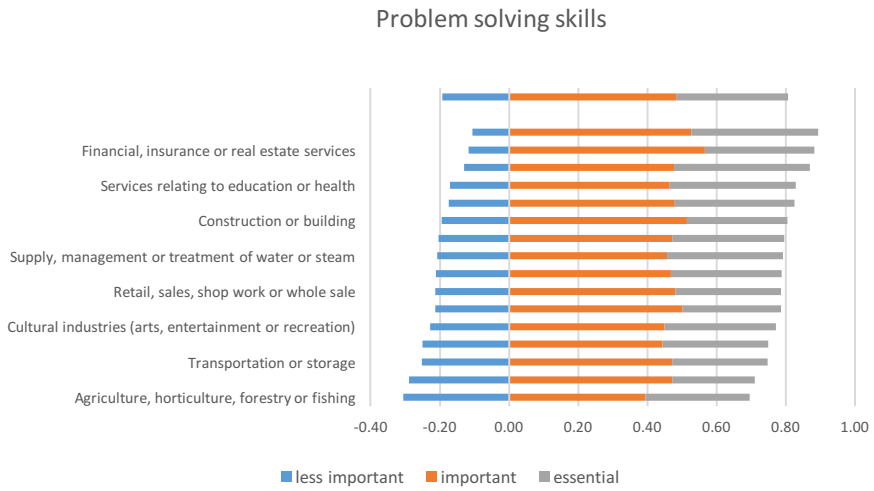


Source: Authors' calculations

Figure 3. Importance of selected specific skills by sector, ESJ

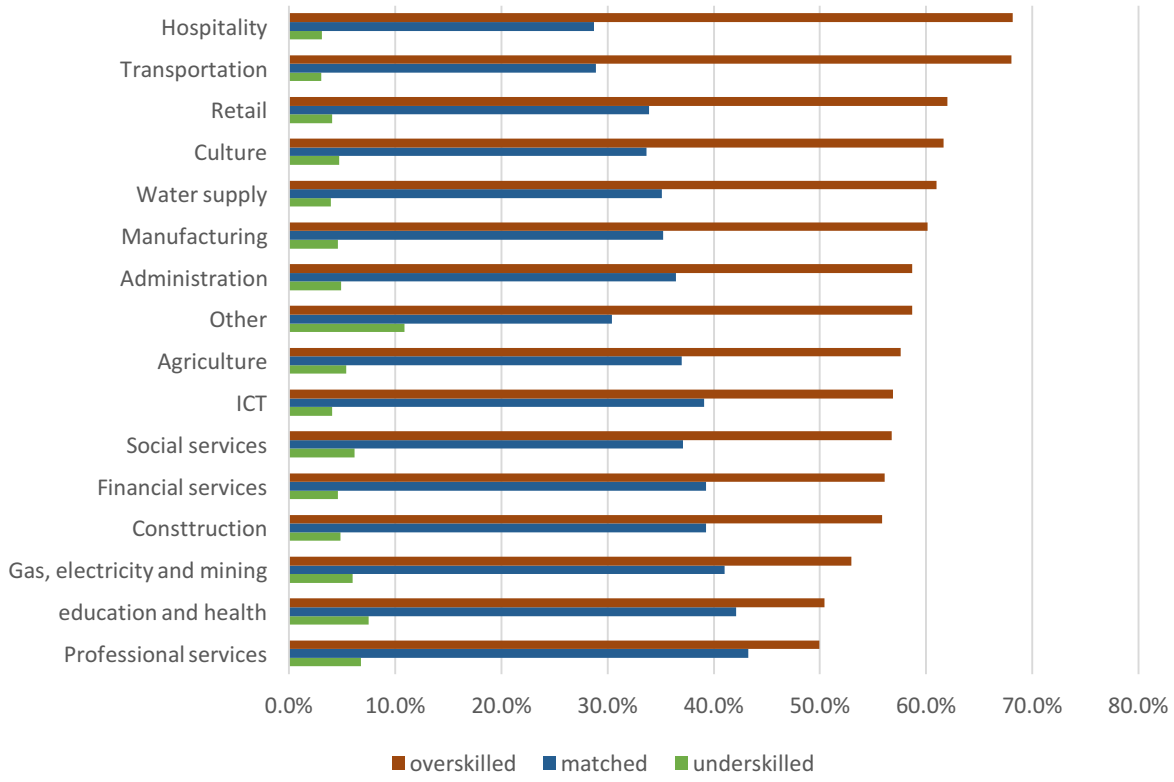






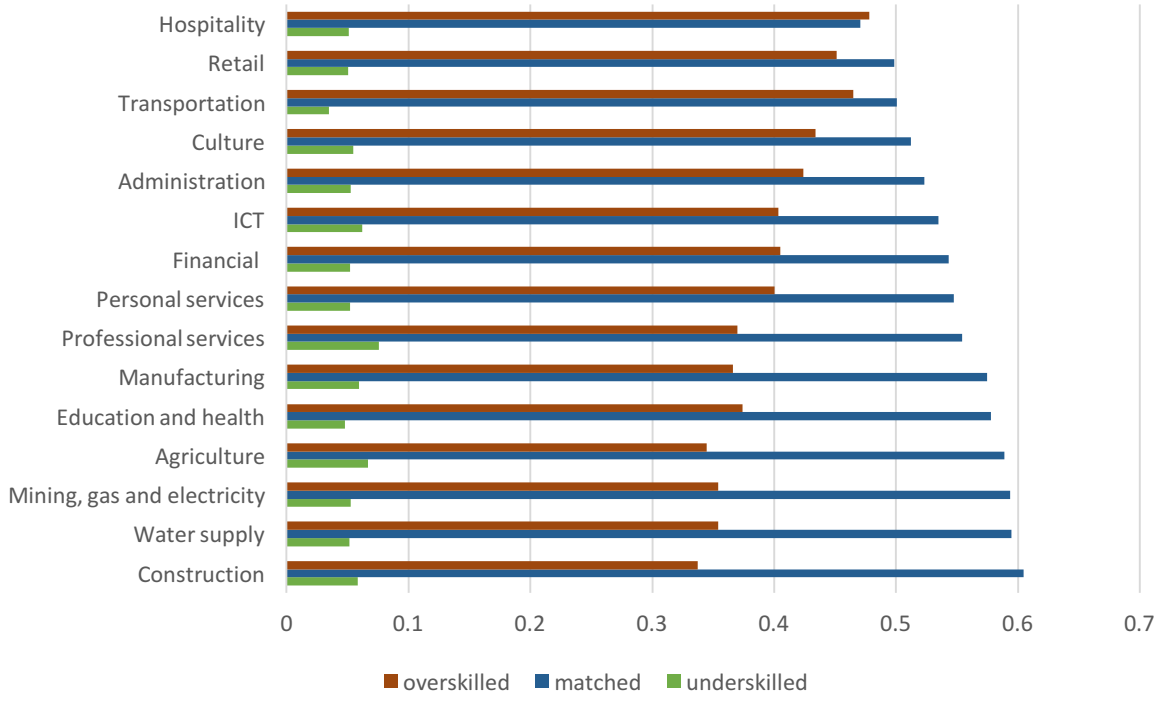
Source: Authors' calculations

Figure 4. Skills match by economic sectors (NACE), PIAAC



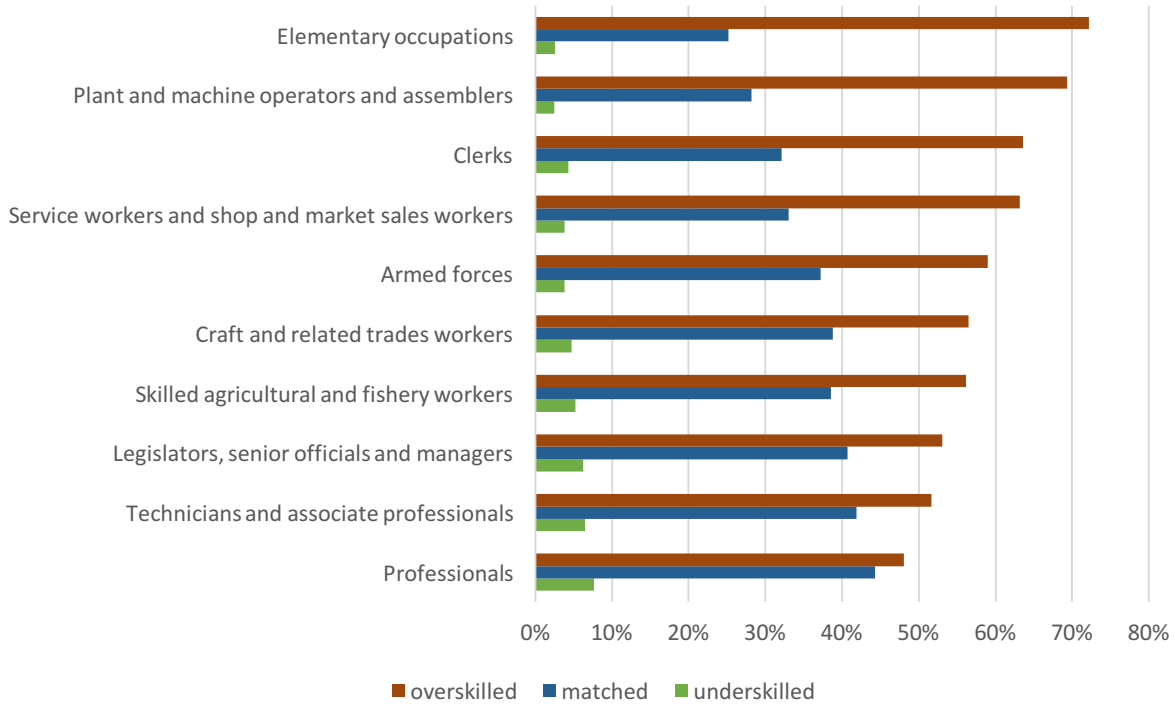
Source: Authors' calculations

Figure 5. Skills match by economic sectors (NACE), ESJ



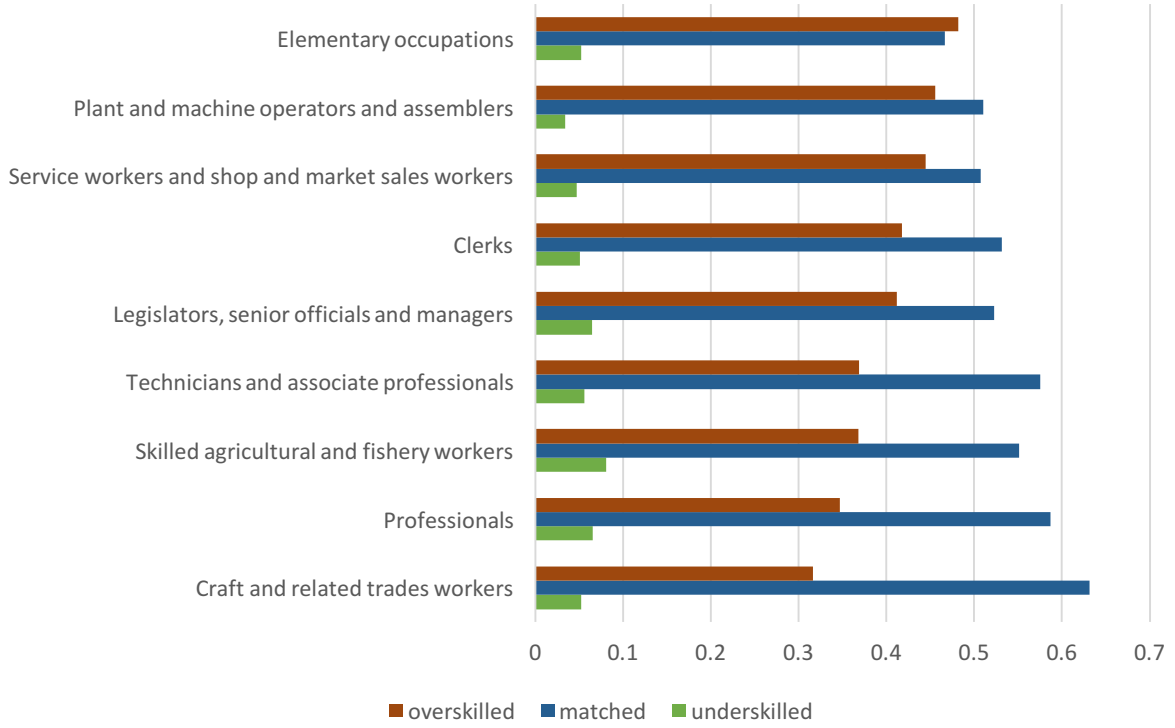
Source: Authors' calculations

Figure 6. Skills match by occupation (ISCO), PIAAC



Source: Authors' calculations

Figure 7. Skills match by occupation (ISCO), ESJ



Source: Authors' calculations

Table 1. Skills match by type of skill and NACE sector

Skills matched	basic literacy	advanced literacy	basic numeracy	advanced numeracy	basic ICT	moderate ICT	advanced ICT	technology	**communication**	teamwork	language	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	0,57	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	0,56	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	0,52	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	0,54	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	0,50	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	0,58	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	0,58	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	0,56	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	0,53	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	0,58	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	0,58	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	0,57	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	0,58	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	0,59	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	0,56	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	0,53	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	0,63	0,57	0,56	0,60	0,57

Note: marked cells indicate sectors, where selected skills match is higher than average

Source: Authors' analysis

Table 2. Overskilling by type of skill and NACE sector

Overskilling	basic literacy	advanced literacy	basic numeracy	advanced numeracy	basic ICT	moderate ICT	advanced ICT	technology	**communication**	teamwork	language	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	0,20	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	0,20	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	0,16	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	0,19	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	0,18	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	0,18	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	0,17	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	0,19	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	0,26	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	0,20	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	0,26	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	0,19	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	0,22	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	0,18	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	0,21	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	0,20	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	0,15	0,35	0,42	0,37	0,38

Note: marked cells indicate sectors, where overkilling in selected skill is higher than average

Source: Authors' analysis

Table 3. Results of multinominal logistic regression skills mismatch, PIAAC

	Skills mismatch in PIAAC	
	Underskilling	**Overskilling**
age	-0,001	-0,001
gender	0,315***	0,058***
primary	0,257**	-0,270***
secondary	0,160**	-0,155***
secondary plus	0,250***	0,005
tertiary	(dropped)	(dropped)
Armed forces	-0,144	0,274**
Legislators, senior officials and managers	0,077	0,044
Professionals	0,117*	-0,081**
Technicians and associate professionals	(dropped)	(dropped)
Clerks	-0,144*	0,371***
Service workers and shop and market sales workers	-0,437***	0,368***
Skilled agricultural and fishery workers	-0,158	0,149*
Craft and related trades workers	-0,171*	0,231***
Plant and machine operators and assemblers	-0,545***	0,703***
Elementary occupations	-0,537***	0,763***
Administration and support services, including public administration and defence	-0,233***	0,135***
Agriculture, horticulture, forestry or fishing	-0,006	0,162**
Supply of gas or electricity, mining or quarrying	-0,154	0,018
Supply, management or treatment of water or steam	-0,118	0,227*
Manufacturing or engineering	-0,081	0,222***
Construction or building	-0,213**	0,050
Retail, sales, shop work or whole sale	-0,170**	0,257***
Accommodation, catering or food services	-0,352**	0,368***
Transportation or storage	-0,174	0,382***
Information technology or communication services	-0,485***	0,237***
Financial, insurance or real estate services	-0,317***	0,142***
Professional, scientific or technical services	-0,092	-0,027
Services relating to education or health	(dropped)	(dropped)
Cultural industries (arts, entertainment or recreation)	-0,262	0,420***
Social and personal services	0,039	0,018
Something else	0,619	0,689*
NMS	-0,458***	-0,410***
_cons	-1,800***	
o._cons		0,327***
Number of observations	53 523	
Residuals		

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

Table 4. Results of multinominal logistic regression, underskilling: general, literacy, numeracy and ICT skills, ESJ

Underskilled	General	Basic literacy	Advance literacy	Basic numeracy	Advanced numeracy	Basic ICT	Moderat ICT	Advanced ICT
female	0,041	-0,336***	-0,173**	-0,077	0,623***	-0,135	0,178**	0,374***
age	-0,015***	-0,024***	-0,023***	-0,012***	-0,004	-0,001	0,002	-0,010
primary	0,250	0,410	1,752***	0,743***	1,064***	0,709**	0,786**	1,994***
secondary	0,114	-0,154	0,855***	-0,069	0,643***	0,415**	0,318**	0,492
secondary plus	-0,023	-0,245*	0,575***	-0,103	0,282**	0,217	-0,005	0,346**
higher (ref.)	ref.	ref.	ref.	ref.	ref.	ref.		
A Manager	0,132	-0,533*	-0,479**	-0,766***	0,666***	0,368	0,082	0,083
A Professional (ref.)								
A Technician or Associate Professional	-0,135*	-0,819***	-0,241*	0,114	-0,002	-0,214	0,087	-0,187
Clerical Support	-0,149**	-0,502**	-0,145	0,087	-0,266	-0,241	-0,014	-0,399*
A Sales, Customer or Personal Service Worker	-0,215**	-0,318	0,203	-0,051	0,608***	-0,350*	0,345**	0,079
A Skilled Agricultural, Forestry and Fishery Worker	0,270	-0,438	1,024*	0,473	1,442**	0,203	-0,382	-10,985
Building, Crafts or a Related Trade Person	-0,399***	-0,535**	-0,543**	-0,052	0,558**	-0,541**	0,571***	-0,043
Plant and Machine Operator and Assembler	-0,553***	-0,185	0,436**	0,472***	1,123***	-0,396	0,550**	-0,313
Elementary occupations	-0,055	0,217	0,410	0,442**	0,756**	-0,392	0,844***	1,077**
None of the above/no answer/don't know	-0,745	-0,873	-0,399	1,201	-11,794	-2,659	-1,436	-13,833
Administration and support services	0,207**	0,303	0,379***	-0,256*	-0,328	-0,637**	-0,357**	0,068
Agriculture, horticulture, forestry or fishing	0,103	-0,214	-0,732	-0,132	-1,502**	0,063	-0,315	-0,694
Supply of gas or electricity, mining or quarrying	0,129	0,989***	0,066	-0,040	-0,478	-0,066	-0,199	0,065
Supply, management or treatment of water or steam	0,097	-0,012	0,818***	0,488*	-0,133	0,054	-0,258	-0,158
Manufacturing or engineering	0,306***	0,244	-0,006	-0,232*	-0,343*	0,299	-0,400***	-0,186
Construction or building	0,192*	0,408	0,132	0,114	-0,138	0,286	-0,316*	-0,684*
Retail, sales, shop work or whole sale	0,184*	0,310	-0,374*	0,024	-0,400*	0,170	-0,138	-0,157
Accommodation, catering or food services	0,249*	0,374	0,413	0,062	0,213	0,335	-0,214	0,522
Transportation or storage	-0,059	-0,063	-0,304	-0,504***	-0,420	-0,203	-0,734***	-0,121
Information technology or communication services	0,315***	-0,335	-0,086	-0,178	-0,008	0,202	-0,436*	-0,444*
Financial, insurance or real estate services	0,118	-0,931*	-0,784***	-0,319	-0,477*	-0,620	-0,552***	-0,223
Professional, scientific or technical services	0,462***	0,047	-0,395*	-0,240	0,024	0,009	-0,743***	-0,123
Services relating to education or health (ref.)								
Cultural industries (arts, entertainment or recreation)	0,201	-1,278	0,040	0,226	-0,509	0,068	-0,324	-0,666
Social and personal services	0,176*	0,080	-0,092	0,275*	0,067	0,399*	-0,178	0,656*
Something else	0,018	0,180	0,587*	-0,423	-0,887	-0,158	-0,671	-5,169
firm_micro	-0,012	0,113	-0,036	0,194	-0,502***	0,254	0,313**	-0,033
firm_small	-0,162***	0,395**	-0,140	0,178*	-0,052	0,453***	0,098	-0,024
firm_large	-0,150**	0,027	-0,184	-0,067	0,103	0,163	0,281**	-0,154
NMS	0,226***	0,111	0,519***	0,185**	0,231*	0,407***	0,050	0,291*
Number of observations	47 993	19 867	23 463	28 029	13 644	9 094	25 101	7 319

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

Source: Authors' analysis

Table 5. Results of multinominal logistic regression, underskilling: specific skills, ESJ

Underskilled	Technical	Communication	Teamwork	Language	Customers	Problem solving	Learning	Planning
female	0,341***	-0,038	-0,231***	0,144***	-0,014	0,096	0,110*	0,045
age	0,004*	-0,008***	0,001	0,018***	-0,002	-0,006*	0,003	-0,004
primary	0,638***	0,960***	0,880***	0,699***	0,848***	0,721***	1,095***	0,937***
secondary	0,086	0,361***	0,415***	0,651***	0,319***	0,208**	0,435***	0,502***
secondary plus	-0,061	0,004	-0,014	0,284***	0,039	-0,092	0,084	0,096
higher (ref.)								
A Manager	0,024	-0,459***	-0,607***	0,142**	-0,566***	-0,347*	-0,040	-0,608***
A Professional (ref.)								
A Technician or Associate Professional	-0,330***	-0,065	-0,305***	0,006	-0,126*	-0,052	0,042	0,007
Clerical Support	0,128*	-0,074	-0,100	-0,020	-0,442***	0,194*	0,006	-0,089
A Sales, Customer or Personal Service Worker	0,197**	-0,046	-0,111	0,130**	-0,449***	0,459***	0,485***	0,087
A Skilled Agricultural, Forestry and Fishery Worker	0,523**	0,283	-0,216	0,148	0,153	0,397	0,316	-0,625
Building, Crafts or a Related Trade Person	-0,213*	0,100	-0,027	0,401***	0,285***	0,312**	0,358**	0,122
Plant and Machine Operator and Assembler	0,125	0,374***	0,002	0,383***	0,492***	0,539***	0,607***	0,402***
Elementary occupations	0,445***	0,604***	0,356***	0,372***	0,395***	0,948***	0,940***	0,687***
None of the above/no answer/don't know	1,005***	-0,459	0,000	-0,230	0,068	0,330	-0,290	0,979**
Administration and support services	0,135*	0,124	0,049	0,006	0,103	0,200*	0,180	0,302***
Agriculture, horticulture, forestry or fishing	-0,034	0,104	-0,196	0,219*	0,437***	0,433*	0,225	0,248
Supply of gas or electricity, mining or quarrying	-0,083	0,447***	-0,037	0,050	0,351***	0,405**	-0,067	0,327*
Supply, management or treatment of water or steam	0,092	0,598***	0,313	0,317***	0,163	0,383	0,446*	0,411*
Manufacturing or engineering	-0,054	0,178*	0,032	-0,149***	0,507***	-0,072	-0,271**	0,198**
Construction or building	-0,086	0,246**	-0,134	-0,069	0,006	0,178	-0,193	-0,046
Retail, sales, shop work or whole sale	0,049	0,152	0,098	-0,110**	-0,184*	-0,019	-0,055	0,243**
Accommodation, catering or food services	-0,218	0,074	0,442***	-0,241***	-0,203	0,247	0,035	0,254*
Transportation or storage	-0,186	-0,119	-0,149	-0,319***	-0,173*	-0,054	0,016	0,212*
Information technology or communication services	-0,233**	0,231*	-0,107	-0,283***	0,152	-0,036	-0,002	0,427***
Financial, insurance or real estate services	-0,199*	0,045	-0,093	0,043	-0,123	-0,288	-0,309*	0,152
Professional, scientific or technical services	-0,118	0,294**	0,053	-0,041	0,210**	-0,207	-0,053	0,197
Services relating to education or health (ref.)								
Cultural industries (arts, entertainment or recreation)	0,140	0,224	0,198	-0,006	0,177	0,437**	0,169	0,376**
Social and personal services	0,239**	0,282**	0,488***	0,122**	0,162	0,164	0,388***	0,222*
Something else	-0,048	0,244	0,408**	-0,314***	0,295*	-0,194	-0,030	0,286
firm_micro	-0,023	-0,018	0,182**	-0,035	-0,263***	-0,086	0,063	0,037
firm_small	-0,056	-0,239***	-0,068	-0,002	-0,205***	-0,119	-0,036	-0,089
firm_large	-0,093	-0,150**	0,134	-0,001	0,054	-0,081	-0,059	0,032
NMS	0,085	0,102	0,175**	0,190***	0,203***	0,082	0,192***	0,235***
Number of observations	46 029	46 492	46 639	40 715	43 201	46 638	46 752	46 016

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

Source: Authors' analysis

Table 6. Results of multinominal logistic regression, overskilling: general, literacy, numeracy and ICT skills, ESJ

Overskilled	General	Basic literacy	Advance literacy	Basic numeracy	Advanced numeracy	Basic ICT	Moderat ICT	Advanced ICT
female	-0,181***	0,206***	0,099***	-0,063**	-0,076*	-0,079	-0,126***	-0,163***
age	-0,001	0,004**	0,012***	0,008***	0,011***	-0,016***	-0,007***	0,011***
primary	-1,074***	-1,553***	-0,159	-1,663***	-0,467**	-0,994***	-0,951***	-0,613
secondary	-0,953***	-0,844***	-0,645***	-0,712***	-0,398***	-0,704***	-0,389***	-0,361***
secondary plus	-0,418***	-0,409***	-0,213***	-0,393***	-0,193***	-0,335***	-0,097***	0,008
higher (ref.)	ref.	ref.	ref.	ref.	ref.	ref.		
A Manager	0,322***	0,156*	0,119**	0,195***	0,243***	0,122	0,057	0,189**
A Professional (ref.)								
A Technician or Associate Professional	0,221***	0,146**	-0,006	0,151***	-0,066	0,262***	0,077*	0,125*
Clerical Support	0,524***	0,154**	0,051	0,182***	0,079	0,375***	0,187***	0,045
A Sales, Customer or Personal Service Worker	0,680***	0,369***	0,116*	0,320***	0,158*	0,439***	0,027	-0,002
A Skilled Agricultural, Forestry and Fishery Worker	0,781***	0,222	-0,085	0,353**	-0,439	0,726***	-0,128	-0,348
Building, Crafts or a Related Trade Person	0,344***	0,022	-0,049	0,178***	-0,170*	0,167	-0,123	0,189
Plant and Machine Operator and Assembler	0,867***	0,500***	-0,108	0,511***	0,060	0,538***	-0,033	-0,108
Elementary occupations	1,067***	0,657***	-0,034	0,601***	-0,003	0,787***	-0,204	0,869***
None of the above/no answer/don't know	0,098	-0,014	0,290	0,339	-0,508	-0,431	-0,157	-2,535
Administration and support services	0,144***	0,121*	0,032	0,116**	0,046	0,154	-0,043	-0,037
Agriculture, horticulture, forestry or fishing	-0,158	-0,038	0,035	0,167	0,130	0,090	0,082	0,008
Supply of gas or electricity, mining or quarrying	-0,103	0,021	-0,176*	0,021	-0,289**	0,146	-0,087	-0,444**
Supply, management or treatment of water or steam	-0,097	-0,186	-0,047	-0,017	-0,146	0,442*	-0,064	-0,226
Manufacturing or engineering	-0,074*	0,050	0,023	0,098*	-0,000	0,070	0,027	-0,202**
Construction or building	-0,089*	0,001	0,041	0,121*	0,065	0,110	-0,061	0,020
Retail, sales, shop work or whole sale	0,278***	0,338***	0,185***	0,506***	0,171**	0,564***	0,159***	-0,033
Accommodation, catering or food services	0,369***	0,366***	0,004	0,413***	-0,040	0,206	-0,045	-0,227
Transportation or storage	0,212***	0,310***	0,155**	0,212***	0,002	-0,028	0,034	-0,106
Information technology or communication services	0,107**	0,328***	0,014	0,098	-0,072	0,774***	0,129*	-0,108
Financial, insurance or real estate services	0,062	0,053	0,007	0,262***	0,062	0,311**	-0,051	-0,072
Professional, scientific or technical services	0,016	0,029	-0,033	0,141**	-0,140*	-0,105	-0,028	-0,083
Services relating to education or health (ref.)								
Cultural industries (arts, entertainment or recreation)	0,227***	0,199	0,161	0,120	-0,484**	0,093	-0,049	-0,028
Social and personal services	0,058	-0,024	-0,073	-0,019	0,014	-0,037	-0,006	-0,132
Something else	-0,049	-0,226	0,171	-0,133	0,392**	0,012	0,080	-0,258
firm_micro	-0,039	-0,068	-0,011	0,106**	-0,087	-0,183**	0,038	0,012
firm_small	0,026	-0,049	-0,041	0,067*	-0,050	-0,183***	0,056	0,100
firm_large	0,049	-0,023	-0,033	0,059	-0,041	0,018	0,044	0,080
NMS	-0,376***	0,019	0,107***	0,174***	0,254***	0,080	0,218***	0,124*
_cons								
o._cons	-0,292***	-0,328***	-0,929***	-0,978***	-0,837***	0,084	-0,247***	-0,686***
Number of observations	47 993	19 867	23 463	28 029	13 644	9 094	25 101	7 319

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

Source: Authors' analysis

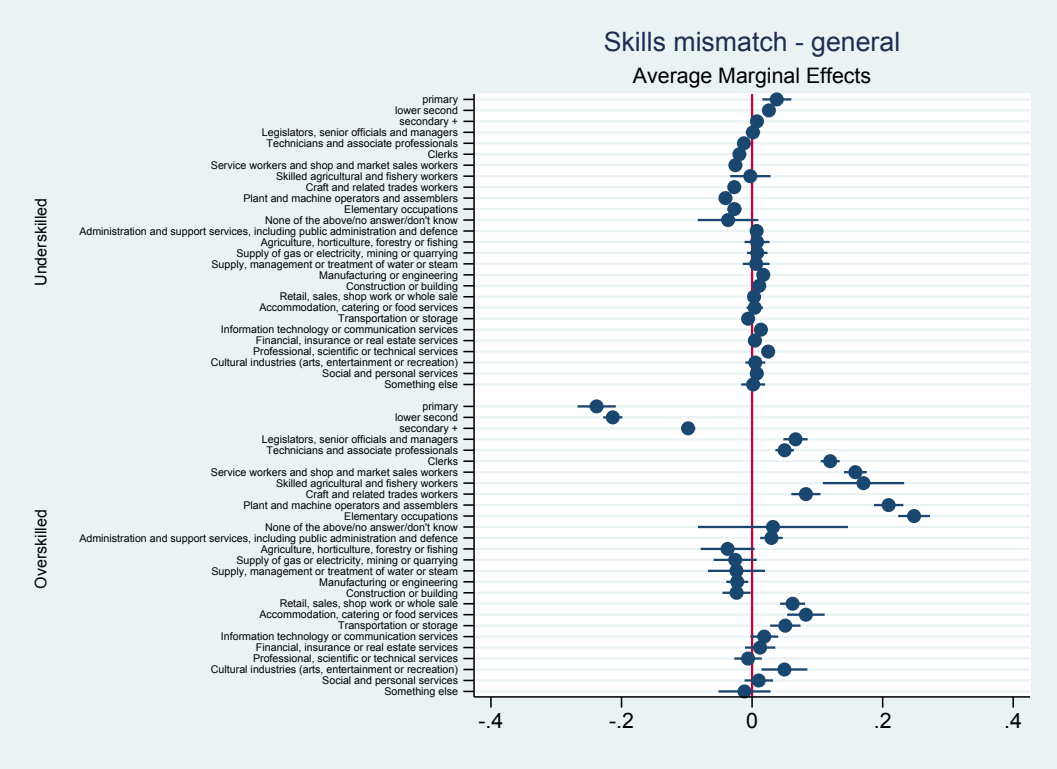
Table 7. Results of multinominal logistic regression, overskilling: specific skills, ESJ

Overskilled	Technical	Communication	Teamwork	Language	Customers	Problem solving	Learning	Planning
female	-0,275***	0,149***	0,118***	0,055*	0,124***	-0,093***	0,062***	0,087***
age	0,009***	0,012***	0,009***	-0,007***	0,010***	0,013***	-0,001	0,008***
primary	-0,523***	-0,453***	-0,337***	-0,670***	-0,256***	-0,316***	-0,588***	-0,620***
secondary	-0,159***	-0,204***	-0,093**	-0,562***	-0,014	-0,170***	-0,302***	-0,309***
secondary plus	0,027	0,008	0,073***	-0,266***	0,097***	0,018	-0,103***	-0,042*
higher (ref.)								
A Manager	0,065	0,314***	0,287***	0,251***	0,447***	0,308***	0,188***	0,436***
A Professional (ref.)								
A Technician or Associate Professional	0,168***	0,003	0,013	-0,102**	0,024	0,001	0,013	0,041
Clerical Support	-0,154***	-0,028	-0,080**	0,073	0,042	-0,104***	-0,004	-0,018
A Sales, Customer or Personal Service Worker	0,076*	0,193***	0,191***	0,017	0,394***	0,022	0,026	0,006
A Skilled Agricultural, Forestry and Fishery Worker	0,346**	0,217	0,159	-0,117	-0,141	0,145	0,426***	0,364***
Building, Crafts or a Related Trade Person	0,197***	-0,094*	0,142***	-0,096	-0,052	-0,047	0,061	0,005
Plant and Machine Operator and Assembler	-0,024	0,027	0,036	0,054	-0,048	-0,252***	-0,046	-0,132**
Elementary occupations	-0,144**	-0,110*	0,002	-0,002	0,002	-0,298***	-0,023	-0,070
None of the above/no answer/don't know	-0,419	-0,064	0,546**	-0,220	-0,343	-0,345	-0,382	-0,590*
Administration and support services	0,030	-0,128***	-0,060	0,180***	0,003	0,045	-0,015	-0,028
Agriculture, horticulture, forestry or fishing	0,012	-0,202**	-0,086	0,188	-0,203*	-0,062	-0,095	0,022
Supply of gas or electricity, mining or quarrying	-0,080	-0,141*	-0,123*	0,217**	-0,183**	0,020	-0,065	-0,005
Supply, management or treatment of water or steam	0,142	-0,384***	-0,319***	0,258*	-0,156	0,046	-0,070	-0,078
Manufacturing or engineering	0,058	-0,243***	-0,141***	0,085	-0,312***	0,018	-0,007	-0,057
Construction or building	0,022	-0,177***	-0,195***	0,061	-0,142***	-0,005	-0,052	-0,050
Retail, sales, shop work or whole sale	0,190***	0,126***	0,080*	0,221***	0,293***	0,215***	0,206***	0,153***
Accommodation, catering or food services	0,301***	0,254***	0,290***	0,609***	0,271***	0,306***	0,251***	0,215***
Transportation or storage	0,048	-0,067	-0,038	0,237***	0,031	0,236***	0,035	0,182***
Information technology or communication services	0,181***	0,096**	0,113**	0,393***	0,177***	0,274***	0,098**	0,031
Financial, insurance or real estate services	0,047	-0,003	0,030	0,093	0,086	0,120**	-0,017	-0,134**
Professional, scientific or technical services	0,162***	-0,199***	-0,129***	0,187***	-0,146***	0,074	0,063	-0,039
Services relating to education or health (ref.)								
Cultural industries (arts, entertainment or recreation)	-0,022	-0,142*	-0,147*	0,249**	0,021	-0,001	-0,012	-0,110
Social and personal services	-0,059	-0,076	-0,024	0,284***	0,027	0,008	-0,082*	-0,008
Something else	0,117	-0,221**	-0,260***	-0,095	0,044	0,254***	0,083	0,134
firm_micro	0,040	0,028	0,015	-0,056	0,101***	0,022	-0,002	0,017
firm_small	0,025	0,049*	0,064**	0,054	0,070**	0,042	0,047	0,019
firm_large	0,150***	0,086***	0,168***	0,094**	0,070**	0,094***	0,073**	0,016
NMS	0,209***	0,335***	0,356***	0,006	0,283***	0,275***	0,310***	0,122***
_cons								
o._cons	-1,025***	-1,047***	-0,940***	-0,838***	-1,230***	-0,992***	-0,470***	-0,814***
Number of observations	46 029	46 492	46 639	40 715	43 201	46 638	46 752	46 016

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

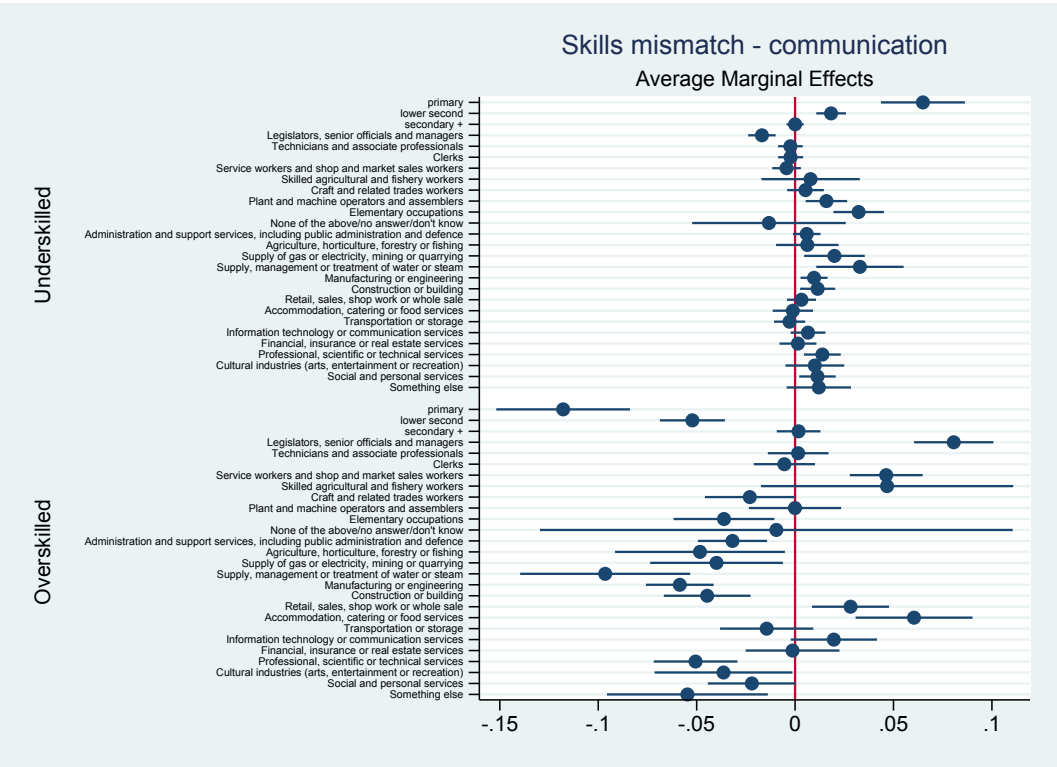
Source: Authors' analysis

Figure 8. Average marginal effects on the general skills mismatch, ESJ



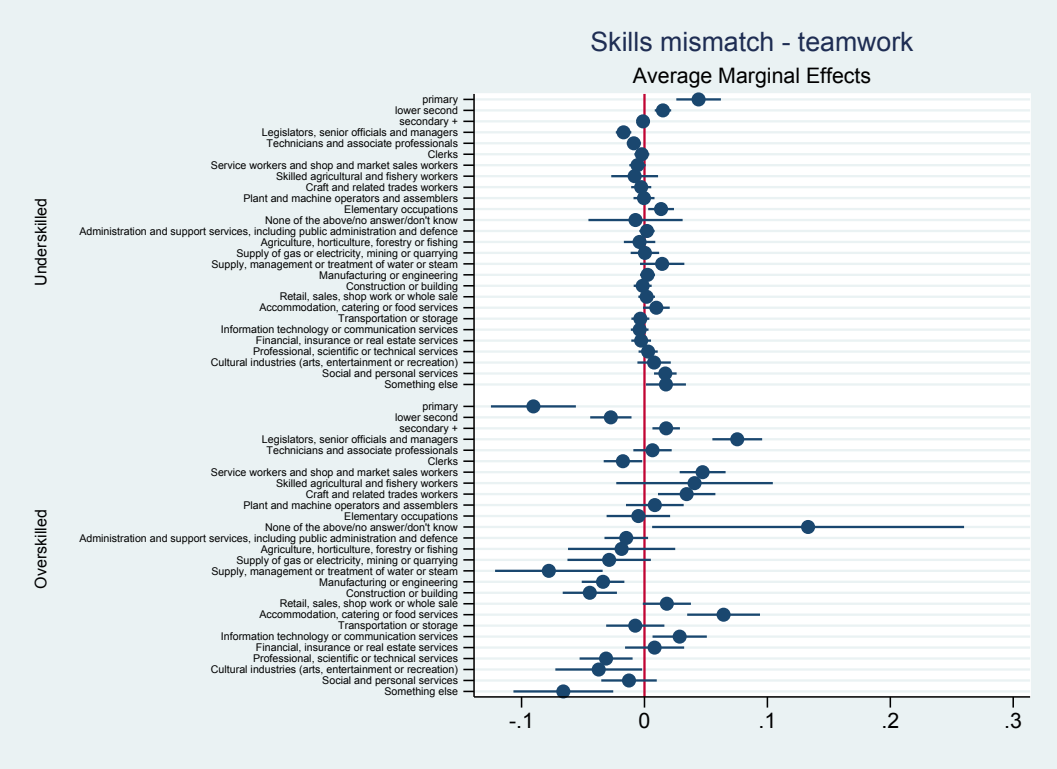
Source: Authors' analysis

Figure 9. Average marginal effects on the communication skills mismatch, ESJ



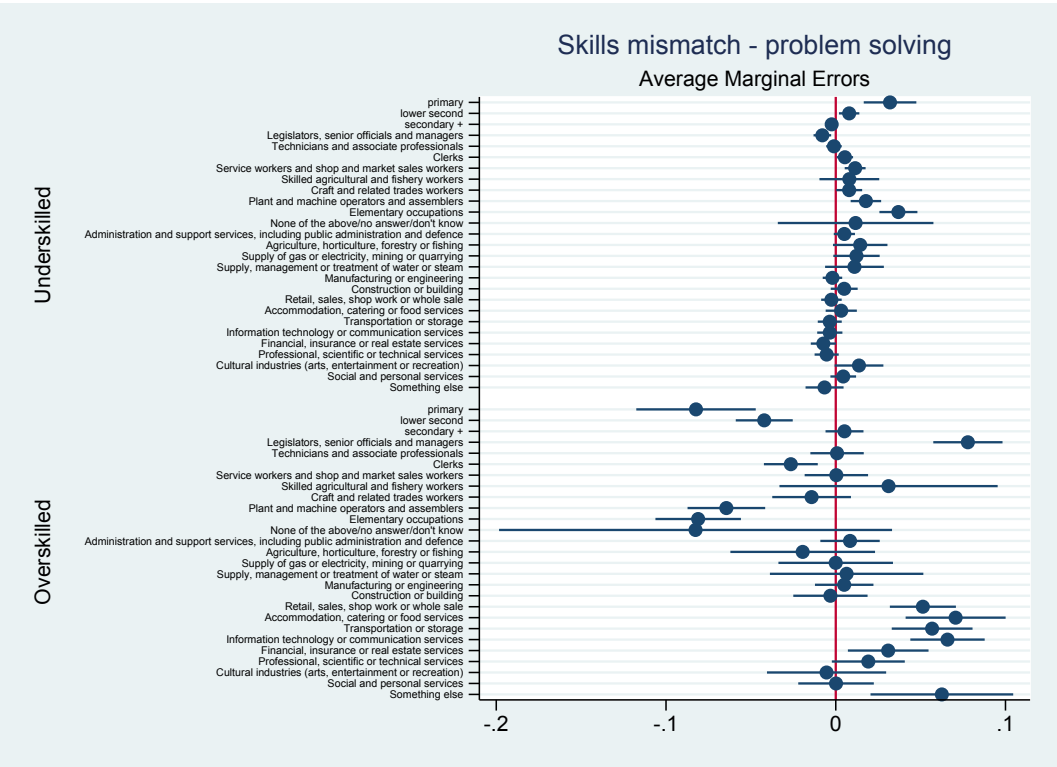
Source: Authors' analysis

Figure 10. Average marginal effects on the teamwork skills mismatch, ESJ



Source: Authors' analysis

Figure 11. Average marginal effects on the problem solving skills mismatch, ESJ



Source: Authors' analysis