

Vocational Education and Skill Mismatch:

A Cross-European Perspective

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What is the effect of vocational education on skill mismatch?

Main features:

- »» Self-reported and actual (absolute) mismatch
- »» Overall skill mismatch and mismatch in skill domains
- »» Cross-survey evidence: ESJS1, ESJS2, PIAAC
- »» Cross-European perspective: up to 27 EU+ countries
- »» Cross-sectional evidence, but strengthened by % bias to invalidate the inference

Vocational graduates vs. skills-for-work (dis)advantage

Vocational education:

- ⊕ Mix of general, occupational, and firm-specific skills;
Collaboration between vocational schools and firms;
Work experience in firms
- Developing of skills directly relevant for employers
e.g., Arum and Shavit, 1995; Heijke et al., 2003; Levels et al., 2014; Blommaert et al., 2020
- ⊕ Wage premium for a more precise match between job skills requirements and workers skills
Morrison et al., 2005; Rinawi and Backes-Gellner, 2021
- ⊖ Narrower skill formation → fewer career possibilities, lock-in employment, limited skill development;
After job transition → less complex job, lower earnings
McKee-Ryan and Harvey, 2011; Hanushek et al., 2017; Schulz et al., 2023

Skill mismatch of workers by education type

Mismatch differences vocationally vs. generally educated workers: Empirical evidence

Short/long-run mismatch Verhaest et al. (2018)	No difference Schweri et al. (2020)	Smaller mismatch Tobback et al. (2023)
ESJS1 and PIAAC (Tobit regr.) education and skill mismatch → early advantage → but increasing mismatch over time	Swiss Household Panel (FE estim.) horizontal mismatch → no wage penalty differences for mismatch	ESJS1 (IV regr.) indirect evidence via training → less early training because higher match of vocationally educ.

Definition of mismatch

We operationalize our **mismatch variables** as:

- **absolute mismatch in skills:**
no distinction by under-/over-skilling
- **overall** mismatch → main focus
- mismatch in multiple skill **domains**
- **self-reported** mismatch
- **actual** mismatch measures:
difference between skill test assessment and experts' scoring of the ISCO 08 4-digit level occupations

Datasets and mismatch variables: ESJS1 (2014)

European skills and jobs survey 1	Mean	(Std. dev.)	N
Overall skill mismatch:			
current: 0-100	17.267	(15.123)	17,633
current: 0/1	0.449	(0.497)	17,542
at start of current job: 0/1	0.492	(0.500)	17,497
in previous job: 0/1	0.411	(0.492)	16,129
Mismatch in skill domains:			
in literacy: 0-5	2.692	(1.794)	17,390
in foreign language: 0-5	1.787	(1.713)	17,523
in customer-handling: 0-5	2.415	(1.919)	17,493
in numeracy: 0-5	2.407	(1.824)	17,441
in ICT skills: 0-5	2.354	(1.828)	17,433
in specialized techn. skills: 0-5	2.582	(1.706)	17,525

⊕ Richest set of self-reported mismatch

▶ ESJS1 questions used

Datasets and mismatch variables: PIAAC (2012-2015)

Programme for the International Assessment of Adult Competencies	Mean	(Std. dev.)	N
Overall skill mismatch:			
overall skill mismatch: 0/1	0.900	(0.300)	19,777
Mismatch in skill domains:			
numeracy self-reported : 0-5.376	0.957	(0.733)	19,465
numeracy (actual : JAM): 0-5	0.970	(0.749)	18,683
literacy self-reported: 0-6.353	0.981	(0.747)	19,575
literacy (actual : JAM): 0-5	0.982	(0.743)	18,683
problem-solving skills self-reported: 0-5.423	0.980	(0.753)	13,488
ICT skills self-reported: 0-6.859	1.093	(0.847)	12,603

- ⊕ Self-reported and actual mismatch measures based on Job Analysis Method available (Pérez Rodríguez et al., 2024)

▶ PIAAC questions used

Datasets and mismatch variables: ESJS2 (2021)

European skills and jobs survey 2	Mean	(Std. dev.)	N
Overall skill mismatch:			
overall: 0-3	0.748	(0.811)	11,637
Mismatch in skill domains:			
in ICT skills: 0-3	1.407	(0.935)	11,632
in numerical skills: 0/1	0.282	(0.450)	11,637
in communication skills: 0/1	0.471	(0.499)	11,637
in technical skills: 0/1	0.386	(0.487)	11,630

⊕ Most recent set of self-reported mismatch

▶ ESJS2 questions used

Sample and vocational education dummy

»» Sample

→ Employed individuals with secondary or upper secondary as their highest educational attainment (ISCED 3 and 4)

»» Vocational dummy is defined as

- **ESJS1:** = 1 if “yes” to *Would you describe your highest qualification as a vocational qualification?* or “yes” to *Study involved some learning in a workplace.*
- **PIAAC:** based on expert assessment
- **ESJS2:** =1 if highest attainment ISCED 35 and ISCED 45

Econometric considerations

Our specification includes a large set of control variables, country and graduation year fixed effects, and country-specific trends in graduation years:

$$y_i = \beta_0 + \beta_1 \text{VET}_i + \gamma \mathbf{X}_i + \theta_c + \lambda_t + \delta_c t + \varepsilon_{ict},$$

- y_i : skill mismatch measure of an individual i
- VET_i : equals one if vocationally educated worker i
- θ_c and λ_t : country and graduation year fixed effects
- $\delta_c t$: country specific linear time trend in graduation years
- \mathbf{X}_i individual, job-specific, and workplace-specific variables
- ε_{ict} clustered standard errors on country \times graduation year level
- for $\hat{\beta}_1$ we calculate the % bias necessary to overthrow the effect due to selection on unobservables

Effect of vocational education on overall mismatch

<i>Dependent variable:</i>	Without controls		With controls	
	(1)	(2)	(3)	(4)
overall mismatch: 0-100 (ESJS1)	-0.846**	-1.369***	-1.332***	-1.261***
	(0.339)	(0.334)	(0.336)	(0.339)
% Bias to invalidate	21.46	52.19	50.57	47.28
overall mismatch: 0/1 (ESJS1)	-0.032***	-0.041***	-0.043***	-0.031***
	(0.011)	(0.012)	(0.012)	(0.012)
% Bias to invalidate	30.5	44.07	46.29	25.01
overall mismatch: 0-3 (ESJS2)	-0.168***	-0.149***	-0.149***	-0.132***
	(0.021)	(0.021)	(0.021)	(0.022)
% Bias to invalidate	75.84	71.91	71.94	68.28
overall mismatch: 0/1 (PIAAC)	-0.024***	-0.017***	-0.022***	-0.020***
	(0.005)	(0.005)	(0.005)	(0.006)
% Bias to invalidate				50.33
country FE		yes	yes	yes
graduation year FE		yes	yes	yes
country-specific LT		yes	yes	yes
individual controls			yes	yes
job/workplace-specific controls				yes

Note: Reported is only the coefficient of vocational education dummy

Mechanism 1: Early match?

Does the better match appear early in the careers of vocationally graduated workers? ESJS1 (2014)

<i>Dependent variable:</i>	Without controls		With controls	
	(1)	(2)	(3)	(4)
mismatch when starting the current job: 0/1	-0.043*** (0.011)	-0.043*** (0.011)	-0.043*** (0.012)	-0.038*** (0.012)
% Bias to invalidate	49.49	47.28	47.48	39.05
mismatch in previous job: 0/1	-0.017 (0.012)	-0.021* (0.013)	-0.021 (0.013)	-0.022* (0.013)
% Bias to invalidate	28.80	15.23	17.01	14.08
country FE		yes	yes	yes
graduation year FE		yes	yes	yes
country-specific LT		yes	yes	yes
individual controls			yes	yes
job/workplace-specific controls				yes

→ Better match starts earlier in the career of vocationally educated workers

Mechanism 2: Workplace characteristics?

Do the job characteristics as *learning* new things, *training*, or *technological change* at the workplace explain the better match of vocationally educated workers?

overall	ESJS1 (2014)		PIAAC (2012-2015)		ESJS2 (2021)	
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Panel A: Always/usually learning new things:</i>						
	yes	no	yes	no	yes	no
vocational educ.	-0.638 (0.516)	-2.049*** (0.470)	-0.011 (0.009)	-0.024*** (0.007)	-0.110*** (0.022)	-0.246*** (0.079)
% Bias to invalidate	36.86	55.02	37.92	38.71	60.26	39.54
Observations	8728	8905	6979	12798	9387	1082
<i>Panel B: Technological change in the last 5 years:</i>						
	yes	no	yes	no	yes	no
vocational educ.	-0.532 (0.476)	-1.828*** (0.470)	n.a.	n.a.	-0.108*** (0.028)	-0.137*** (0.029)
% Bias to invalidate	42.95	49.57			50.45	59.21
Observations	8035	9598			4237	6226
<i>Panel C: Training at the current job:</i>						
	yes	no	yes	no	yes	no
vocational education	-0.873** (0.412)	-1.127** (0.565)	-0.008 (0.009)	-0.028*** (0.007)	-0.130*** (0.029)	-0.122*** (0.035)
% Bias to invalidate	7.35	1.79	56.86	48.00	56.71	43.65
Observations	9188	6054	7581	11884	5624	4845

Mechanism 3: Self-reporting?

Is the better match due to differential self-reporting on skill match of vocationally graduated workers? **PIAAC (2012-2015)**

<i>Dependent variable:</i>	Without controls		With controls	
	(1)	(2)	(3)	(4)
numeracy, self-reported: 0-5.376	-0.052*** (0.012)	-0.031** (0.014)	-0.035** (0.014)	-0.035** (0.014)
% Bias to invalidate				20.97
numeracy, actual-JAM: 0-5	0.012 (0.012)	0.013 (0.015)	0.008 (0.015)	0.003 (0.015)
% Bias to invalidate				98.94
literacy, self-reported: 0-6.353	0.008 (0.012)	0.015 (0.014)	0.018 (0.014)	-0.006 (0.014)
literacy, JAM: 0-6	-0.015 (0.012)	-0.007 (0.015)	-0.012 (0.015)	0.005 (0.016)

- no actual measure of overall mismatch available
- Based on numeracy: some (weak) evidence on differential reporting of skill match between vocationally and generally educated workers

Outlook on further mechanisms

»» Education-employment linkages (EEL)

e.g., Bolli et al. (2018); Eichhorst et al. (2015)

- **Apprenticeship** countries:

Austria, Denmark, Germany, Luxembourg

- Countries with a high share of **work-based learning** (in addition to apprenticeship countries):

Czech Republic, Hungary, Poland Slovakia, Slovenia, UK (OECD)

»» **Quality** of vocational education: Education expenditures per vocational student (*OECD, Education at a Glance, 1999-2024*)

→ High expenditure countries (>10,000 USD per student): Austria, Belgium, Germany, France, Luxembourg, Netherlands, Sweden, UK

»» Societal **recognition** of vocational education

(Cedefop, 2016; UNESCO-UNEVOC, 2018; Billett, 2020)

Conclusions

- »» We find **better overall skill match** (= lower overall skill mismatch) for vocationally educated workers in three representative skills surveys across European countries
- »» Our **exploration into mechanisms** of this primacy leads to
 - Better match happens early in the career **»» and stays**
 - Effect driven by vocationally educated workers in jobs that encompass less training, less learning, and at workplaces without much technological change, but does not hold in the post-COVID era
 - Differential perception of match could be a partial explanation
 - There is no clear pattern in self-reported match in skill domains **»» Results for skill domains**
 - Remain to be explored: education-employment linkages, vocational education quality, and societal recognition
- »» Thank you!

Auxiliary Slides

ESJS1 survey questions used for mismatch variables

- **current: 0-100:** 100 - q20b
q20b: Rate your level of skills needed to do your job as well as possible: 0 need to develop all of your skills and 100 have all the skill
- **current: 0/1:** 1 if q24=1 or q24=3
q24: Overall, how would you best describe your skills in relation to what is required to do your job? My skills are higher (1)/lower (3) than required by my job
- **at start of current job: 0/1:** 1 if q30 =1 or q30 =3
q30: When you started your job with your current employer, [q24]
- **in previous job: 0/1:** 1 if q46 =1 or q46 =3
q46: When working in your previous job, ... [q24]
- **in skill domains: 0-5:** $\text{abs}(5 - \text{q22b}_3) / \text{abs}(5 - \text{q23b}_3)$
q22b/q23b: How would you best describe your skills? 0: My level of skill is a lot lower than required, 2, 3, 4, 5: is matched to what is required, 6, 7, 8, 9, 10: is a lot higher than required.

ESJS2 survey questions used for mismatch variables

- **overall: 0-3:** based on q60 (skill utilization)
To what extent can you use your current knowledge and skills in your main job?, defined on the scale 0 to 3 (0 great extent, 1 moderate extent, 2 small extent, 3 not at all, i.e. larger values mean larger mismatch)
- **ICT skills: 0-3:** based on q61 (need for skill development)
To what extent do you need to further develop your computer/IT skills to do your main job even better?, defined on the scale 0 to 3 (0 great extent, 1 moderate extent, 2 small extent, 3 not at all, i.e. larger values mean larger mismatch)
- **further 3 skill domains: 0/1:** based on q62_ = yes
Do you need to further develop any of the ... skills to do your main job even better?, yes/no

PIAAC survey questions used for mismatch variables

- **overall: 0/1:**
Dummy that takes the value 1 if the respondent affirms either of the two statements: 1. I am not challenged enough at work. 2. I need more training.
- **numeracy, literacy, problem-solving and ICT skills:**
We use the first plausible value of the skill level and standardize it. On the skill need side we use a series of questions about the frequency of using different relevant skills at work and standardize it. The mismatch is then calculated by contrasting the respondents skill level with the job's skill needs.
- **actual skills:** based on JAM method (Pérez Rodríguez et al., 2024) *difference between skill assessment and expert scoring for the ISCO 08 4 digit level occupations*

Dealing with selection into vocational education

Unobserved ability impacts decisions to pursue a vocational degree. It may confound with the effect of VET on mismatch. Solutions:

- Large set of further control variables ✓
 - Country & year FEs, country specific linear time trends ✓
 - Individual FEs (e.g. Schweri et al. 2020): not available, our data are cross sectional
 - Use of instrumental variable: VET enrollment rates (e.g. Aepli et al. 2021; Tobback et al. 2023): not enough variation and only available since 1999
- % bias necessary to overthrow the effect (e.g. Frank et al. 2023) ✓

Effect of vocational education in skill domains

ESJS1 (2014) Dependent variable:	Without controls		With controls	
	(1)	(2)	(3)	(4)
literacy	-0.046 (0.041)	-0.097** (0.040)	-0.110*** (0.040)	-0.098** (0.042)
foreign language	0.034 (0.045)	-0.018 (0.042)	-0.031 (0.043)	-0.033 (0.044)
customer-handling	0.091** (0.041)	0.057 (0.041)	0.051 (0.042)	0.061 (0.042)
communication	0.147*** (0.035)	0.118*** (0.036)	0.103*** (0.037)	0.088** (0.036)
numeracy	-0.008 (0.040)	-0.007 (0.041)	-0.024 (0.040)	-0.002 (0.041)
ICT	0.122*** (0.037)	0.123*** (0.038)	0.105*** (0.038)	0.123*** (0.039)
specialized technical	0.193*** (0.034)	0.231*** (0.036)	0.215*** (0.036)	0.180*** (0.037)
problem-solving	0.076** (0.035)	0.100*** (0.035)	0.089** (0.035)	0.062* (0.036)

Note: Reported is only the coefficient of vocational education dummy

Mismatch by graduation years

