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Vocational Education and Underskilling: Lessons from European Skills and Jobs Surveys

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Abstract

Context: Vocational education and training (VET) aims to equip students with a mix of general, occupational, and firm-specific skills—skills that are directly relevant to the “world of work”. In this paper, we investigate whether workers with a VET background have an advantage in securing jobs that match their skills. We focus on underskilling, a condition in which workers' skills are insufficient to meet the demands of their job.

Approach: We estimate the association between vocational education and underskilling, using both European Skills and Jobs Surveys (ESJS1 and ESJS2), each providing a unique perspective on skills. Both waves of this survey allow us to construct multiple self-reported measures of underskilling.

Findings: Using the ESJS1, we find that VET workers perceive, on average, a lower degree of underskilling, compared to those with general education. Examining the patterns behind this effect, we show this different perception is driven by lower underskilling in specialized technical skills and already present earlier in their careers. None of these results are replicated using the ESJS2, likely because underskilling is indirectly measured via skill deficit. However, in both surveys, we find that underskilling measures of VET workers fare better in VET systems that are more closely linked to the labor market.

Conclusions: The analyses on the ESJS1 sample suggest that vocational education adequately fulfils its function as collective skill formation system: workers with a VET background experience less or equal underskilling than workers with a general education background. Differences between results obtained via ESJS1 and ESJS2 underline the importance of underskilling measurement. The closeness of VET systems to labor market seems to matter for better underskilling outcomes of VET workers in both surveys.

Keywords

underskilling, initial vocational education, collective skill formation systems

1 Introduction

One of the crucial roles of vocational education and training (VET) programmes is to prepare students for specific occupations providing them with skills that are relevant to the labour market (Eichhorst et al., 2015).¹ Of the many labour market outcomes, e.g. employment, wages, job quality, or career progression—job-skill match is more closely linked to the VET system than others and can be regarded as the direct outcome of the role played by the VET system in an economy. Various stakeholders and the governance mechanisms that control the supply of skills and their utilization in an economy is called a collective skills formation system (Busemeyer & Trampusch, 2012; Thelen, 2004). VET as a part of this system plays a role alongside all other key actors as the general education system, employers, unions, or the government. The supply of skills may be collectively organized with the involvement of businesses, industry chambers, and unions supported by state in execution, finance, and monitoring (Busemeyer & Trampusch, 2012; Eichhorst et al., 2015; Ibsen & Thelen, 2024). The initial VET, by providing education for youth not yet in the labor market, plays a core role in such formation process. Its governance often foresees the participation of firms and employer associations in the VET curriculum (Thelen, 2004). While such participation can take on different forms in different countries (Mende et al., 2023), it is generally true that the initial VET programs have stronger connections to the “world of work” than general education programs (Bolli et al., 2018).

The ability of the VET system to form skills that are valued by employers is central to the VET effectiveness. It is often assessed by measuring the advantages the VET confers to workers who have participated in such programmes compared to those who did not. For example, such effectiveness is reflected by shorter duration of the school-to-work transitions experienced by upper secondary VET graduates compared to graduates from general upper secondary schools (Middeldorp et al., 2019; Pastore et al., 2021).² More often, however, the effects of VET on labour market outcomes are less clear-cut. The initial advantage is reversed later in their career, and this evidence has been used to question the effectiveness of initial VET. Compared to general education graduates, VET graduates tend to earn a higher wage in the first part of their career, but then the advantage evaporates and turns into a disadvantage later in their careers (Brunello & Rocco, 2017; Hanushek et al., 2017). Similarly, workers with a VET background are less likely to experience a spell of unemployment in the early part of their career (Vermeire et al., 2022). Yet, they also seem to be more likely to find fixed term contract and to be in jobs with lower skills requirements than workers with a general education background (Vermeire et al., 2022). The initial advantage of VET students in terms of the likelihood of being in employment evaporates over time (Forster et al., 2016; Forster & Bol, 2018; Hampf & Woessmann, 2017). These findings seem to suggest a policy trade-off between a short-term and long-term labour market outcomes (Hanushek et al., 2017), and signal inefficiencies of initial VET in the collective skills formation.

Analyses that use skills mismatch as a labor market outcome variable, find that a VET background gives an initial advantage in terms of match and job quality (Heijke et al., 2003; Tobback et al., 2024). This initial advantage decreases over time but never turns negative (Verhaest et al., 2018). This signals that initial VET is effectively contributing to the collective skills

¹ The focus of the analysis is therefore on initial VET.

² In dual VET systems, students are already in the labour market. However, they also move out from the dual vet system to full-time work.

formation system. However, mismatch conflates two types of misalignments between workers' skills and job requirements. Overskilling characterizes a situation in which workers' skills set is wider than what required by the job—the problem not directly linked to VET system—but how organizations use their workers' skills or are results of job search and recruitment frictions. On the contrary, underskilling is an issue that is directly connected to the VET system signaling that the VET system is not delivering the skills required by employers. Consequently, our ex-ante working hypothesis is that the relationship between VET background and underskilling is informative about the way VET fulfils its duties in the collective skills formation system. If there is a negative correlation between them, workers with a VET background tend to suffer less from underskilling than those with a general education background. In addition, in VET systems that have a stronger linkage with the “world of work” the relationship between a VET background and underskilling is even stronger (Levels et al., 2014). Conversely, when the VET system is weakly linked to the world of work, firms would experience difficulties in recruiting applicants with the required skills (Brunello et al., 2021; Weaver & Osterman, 2017), thus signaling that the VET system's contribution to the collective skills formation system is defective.

This paper focuses on the relationship between initial VET background and underskilling using both European Skills and Jobs Surveys (ESJS1 from 2014 and ESJS2 from 2021) performed in 27 European Union countries. We restrict our analysis to a comparison between VET and general education at the upper secondary level at which the VET definition is clear for each participating country.³ From both surveys, we construct multiple self-reported measures of underskilling between perceived job requirements and individual skill endowment. Using two surveys, seven years apart, allows us to compare the VET effects in underskilling using a larger number of measures, in different point in time and using two different ways of ascertaining a VET background—self-reported in ESJS1 and expert assessed in ESJS2.

2 Data

In our analysis we use both waves of the European Skills and Jobs Surveys (ESJS1, 2014; ESJS2, 2021). They are both representative samples of European population on self-reported skill measures. Each survey offers some comparable self-reported mismatch measures allowing for external validity of the results, rather than potentially being only collection-specific. Moreover, each survey has its specific component that enables us to expand the variety of our underskilling measures.

The ESJS1 (2014) surveys about 49'000 adult employees, aged 24 to 65, from all EU-27 member states and the United Kingdom (Cedefop, 2018). It collects detailed information on job-skill requirements, digitalization, skill mismatches, and workplace learning, with the aim to assess dimensions of skill shortages and skill underutilisation. The ESJS1 survey is the richest source of self-reported mismatch measures of general and of skill-specific nature. The ESJS2 (2021) surveys 46'213 adult employees, aged 24 to 65, in the EU-27 Member States, Norway, and Iceland (Cedefop, 2022). It examines drivers of skill development in relation to changing task complexity and skills requirements of jobs. The special focus of ESJS2 is in changing skill needs and job tasks of workers due to digitalization and underlying adaptability.⁴

³ VET at the tertiary level does not exist in all European countries.

⁴ There are other surveys containing information on skills: The European Working Conditions Survey (EWCS) from Eurofound and the LFS ad-hoc module on skills utilization. However, the EWCS does not include variables that could be used to identify a VET background, while the LFS ad-hoc module consists of a Job Requirement Module that allows inference on skills utilisation but does not contain a measure of underskilling. For these reasons the EWCS and the LFS ad-hoc module on skills utilization were not included in the analysis.

In our analysis we focus on a joint subset of all 27 EU countries existing in both datasets. Across European countries vocational education has a long tradition. It also allows us to leverage the differences between the country's VET system. VET generally does not exist on the lower secondary level. As for tertiary level, it exists in some countries, but its definition is not unified across countries. All countries have a VET system at the upper and post-secondary (non-tertiary) level of education. Therefore, the analyses will be restricted to the samples of individuals holding an upper or post-secondary education as their highest educational attainment (levels 3 and 4 of ISCED 97), which is around 35-40% of the total samples.

The fraction of vocationally educated workers varies across surveys. The VET share is 74% in ESJS1 where the VET secondary attainment is self-reported. It is less in ESJS2 (62%), where the VET degree is based on expert knowledge of the country's education systems and each respondent is aligned with an ISCED 3 or 4 attainment is a VET worker (cf. Table 1). Additionally, the reduction in the VET share between the two rounds of ESJS surveys is also in line with the decrease in VET school enrolment experienced by most participating countries.

2.1 Measures of Underskilling

Both waves of the ESJS survey have a variant of an overall underskilling measure and several measures of skill domains underskilling. In the ESJS1 the overall underskilling measure is based on two consecutive questions. In the first one, each respondent is asked to *best describe their skills in relation to what is required to do their job*. If answering *some of my skills are lower than what is required by my job*, a follow up question is asked to assign the extent of the underskilling between 1 (=my skills are a little lower than required) and 5 (=my skills are a lot lower than required). Accordingly, the measure of current job underskilling equals zero if the respondent feels perfectly matched or overskilled. Depending on the individual perception of underskilling, it takes one of the integer values 1 to 5. An equivalent set of two questions exists in ESJS1 also with a reference to the situation when starting the current job as well as for four skill domains we explicitly look at: numeracy skills, specialized technical skills, information and communication technology (ICT) skills, and problem-solving skills. A separate explicit question is asked on another place of the ESJS questionnaire concerning *rating of an own level of skills*. The question is to be answered on a scale of 0 to 100. For the purposes of our analysis, we rescale the current job underskilling measure (0-100) in such a way that 0 indicates that the respondent has all the skills needed and 100 indicates a need to develop all skills.

In general, few people feel underskilled. In the ESJS1 survey the share of current job underskilling is only 6%. Accordingly, the means of the underskilling measures are low, that corroborates our 0-100 underskilling measure—the average need for reaching the perfect match is 17 points out of 100. The average underskilling levels are between 0.05 to 0.1, except for underskilling when starting the current job which is substantially higher at 0.5 (cf. Table 1, Panel A).

The ESJS2 survey has a single overall underskilling measure. It is based on a skill deficit question: *To what extent do you need to further develop your overall level of knowledge and skills to do your main job even better?*. The answer can take four possible levels from *to a great extent* down to *not at all*. For our analysis we directly used the answers to build the underskilling measure such that zero means no underskilling and 3 stands for being underskilled to a great extent. An equivalent question exists for ICT underskilling. For the two remaining skill domains available in the ESJS2, numeracy and specialized technical skills, we build dummy variables based on yes/no answers to a question *do you need to further develop numeracy/technical skills to do your main job even better*. Underskilling is much more frequent in the ESJS2 survey averaging 1.4 and 1.6 of 0-3 integer levels for ICT and overall skills (about 80% of the respondent report to be underskilled). In total, 30% and 40% of the respondents report underskilling in

numeracy and specialized technical skills (cf. [Table 1](#), Panel B). The large incidence of underskilling compared to ESJS1 is due to the prospective nature of the question: *Compare the skills that you have today to those you will need in the future to have a better performance*. With this formulation everybody that expect to increase its performance is underskilled. Those who are not underskilled according to this measure are those that cannot increase their performance or do not want to increase their performance.

Table 1

Descriptive Statistics of Vocational Dummies and Underskilling Measures in Both ESJS Surveys

	Mean	(Std. dev.)	N
Panel A: ESJS1			
vocational education	0.755	(0.430)	16,764
Overall underskilling measures			
current job: 0-5	0.103	(0.509)	16,652
current job: 0-100	17.288	(15.120)	16,764
when starting the current job: 0-5	0.541	(1.145)	16,575
Underskilling measures in domains			
numeracy: 0-5	0.053	(0.360)	16,500
specialized technical: 0-5	0.100	(0.524)	16,448
ICT: 0-5	0.054	(0.354)	16,450
problem-solving: 0-5	0.044	(0.329)	16,402
Panel B: ESJS2			
vocational education	0.616	(0.486)	11,381
Overall underskilling measures			
current job: 0-3	1.640	(0.853)	11,380
Underskilling measures in domains			
numeracy: 0/1	0.283	(0.450)	11,383
specialized technical: 0/1	0.387	(0.487)	11,376
ICT: 0-3	1.409	(0.935)	11,378

Note. ESJS1(2014) and ESJS2 (2021) subsamples of ISCED 3-4 educational attainment. ICT = Information and communication technology.

3 Empirical Approach

In our empirical specification we take inspiration from [Hanushek et al. \(2017\)](#) who estimate the age profile of lifetime employment and earnings; and [Verhaest et al. \(2018\)](#) who estimate a graduation year profile of education and skill mismatches. In our case we explain underskilling by use of a following equation:

$$(eq. 1) \quad y_i = \beta_0 + \beta_1 VET_i + \gamma X_i + \theta_c + \lambda_t + \delta_c t + \varepsilon_{ict},$$

where y_i is an underskilling measure of an individual i . The θ_c and λ_t stand for country and graduation year fixed effects. The country fixed effect control for time invariant specificities of countries' labour markets, while the graduation year fixed effects are dummies controlling for structural factors generally present at the time of an individual entering the labour market. To allow for country specific developments related to underskilling we include also country specific linear time trend $\delta_c t$ in graduation years. Furthermore, we cluster standard errors, ε_{ict} ,

on country×graduation year level. We justify our clustering level by the relevance of this grid for the VET variable.

The matrix X_i includes three sets of variables which further explain the individual underskilling, and control, albeit imperfectly, for selection into VET education due to observable characteristics. Accordingly, the vector γ stores the underlying coefficient estimates. The first set contains five individual control dummies: female, post-secondary education, migration status, living with a partner and living with children. Next, job-specific controls include temporary contract and part time dummies, three tenure dummies, four occupation level dummies and, lastly, high job-autonomy, high level of learning, and high level of team-work dummies. Finally, in the third set are workplace-specific variables: three firm-size dummies and 15 industrial sector dummies. The reason behind these broad sets of control variables is to demonstrate stability of the VET coefficient including all available information regarding each individual the ESJS surveys offer.

Our core interest lies in the distinction between the average underskilling of VET and generally educated individuals controlling with an extensive set of observables for selection into VET education track. Accordingly, in eq. 1 the coefficient of interest is β_1 . If negative, secondary VET education leads to a smaller underskilling probability in the underlying skill as compared to generally educated. If positive, VET educated workers have higher levels of underskilling.

To assess the robustness of the estimates to the effect of unobservable variables, we apply an approach originally suggested by Altonji et al. (2005) and Oster (2019). It measures the connection of bias with treatment coefficient stability—in our case vocational education—regarding the explanatory power of observed confounders in total variation of the outcome. On the practical side we accompany any of our significant results with a percentage bias necessary to overthrow the effect of vocational education dummy (Xu et al., 2019). An estimate is proclaimed as significant in the presence of unobserved heterogeneity if the percentage bias is at least 50%. Finally, we apply throughout our analysis linear regression, albeit our dependent variables are mostly ordinal variables taking integer values between zero and three (five) and eventually dummies. We justify our choice by having a possibility of direct interpretation. We obtain equivalent results, qualitatively, when using probit or ordinal probit, respectively.

4 Results

4.1 VET and Overall Underskilling

Our measures of overall underskilling assess underskilling levels which are not bound to any specific skill domain but rather reflect a general match perception of individuals vis-à-vis their current work. There are three measures of this type available in the ESJS1 and one in the ESJS2. In Table 2 we report VET coefficients employing regression equation (eq. 1) without controls (column 1), including fixed effects and linear time trends in graduation years (column 2); adding individual (column 3); and job and workplace-specific controls (column 4).

Reported is only the coefficient of the vocational education dummy. Each coefficient stems from a separate linear regression with an underskilling measure as dependent variable (see row headings) optionally including fixed effects and control variables (see bottom part of the table). Observations are weighted by sampling weights. Robust standard errors clustered by country × graduation year are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Using any of the three measures of underskilling in the ESJS1 survey we find that workers with a vocational education degree perceive themselves as less underskilled in their current job as well as when starting their current job. Including fixed effects, country-specific linear trend and control variables does not change the coefficient of vocational education dummy much, demonstrating stability of the VET coefficient. Focusing on the full model (column (4)), the

coefficients of the VET dummy at the 0-100 scale variables indicate a lower underskilling probability by the same level of about 1.5 percentage point (pp). Using the mean of 17.3 of the 0-100 underskilling measure (Table 1), the 1.5pp translates into a 9% smaller underskilling of vocationally educated workers. For the 0-5 scale underskilling variable, both currently and when starting the current job, the association is nominally similar, pointing to less underskilling by 0.05pp. However, when accounting for the respective means of 0.1 and 0.54, the effect is about 11% reduction in underskilling for the situation when starting the current job, but VET workers are by 40% less underskilled when using their answers to less precise 0-5 underskilling measure. The percentage bias to invalidate the inference is high for both current measures of underskilling, corroborating the significance of the VET coefficients in current perceptions of underskilling (cf. Table 2, Panel A).

Table 2

Association of Vocational Education with Self-reported Underskilling

Underskilling measure:	(1)	(2)	(3)	(4)
Panel A: ESJS1				
Current job: 0-5	-0.048*** (0.012)	-0.042*** (0.013)	-0.040*** (0.013)	-0.045*** (0.013)
% Bias to invalidate inference	49.39	40.1	38.53	41.83
current job: 0-100	-1.469*** (0.349)	-1.517*** (0.342)	-1.507*** (0.346)	-1.544*** (0.355)
% Bias to invalidate inference	53.45	55.86	55.05	54.98
When starting the current job: 0-5	-0.050* (0.027)	-0.039 (0.028)	-0.037 (0.028)	-0.058** (0.028)
% Bias to invalidate inference				3.51
Panel B: ESJS2				
Current job: 0-3	0.069*** (0.025)	0.066*** (0.025)	0.066*** (0.025)	0.059** (0.025)
% Bias to invalidate inference	30.22	26.25	24.42	18.08
country & graduation year FE		yes	yes	yes
country-specific LT in graduation year		yes	yes	yes
individual controls			yes	yes
job/workplace-specific controls				yes

Note. ESJS1(2014) and ESJS2 (2021) subsamples of ISCED 3-4 educational attainment.

These results are not replicated using the more recent ESJS2 survey. Here, VET workers self-report larger underskilling as compared to generally educated workers. However, economically, this difference is small. The mean overall underskilling is much higher in ESJS2 (1.64) than in the ESJS1. The coefficient's size of 0.06 translates into a very small actual disadvantage for VET workers: their underskilling is only about 3.6% higher than for workers with general education. Moreover, the percentage bias is low at 18%, when we include job and workplace characteristics into regression, thus it is likely that the measured association would be overthrown when having a fuller account of unobserved heterogeneity (cf. Table 2, Panel B). Additionally, the measure of underskilling adopted in the ESJS2—skill deficit—is further away from

the actual job-skill underskilling. In fact, a well-functioning VET system may imply a positive relationship between a VET background and skill deficit.⁵

4.2 VET and Skill Domains Underskilling

In the consecutive analysis we explore which specific skill domains drive the VET effects in overall underskilling. Both surveys collect explicit self-reports of underskilling in various skill domains. We focus on the specialized technical domain because it is by construction the skill that VET education is designed to train.⁶ We also consider three other domains, numeracy, problem-solving and ICT skills, in which generally educated workers should have an advantage.

In both surveys the domain of specialized technical skills is the only domain for which the VET coefficient is significant. In all other domains the difference in underskilling between VET and generally educated is negligible. Indeed, it is the job-specific skills domain where the VET workers perform better (ESJS1) or worse (ESJS2). Reflecting upon the percentage bias, this evidence is not strong, nevertheless it is the only skill domain which shows a systematic difference in underskilling. (cf. Table 3, both specialized technical rows). Moreover, for both surveys the VET coefficient in specialized technical domain underskilling is about half of the coefficient size in overall underskilling, underscoring the primacy of the domain in the overall perception of underskilling.

4.3 VET and Underskilling in VET Systems Closer to Labor Market

Initial VET systems across Europe differ in their closeness to labor market needs. In this section we specifically estimate VET coefficients for subset of countries that, by observable characteristics, are more closely linked to the labor market in their VET tracks. The first obvious characteristic is an apprenticeship format of VET. In such systems firms take over responsibility for practical training and trainees are bound to firm via a work contract. However, even without apprenticeships, VET systems might have close links to the labor market. To capture this, we use results of the qualitative analysis by Bolli et al. (2018) upon education-employment linkages (EEL) for 18 countries' VET systems. We study the association of VET with underskilling in the seven above average EEL countries. Lastly, we use OECD (2017) statistics and distinguish nine countries where workplace training takes up at least 50% of the VET education (cf. bottom part of Table 4 for countries sets).

In Table 4 we report VET coefficients for underskilling measures for the three subsets of countries (columns (2) to (4)). For an easy comparison, we re-report in column (1) coefficients based on all EU 27 countries from estimations. We only report results including all fixed effects and control variables. For the ESJS1 results, the current job underskilling primacy of VET workers is slightly stronger in the set of high EEL countries and about the same for the subsets of apprenticeship and high WPT countries. The underskilling disadvantage is smaller for all three countries subsets based on the ESJS2 (Table 4, Panel B).

⁵ For example, if the relationship between skills and job performance is characterized by decreasing marginal improvements and assuming that workers with a VET background are less underskilled than those with general education background, workers with VET background would need a larger increase in skills than that needed by workers with a general education background to attain the same level of performance increase.

⁶ In ESJS2 the reference to specialized technical skills is accompanied by explanatory text making an explicit reference that the job requirements--skill endowment match is being asked for: *Technical skills or job-specific skills e.g. engine repair if you are a mechanic, applying accountancy rules if accountant, using design software if graphic designer, using programming software if computer scientist etc.*

As for skill domains, underskilling results improve for VET workers in both surveys. Based on ESJS1, underskilling is smaller in all domains but ICT. For ESJS2 the underskilling disadvantage in specialized technical domain we see for all countries disappears, and there is slightly lower underskilling probability in numeracy and in the ICT skill domains. All results reported in Table 4 are not sufficiently robust to pass the percentage bias test to invalidate inference, but they are indicative of the role that VET, and in particular in countries with stronger labor market links, has in making the job-skill match more precise.

Table 3

Association of Vocational Education with Self-reported Underskilling in Specific Domains

Underskilling measure:	(1)	(2)	(3)	(4)
Panel A: ESJS1				
specialized technical: 0-5	-0.022*	-0.034**	-0.032**	-0.020
	(0.013)	(0.014)	(0.014)	(0.014)
% Bias to invalidate inference	15.59	18.23	13.65	30.17
numeracy: 0-5	-0.003	-0.010	-0.009	-0.010
	(0.008)	(0.009)	(0.008)	(0.009)
ICT: 0-5	-0.011	-0.015*	-0.015*	-0.011
	(0.009)	(0.009)	(0.009)	(0.009)
problem-solving: 0-5	-0.009	-0.009	-0.007	-0.007
	(0.007)	(0.007)	(0.008)	(0.008)
Panel B: ESJS2				
specialized technical: 0/1	0.031**	0.035**	0.035**	0.032**
	(0.014)	(0.014)	(0.014)	(0.014)
% Bias to invalidate inference	12.88	20.47	23.08	14.27
numeracy: 0/1	-0.005	-0.007	-0.007	0.000
	(0.012)	(0.012)	(0.012)	(0.012)
ICT: 0-3	-0.034	-0.019	-0.018	0.011
	(0.024)	(0.025)	(0.025)	(0.025)
country & graduation year FE		yes	yes	yes
country-specific LT in graduation year		yes	yes	yes
individual controls			yes	yes
job/workplace-specific controls				yes

Note: ESJS1(2014) and ESJS2 (2021) subsamples of ISCED 3-4 educational attainment. Reported is only the coefficient of the vocational education dummy. Each coefficient stems from a separate linear regression with an underskilling measure as dependent variable (see row headings) optionally including fixed effects and control variables (see bottom part of the table). Observations are weighted by sampling weights. Robust standard errors clustered by country $\times$ graduation year are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4

Association of Vocational Education with Underskilling by Labour Market Tightness of VET Education Systems

Underskilling measure:	All (1)	High EEL (2)	Apprenticeship (3)	High WPT (4)
Panel A: ESJS1				
current job: 0-5	-0.045*** (0.013)	-0.052** (0.023)	-0.044 (0.030)	-0.032 (0.025)
% Bias to invalidate inference	41.83	14.44		
specialized technical: 0-5	-0.020 (0.014)	-0.026 (0.032)	-0.038 (0.046)	-0.042 (0.037)
numeracy: 0-5	-0.010 (0.009)	-0.027 (0.020)	-0.047* (0.028)	-0.043* (0.022)
ICT: 0-5	-0.011 (0.009)	0.017 (0.016)	0.030 (0.022)	0.020 (0.018)
problem-solving: 0-5	-0.007 (0.008)	-0.020 (0.015)	-0.019 (0.022)	-0.021 (0.018)
Panel B: ESJS2				
current job: 0-3	0.059** (0.025)	0.044 (0.041)	0.045 (0.051)	0.037 (0.042)
specialized technical: 0/1	0.032** (0.014)	-0.002 (0.025)	-0.018 (0.030)	-0.013 (0.025)
numeracy: 0/1	0.000 (0.012)	-0.033* (0.018)	-0.045** (0.023)	-0.033* (0.019)
% Bias to invalidate inference		6.65	1.16	11.66
ICT: 0-3	0.011 (0.025)	-0.076* (0.040)	-0.094* (0.050)	-0.073* (0.042)
countries included:	All EU27	Austria Denmark Germany Finland Estonia Poland Slovenia	Austria Denmark Germany Luxembourg	Austria Denmark Germany Luxembourg Finland Belgium Croatia Latvia Netherlands

Note: ESJS1(2014) and ESJS2 (2021) subsamples of ISCED 3-4 educational attainment. Reported is only the coefficient of the vocational education dummy. Each coefficient stems from a separate linear regression with an underskilling measure as dependent variable (see row headings) and including full set of fixed effects and control variables (see Table 2, column (4)). Above average EEL= education-employment linkages index (Bolli et al., 2018), More than 50% of WPT: workplace training. Observations are weighted by sampling weights. Robust standard errors clustered by country $\times$ graduation year are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

5 Conclusions

The aim of this paper is to investigate the contribution of the VET system to the collective skill formation system. One of the key roles of the VET system is to supply occupational and professional skills at a scale. Underskilling is the labor market outcome that is very closely related to the way in which the VET system fulfils its function within the collective skills formation system. Consequently, our empirical analysis is built on the ex-ante hypothesis that

workers with a VET background would experience both a lower incidence and a lower degree of underskilling than workers with a general education background.

We explore this hypothesis using two waves of European Skills and Job Surveys. Our results are not robust enough to support a clear conclusion on the VET ability to provide workers with the skills they need for labor markets. When overall underskilling is measured by a subjective comparison between one's skills and the skills requirement of the job, vocational background is associated with a lower likelihood of overall underskilling (ESJS1). The VET coefficients we obtained are also robust to the omitted variable bias, in the sense that the percentage of bias that would be needed to nullify the inference is implausibly high. When underskilling is measured via skills development that would support a foreseen improvement in work performance, we find weakly positive association between underskilling and VET (ESJS2).

We specifically examine the association between VET and underskilling for subsets of countries where the VET system is more closely linked to labor markets. It appears that the advantage of having a vocational background is in such systems stronger related to the better connection with the "world of work". Based on the ESJS1 sample, our results suggest that the VET system discharges its role in the collective skills formation system adequately. Based on the ESJS2 sample we can at least exclude large underskilling disadvantages of VET workers. This is a positive result that reinforces the recent literature on the parity between general education and vocational education (e.g., Schweri et al., 2020; Silliman & Virtanen, 2022).

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