



# **Skills mismatch, earnings and job satisfaction among older workers**

**Research paper  
FACTAGE – WP 3.1**

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# **FACTAGE**

## Preface

This report was written by Senior Researchers of Statistics Austria, which is one of five members of the FACTAGE project consortium. FACTAGE is a project funded in the framework of the first call of the Joint Programming Initiative 'More Years, Better Lives' ('Extended Working Life and its Interaction with Health, Wellbeing and beyond').

FACTAGE is funded nationally by the Austrian Federal Ministry of Education, Science and Research.

This report is the first in a series of two reports to be produced in FACTAGE Work Package 3. Its subjects are the differences in skill level and skill use at work between two age groups (25-49, 50-65). We analyze how older workers (50-65) utilize their skills in the workplace compared with the younger ones and the effects of over- or underutilization of skills on earnings and job satisfaction.

This report was reviewed internally (within the FACTAGE project consortium) by the National Institute of Economic and Social Research (NIESR).

## Abstract

Skills are viewed as a major ingredient of knowledge-based economies. Individual level skills can support labor market success and can influence earnings and job satisfaction. But skills must be used in an efficient way to generate these positive labour market outcomes.

In this paper we analyze differences in skills and skills mismatch between younger (25-49) and older workers (50-65). The focus of our empirical research is on the analysis of the PIAAC dataset for five countries - Austria, Germany, Spain, Belgium (Flanders) and the UK (England and Northern Ireland).

We find that older workers have in general lower skills than younger workers but overutilize their skills more. So the potential risk to lose their skills would be higher for younger workers with less (skill) demanding jobs. The relationship between age and skill utilization is still significant in all countries except England and Northern Ireland when controlling for many other variables in a multiple regression analysis.

Our analysis shows similar effects of skill mismatch on income as in prior studies. Skill overutilization leads in general to a wage premium compared to well matched workers. Skill underutilization results in a wage penalty.

We observe that in some countries skills are more overutilized than in others, and that some countries underutilize a large pool of skills. These national differences can be partly explained by different national skill formation systems and different institutional settings, though the influence of these national differences on skills, skill mismatch and their relationship to labor market outcomes is at this point not clear.

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## Keywords

Skills, skill use, skill mismatch, literacy, numeracy, age, PIAAC

## Introduction

Skills are viewed as a major ingredient of knowledge-based economies. Individual level skills can support labor market success and can influence earnings and job satisfaction (Hanushek, Schwerdt, Wiederhold, Woessmann 2014). But skills must be used in an efficient way to generate these positive labour market outcomes. If this is not the case skill mismatch occurs. This means that workers do not meet the skills required at their workplace (under-skilled / overutilization) or on the other hand have higher skills than needed (over-skilled / underutilization).

In this paper, we look at differences between two age groups (25-49, 50-65) with regard to their skill levels and their skill use at the work place. We analyze how older workers (50-65) utilize their skills in the workplace compared with the younger ones. And what are the effects of over- or underutilization of skills on earnings and job satisfaction.

The focus of our empirical research is on the analysis of the PIAAC dataset for the five countries that participate in the European FACTAGE (Fairer Active Ageing for Europe) project: Austria, Germany, Spain, Belgium and the UK.

The PIAAC dataset offers the opportunity to measure skill mismatch in a comparable way in different countries. PIAAC provides recent data on basic skills and skill use (literacy, numeracy, problem solving in technology rich environments) as well as an extensive set of background variables.

In a further step we look into the question how national differences concerning the skill utilization of older employees can be explained against the backdrop of various national “skill formation systems”.

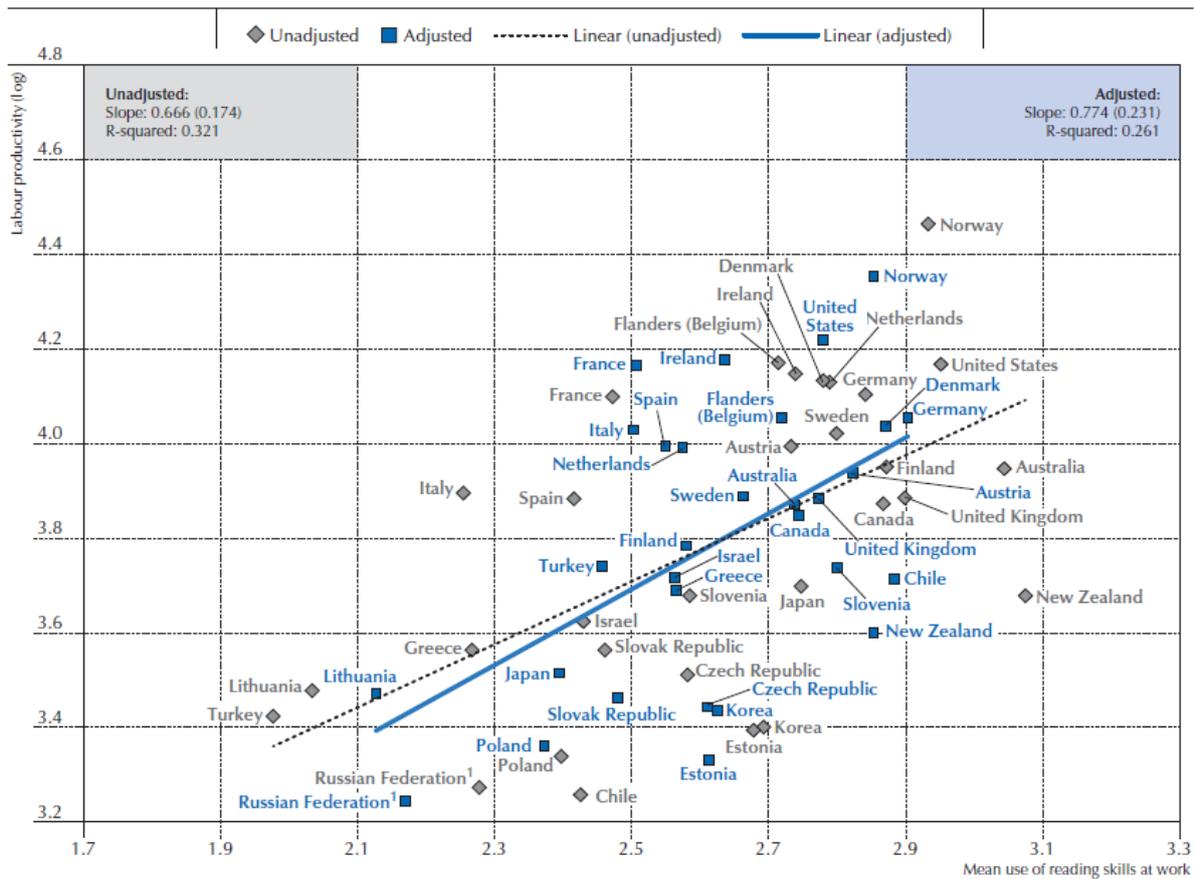
## Theoretical background

### Skill mismatch and labour market outcomes

Workers who use their skills more often tend to have higher wages and more effective skill use is also connected with higher job satisfaction and employee well-being (OECD 2016a, p 100). But sometimes skills are not used efficiently – i.e. when workers face a mismatch between skill use and skill level in their job. So skill use and skill mismatch could be a stronger determinant of wages and productivity than the actual skill level of a person.

Figure 1 shows the correlation between the use of reading skills at work and labour productivity (output per hours worked). The positive relationship between skill use and labour productivity remains strong even after adjusting for literacy and numeracy skills, which shows the importance of skill use when explaining productivity.

Figure 1: Labour productivity and the use of reading skills at work



Notes: Lines are best linear predictions. Labour productivity is equal to the GDP per hour worked, in USD current prices 2012 for Round-1 and 2014 for Round-2 countries/economies. Adjusted estimates are based on OLS regressions including controls for literacy and numeracy proficiency scores. Standard errors in parentheses.

Source: OECD 2016a

Allen and van der Velden (2013) developed a new skill mismatch measure that relates skill level to skill use (see also skill mismatch measures in the section “empirical approach”). They define all individuals with a much higher skill use relative to one’s own skill level as “overutilized” and individuals with a much lower skill use than expected according to their skill level as “underutilized”.

In general, they conclude that higher skill utilization is beneficial in terms of productivity and job satisfaction<sup>1</sup>. On average across all participating countries, they observe that literacy underutilization is associated with a wage penalty of around 11%, and overutilization with a wage premium of around 7%<sup>2</sup>. So overutilization of skills points more towards a fuller use of the available human capital. Underutilization on the other hand points to not reaching the full potential.

Their empirical findings also show a correlation between underutilization of literacy skills and age. Younger individuals tend to underutilize their literacy skills more than older ones. However, this correlation is not statistically significant in all observed countries. Among the 5 FACTAGE-countries only Austria and the United Kingdom show a significant correlation between age and literacy underutilization. The correlation between numeracy utilization and age, in general, is weaker and only in a few countries statistically significant.

<sup>1</sup> Allen et al (2013) use in their analysis the PIAAC-datasets for 22 countries.

<sup>2</sup> The corresponding figures for numeracy are 4% and 5%.

Their explanations for the higher underutilization level by younger workers are that workers might take more demanding tasks when growing older and take up more responsibility.

Perry, Wiederhold and Ackermann-Piek (2014) systematically compare existing measures of skill mismatch with regard to their implications for labor market outcomes. They run their analysis with PIAAC-data for Austria, Germany and the United States and use only numeracy skills. They conclude that over skilled (underutilized) workers suffer a wage penalty and under skilled (overutilized) workers receive a wage premium. But these general wage implications of being mismatched differ widely between the various skill mismatch measures. Furthermore a detailed analysis of the correlation between age and skills mismatch is still missing.

## Research questions

In order to receive a detailed picture of the skill mismatch level, we focus on the skill use and the skill utilization of older workers compared to younger ones for the five countries of the FACTAGE-project (Austria, Germany, Belgium, Spain, UK).

Our starting point was the assumption that older workers risk their skills not being fully utilised in the workplace and that this has a negative effect on earnings and job satisfaction. What are the differences in skill level, skill use and skill utilization for the two age groups (25-49, 50-65) in Austria, Germany, Belgium, Spain and the UK? To what extent do older workers utilize their skills at work?

We also focused on a better understanding of the effects of skill utilization on different labour market outcomes and also on the effects that drive skill utilization.

Which factors influence skill utilization? Does age have a relevant effect when controlling for gender, education and other variables?

What are the effects of over- and underutilization on wages and job satisfaction?

In a further step, we attempted to explain national differences concerning the extent of skill mismatch of older employees and the effects of over- and underutilization against the backdrop of various national "skill formation systems". This means that the contribution of the formal education system on the one hand and workplace learning opportunities in companies on the other hand differ with regard to the actual skill level of employees between countries and these divergent national skill systems have, therefore, to be taken into account when conducting cross-national skill mismatch analyses.

## Empirical approach

The aim of the paper is to compare the skill mismatch level for two age groups within and between the five FACTAGE-countries. Therefore we first calculate the age specific proportions of matched and mismatched workers by each country. In the next step we analyze the determinants of skill mismatch, before we focus on the relation between skill mismatch and some labour market outcomes – namely hourly earnings and work satisfaction. In the following section the methodology used for these analyses is described in detail.

## Data

Data from the Programme for the International Assessment of Adult Competencies (PIAAC; OECD 2016) provides the opportunity to measure skill mismatch in a comparable way in various countries. PIAAC gathers broad information on basic skills (Literacy, Numeracy, Problem solving in technology rich environments) and on the use of these skills at work for adults aged 16 to 65. PIAAC is a cross sectional survey conducted in over 30 countries. The data was collected in 2011/12 with a sample size of approximately 5.000 persons (16 to 65) per country.

For this paper the PIAAC data from Austria, Germany, Belgium (Flanders), Spain and UK (England, Northern Ireland) was analysed and we used literacy and numeracy skills<sup>3</sup> and the corresponding information on skill use.

## Skill mismatch measures

This analysis uses skills mismatch or skill utilization as the variable of interest when examining labour market outcomes and not qualification mismatch. The two constructs should be carefully distinguished (Allen, van der Velden 2001). A person can be over-qualified, but at the same time be appropriately matched regarding his or her skill level – after all skills can depreciate over time if not used. On the other hand skills can also be acquired outside the schooling system, which can lead to adequate utilization while being under-qualified.

The analysis of skill mismatch is difficult, because different measures can lead to different results regarding the correlation between skill mismatch and labour market outcomes (Perry et al 2014).

Our skill mismatch analyses are based on an adjusted version of the skill mismatch measures suggested by Allen et al. (2013). The measures developed by the authors represent the extent of skill use relative to the skill level. The method used by the authors to derive skill mismatches is quite simple. First, they standardize the first plausible value<sup>4</sup> of the literacy and numeracy scale respectively. In a second step, they construct scales to examine skill use. For literacy use they averaged twelve items included in the background questionnaire to indicate literacy use at work – for numeracy use six numeracy use items were averaged (for detail see also Annex 2). Afterwards they standardize the skill use scales to make them comparable to the skill level scales, before they subtract each standardized skill use measure from the corresponding standardized skill level measure. The resulting measures are metric scales which link skill level and use with each other. In the following these metric scales will be referred as relative utilization measures. Allen et al. (2013) define all individuals with a score below -1.5 as overutilized – respondents with a value greater than 1.5 are defined as underutilized (see also Figure 2). Respondents which are neither over nor underutilized are considered as well matched. Contrary to the measure suggested by Allen et al. (2013) we did not use only one single plausible value for our analysis, what would lead to biased

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<sup>3</sup> The PIAAC skills test is usually administrated in the main national language of a country (e.g. German for Austria)

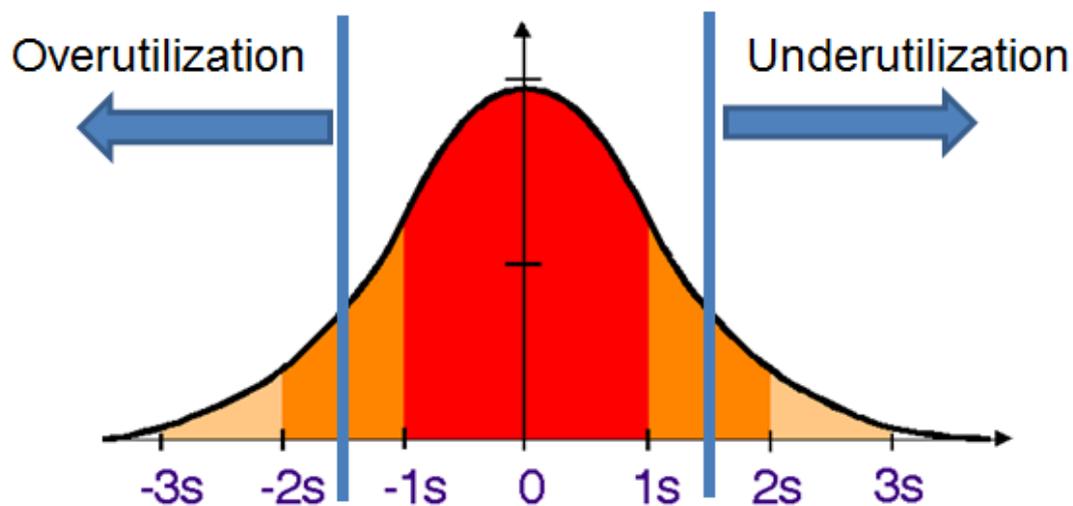
<sup>4</sup> Plausible values (PVs) are a statistical means to replicate a probable score distribution that summarizes how well each respondent answered a small subset of the assessment items; and, how well other respondents from a similar background performed on the rest of the assessment item pool. Each individual case in the PIAAC dataset has a set of ten PVs for each proficiency domain (literacy, numeracy, problem solving in technology-rich environments), and all ten PVs must be used together to estimate proficiency. (see also AIR-PIAAC-Newsletter; [https://static1.squarespace.com/static/51bb74b8e4b0139570ddf020/t/54e773d7e4b0328389a39b36/1424454615327/WorkingWithPIAACData\\_022015.pdf](https://static1.squarespace.com/static/51bb74b8e4b0139570ddf020/t/54e773d7e4b0328389a39b36/1424454615327/WorkingWithPIAACData_022015.pdf) )

estimates. Instead we repeated the above procedure for all plausible values to account for imputation variance and derive unbiased estimates.

We performed our skill mismatch analysis on a restricted sample. PIAAC-Respondents, who were younger than 25 years of age, who were not in paid employment, or who specified their status as pupil, student, or apprentice were excluded from the sample.

For the restricted group we constructed our adjusted skill mismatch measure using pooled data from all countries. If we assume that skill level and skill use scales are comparable between countries, this allows us cross-national comparisons of skill mismatch and its relation to labor market outcomes.

Figure 2: Skill mismatch measure (Allen et al. 2013)



## Regression Analysis

Possible determinants of skill mismatch were examined by regression analyses. For every FACTAGE-county one regression analysis was performed. The relative utilization measure served each time as the dependent variable. The following independent variables were considered as possible determinants:

- Age: Using two broad age groups to differentiate young and mid-age respondents (< 50) from older respondents (50+).
- Gender.
- Highest formal education: distinguishing between the following categories: Lower secondary or less (ISCED 1,2, 3C short or less), Upper secondary (ISCED 3A-B, C long), Post-secondary-non-tertiary (ISCED 4A-B-C) and Tertiary (ISCED 5A-B/6).
- Educational-Mismatch: Respondents, who reported to hold a lower qualification than actually needed for the job (self-assessment) were categorized as undereducated – persons with a higher qualification as overeducated. Those, who reported to have the same qualification as required were classed as matched. Again the above mentioned educational attainment categories were used for this classification.

- Native Language: Test language is the same as native language versus test language is not the same as native language.
- Occupational classification of respondent's job: Distinguishing between skilled occupations, semi-skilled white-collar occupations, semi-skilled blue-collar occupations and elementary occupations.
- Economic sector of respondent's job: private versus public/non-profit sector.
- Amount of people working for employer: Categorized in four categories: 1-10, 11-50, 51-1000 and 1001+
- VET: Indicator distinguishing between vocational and general education (only derived for respondents with secondary education)<sup>5</sup>.

So we simultaneously estimated the relationship between skill mismatch and a number of characteristics by regression analysis. We don't maintain causality between skill utilization and all used independent variables, but we argue similar to Allen et al. (2013) that the used characteristics refer to group differences, which are interesting in itself for policy makers.

The relation between skill mismatch and labour market outcomes were also examined by regression analysis. Labour market outcomes (namely job satisfaction, which was measured through a five point likert scale, and logarithmised hourly earnings<sup>6</sup> reported by workers) functioned as dependent variables - the relative utilization measures as independent variables. The above mentioned characteristics which served as independent variables at the prior analysis were used in this context as control variables. For the regression on earnings, age in years instead of age in broad categories was used. To account for positive but diminishing returns of age on earnings additionally a quadratic polynomial in age was added to the model. In economic research such a model is called a Mincer-type regression model (Mincer, 1974).

## Results

### Skills, skill use and skill mismatch in the FACTAGE-countries – Descriptive results

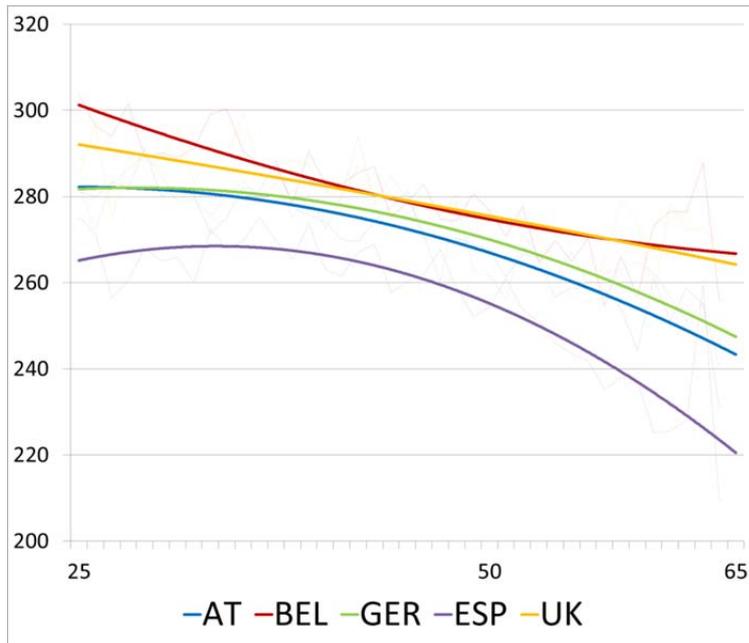
Literacy skills and also numeracy skills are decreasing with age in all 5 countries. This pattern is very similar in Belgium, Germany, Austria and Spain – although on a different absolute skill level. In England and Northern Ireland there is a slightly different pattern. Skills are also decreasing by age but not as pronounced as in the other countries. Figure 3 and figure 4 show the age-skills-profile of 25 to 65 year old employed persons in the different countries. The decrease of skills can be explained by a cohort effect or/and an age effect. So the expansion of education and/or educational reforms can increase the potential skill level of younger cohorts. But also a cognitive decline can have an effect on the skill level of older people. The cross sectional design of PIAAC does not allow to disentangle the two effects. Only longitudinal data would provide a clearer picture.

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<sup>5</sup> It should be noted, that the reference category of the VET variable is “non secondary” respectively “non stated”. The categories were merged to avoid sample exclusions. Furthermore in the case of Germany it was not possible to include the variable in the model due to collinearity problems with the highest formal education variable.

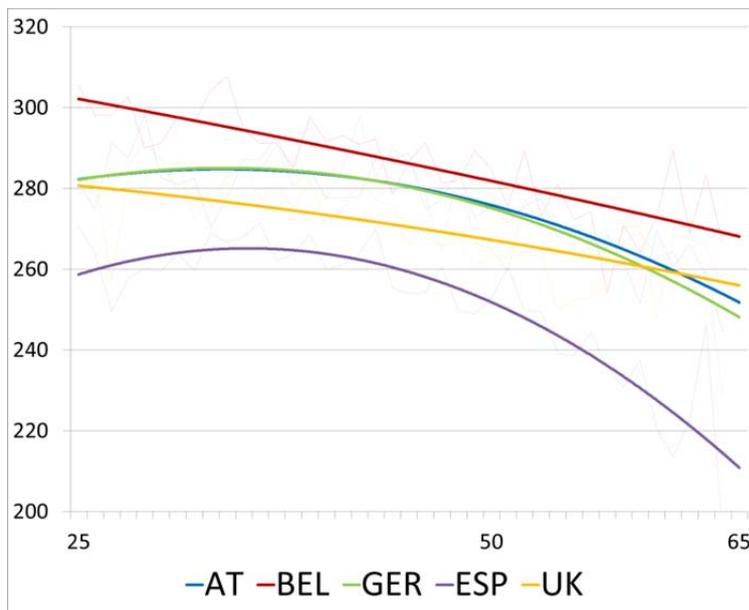
<sup>6</sup> To bypass any possible outlier bias the highest and lowest 1% of reported earnings were trimmed.

Figure 3: Literacy skills by age in the 5 Factage countries (only currently employed persons)



Source: PIAAC 2012

Figure 4: Numeracy skills by age in the 5 Factage countries (only currently employed persons)



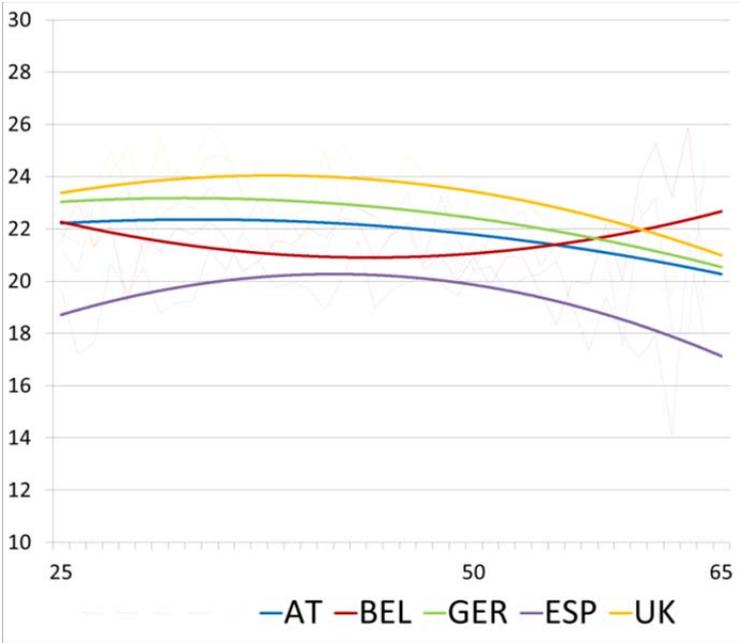
Source: PIAAC 2012

### *Skill use at work*

The relationship between literacy skill use and age does not point to a clear trend (see Figure 5). In most countries there is a little peak of skill use between the age of 35 and 45, and also older individuals (50-65) tend to use their skills a bit less, but the differences are small. The trend in Belgium looks a little bit different. Here the older workers tend to use their skills a bit more.

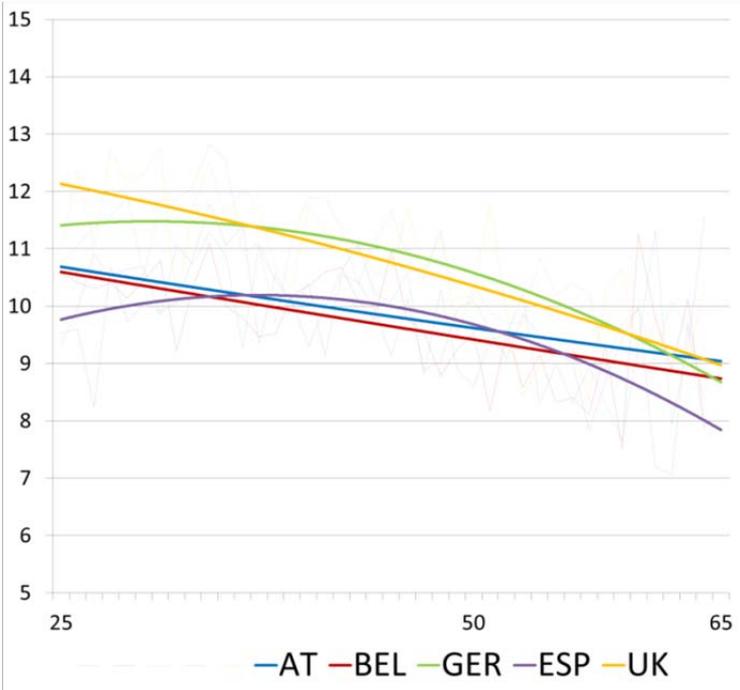
The use of numeracy skills shows a consistent relationship with age. In all observed countries older workers use their numeracy skill less often at their workplace than younger ones (see Figure 6).

Figure 5: Literacy skill use by age in the 5 Factice countries (only currently employed persons)



Source: PIAAC 2012

Figure 6: Numeracy skill use by age in the 5 Factice countries (only currently employed persons)



Source: PIAAC 2012

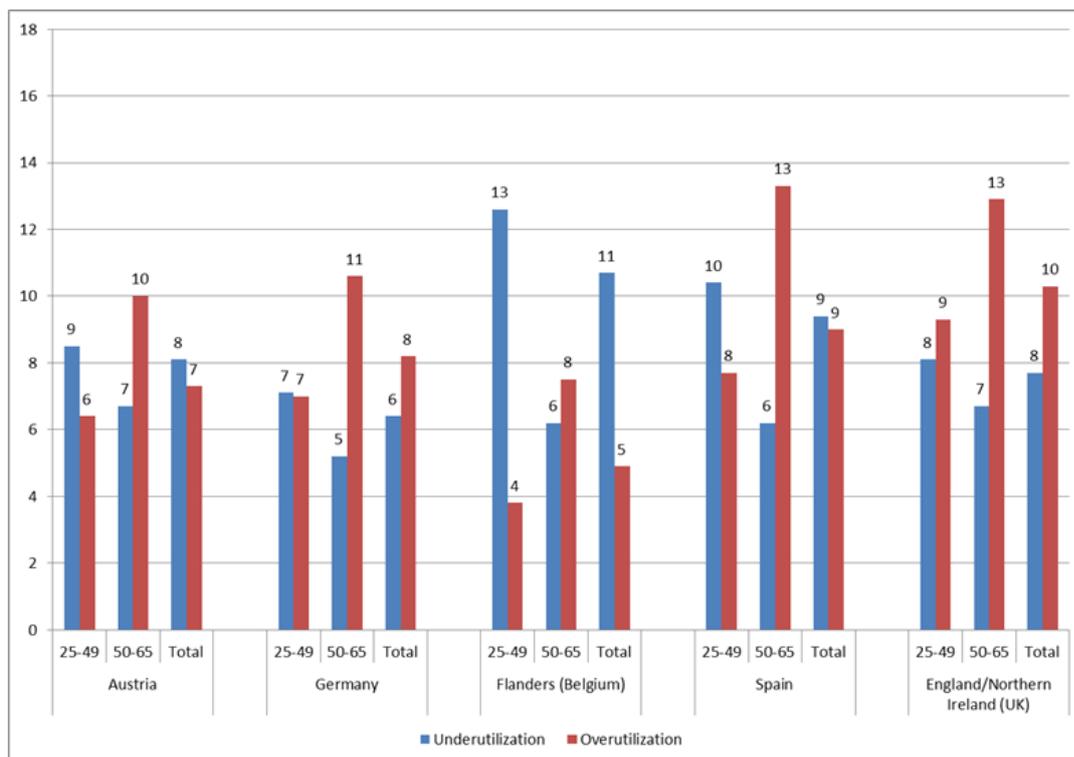
## Skills mismatch

In the next step, we combine data on skills and skill use to look at skills mismatch. Literacy mismatch in our analysis is the respondent's mismatch regarding the "ability to understand, evaluate, use and engage with written texts in order to participate in society, achieve one's goals, and develop one's knowledge and potential" (OECD 2016a).

The percentage of matched workers (adequate utilization of literacy skills) is quite comparable between countries, ranging from around 85% in Austria, Germany and Belgium to around 82% in Spain and the UK. The underutilization of literacy skills is highest in Belgium with 11% and lowest in Germany with 6% (see Figure 7 or Table 8 in Annex 1). Overutilization of literacy skills is highest in England/Northern Ireland with 10% and lowest in Belgium with 5%.

But one clear trend can be observed in all countries: Older workers (50-65) tend to overutilize their literacy skills more than younger workers. The highest percentage of older workers overutilizing their skills can be found in Spain (13%) and in England/Northern Ireland (13%). The lowest in Belgium with 8%.

Figure 7: Literacy under- and overutilization (25-49, 50-65) in the 5 Factice countries

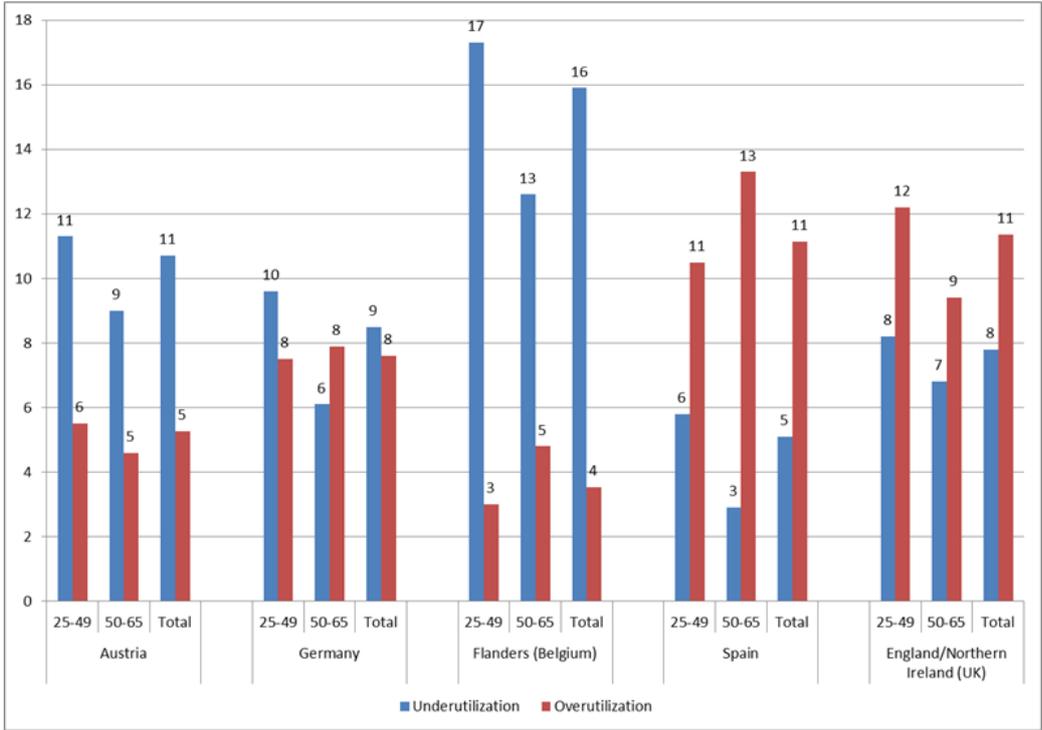


Source: PIAAC 2012

The percentage of matched workers (adequate utilization of numeracy skills) is also quite comparable between countries, ranging from around 84% in Austria, Germany and Spain to around 81% in Belgium and the UK. The underutilization of numeracy skills (see Figure 8 or Table 9 in Annex 1) is highest in Belgium (16%) and lowest in Spain (5%). The overutilization of numeracy skills is highest in England/Northern Ireland and in Spain (both around 11%) and lowest in Belgium with 4%.

The relationship between utilization and age is less clear and less significant when looking on numeracy skills. In Austria and England/Northern Ireland the overutilization of numeracy skills is even lower for the 50 to 65 year old workers compared to the younger ones.

Figure 8: Numeracy under- and overutilization (25-49, 50-65) in the 5 Factage countries



Source: PIAAC 2012

**Country profiles**

Our analysis shows the highest rate of underutilization for literacy and numeracy in Belgium (Flanders). The underutilization rate for literacy for the 25 to 49 old is up to 17%, which points to a less effective use of skills and possible negative effects on productivity and on the skills itself. Older workers in Belgium tend to overutilize their skills more than younger ones – especially in Literacy.

In England and Northern Ireland the percentage of well matched persons in Literacy and Numeracy is a bit lower than in the other countries, and the overutilization rate is quite high in comparison to the other countries (10% in Literacy and 11% in Numeracy), which points to a better use of the available human capital or probably a lack of available human capital. Older workers show a higher overutilization rate only in Literacy.

Spain has a quite similar profile to England and Northern Ireland. Here we observe high overutilization rates in Literacy (9%) and in Numeracy (11%). Older workers in Spain overutilize their skills in both domains (Literacy and Numeracy).

Germany and Austria show a slightly higher rate of well matched workers. In Germany, older workers overutilize their skills in Literacy and Numeracy – in Austria only in Literacy. The rate of underutilization in Numeracy in Austria is quite high compared to the other countries.

## Effects on skill utilization

To get a better understanding of the relationship between skill utilization and age, we have to look at multivariate models to account for other relevant variables. Is there a significant relationship between age and skill utilization when also controlling for other variables like gender or education?

The multiple regression model includes the following variables: Gender, Age (25-49, 50-65), native language, educational-mismatch, education, firm size, occupational classification (ISCO), economic sector (private/public), orientation of the education system (VET, general)

Also in the multivariate analysis, there is a significant relationship between age and skill utilization in literacy. Workers aged 50 to 65 tend to overutilize their skills more than younger ones. England and Northern Ireland are an exception, where the age effect is not significant (see Table 1)<sup>7</sup>.

The educational level of a person is not clearly related to skill utilization. But the educational mismatch shows a strong relationship with skill utilization. An underqualified person tends to overutilize their skills and an overqualified person tends to underutilize their skills.

Respondents whose highest completed education is a secondary vocational (VET) qualification show only in Belgium a significantly higher overutilization rate. On the other hand, respondents with a general secondary qualification are significantly underutilizing their skills in Spain and in England/Northern Ireland.

Another relevant variable when looking on skill utilization is the occupational classification. Workers in high skilled jobs tend to overutilize their skills more than workers in low skilled jobs.

A strong gender effect on skill utilization can be observed in Austria. Female workers in Austria tend to underutilize their skills more than men. A smaller gender effect in the same direction is visible in Germany and Belgium/Flanders, but not in Spain and England/Northern Ireland. The language of a person has also an effect on skill utilization. Non Natives, with another native language than the test language, are overutilizing their skills more than Natives.

The effect of part time occupations (less than 35 hours per week) on skill utilization was also examined by the model. Although part time had a significant effect on skill utilization, the other results were quite stable – only the gender effect decreased, because of the close relation between part time and gender. However, we decided to exclude part time as a predictor in the model, because we think that part-time occupation is more a constituent characteristic of skill utilization than a cause of it.

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<sup>7</sup> Looking at the skill utilization in numeracy, we find a significant relationship between age and skill utilization in all countries except Austria and England/Northern Ireland. These results are not reported in this paper, but are available on request.

Table 1: Effects of different variables on skill utilization (literacy), per country

	AT		GER		BEL		ESP		UK										
	B	SE	B	SE	B	SE	B	SE	B	SE									
(Intercept)	-0,16		0,13		-0,24		0,15		0,01		0,12		0,19	*	0,10		-0,20	*	0,11
AGE 50+	-0,19	***	0,05		-0,22	***	0,05		-0,26	***	0,04		-0,30	***	0,06		-0,09		0,06
ED_MISMATCH - overeducated	0,30	***	0,06		0,34	***	0,07		0,19	***	0,07		0,45	***	0,08		0,22	***	0,07
ED_MISMATCH - undereducated	-0,18	***	0,06		-0,17	*	0,09		-0,28	***	0,07		-0,39	***	0,09		-0,15		0,09
ED- Upper secondary	-0,21		0,18		0,14		0,13		0,17	**	0,08		-0,91	***	0,33		0,11		0,08
ED - Post-secondary, non-tertiary	-0,01		0,17		0,37	**	0,17		-0,01		0,14		-1,03	***	0,38		0,57		0,46
ED - Tertiary	0,00		0,11		0,25	*	0,13		0,25	***	0,09		-0,35	***	0,08		0,31	***	0,09
FIRMSIZE - 11-50	0,02		0,07		-0,08		0,07		0,01		0,07		-0,07		0,06		-0,27	***	0,09
FIRMSIZE - 51-1000	0,04		0,06		-0,07		0,06		0,02		0,06		-0,05		0,06		-0,07		0,07
FIRMSIZE - 1001+	-0,01		0,08		0,09		0,08		0,15		0,09		-0,23	**	0,11		-0,23	***	0,08
GENDER - female	0,29	***	0,05		0,14	***	0,04		0,13	***	0,04		0,06		0,06		0,06		0,06
ISCO - Elementary occupations	0,63	***	0,11		0,69	***	0,10		0,49	***	0,10		0,45	***	0,11		0,41	***	0,11
ISCO - Semi-skilled blue-collar occupations	0,53	***	0,08		0,24	***	0,07		0,43	***	0,08		0,27	**	0,10		0,16	*	0,09
ISCO - Semi-skilled white-collar occupations	0,19	***	0,07		-0,06		0,05		0,20	***	0,06		0,06		0,08		0,07		0,06
NATIVELANG - not native language	-0,42	***	0,07		-0,34	***	0,09		-0,47	***	0,11		-0,17	*	0,08		-0,47	***	0,10
SECTOR - public/non-profit sector	-0,11	**	0,05		-0,14	**	0,06		-0,10	*	0,05		-0,05		0,06		-0,07		0,06
VET - general	0,33		0,22										0,66	**	0,33		0,32	***	0,08
VET - vocational	0,01		0,18						-0,22	***	0,08		0,47		0,30		0,06		0,15

Source: PIAAC 2012. \*\*\*:  $p < 0,01$ ; \*\*:  $p < 0,05$ ; \*:  $p < 0,1$

## Over- or underutilization and outcomes

In this section we look at the relationship between skill utilization and labour market outcomes (earnings and job satisfaction)<sup>8</sup>. Our results confirm the commonly found relationship between skills mismatch and earnings (Allen et al. 2013, Perry et al 2014). Workers who overutilize their skills earn a wage premium and the underutilization of skills results in a wage penalty. The amount of the wage premium for overutilization varies between 4% in Belgium/Flanders and 13% in Spain (see Table 2). The wage penalty for underutilization is with 5% also quite small in Belgium/Flanders. In all other countries the wage penalty varies between 11% and 13%. Especially in Spain and England/Northern Ireland we observe a strong relationship between skill utilization and earnings.

When looking at numeracy skills we find similar, but less significant relationships between skill utilization and earnings<sup>9</sup>.

Table 2: Relation between literacy skill mismatch and earnings

	Literacy overutilization			Literacy underutilization			
	B		SE	B		SE	
Austria	0,09	**		0,03	-0,12	***	0,03
Germany	0,07	*		0,03	-0,12	***	0,03
Flanders (Belgium)	0,04			0,04	-0,05	**	0,02
Spain	0,13	***		0,04	-0,13	***	0,03
England/Northern Ireland (UK)	0,11	***		0,03	-0,11	***	0,03

Source: PIAAC 2012. \*\*\*:  $p < 0,01$ ; \*\*:  $p < 0,05$ ; \*:  $p < 0,1$

<sup>8</sup> For details on model specifications and control variables see chapter „Regression analysis“.

<sup>9</sup> These results are not reported in this paper, but are available on request.

Table 3 shows the results of a regression model with skill utilization and job satisfaction<sup>10</sup>. Almost all relationships between skill overutilization and job satisfaction are not significant. There is a significant negative relationship between skill underutilization and job satisfaction only in Belgium/Flanders.

Table 3: Relation between literacy skill mismatch and job satisfaction

	Literacy overutilization		Literacy underutilization		
	B	SE	B	SE	
Austria	-0,23	0,36	0,19		0,26
Germany	-0,15	0,21	0,07		0,24
Flanders (Belgium)	0,00	0,42	0,66***		0,20
Spain	-0,41	0,26	0,30		0,22
England/Northern Ireland (UK)	-0,28	0,23	0,32		0,25

Source: PIAAC 2012. \*\*\*: p<0,01; \*\*:p<0,05; \*:p<0,1

## National skill formation systems and institutional settings

In this section we raise the question how national differences concerning the skill utilization can be explained against the backdrop of various national “skill formation systems” and different national institutional settings.

### Older workers differ between countries

It is important to keep in mind when we talk about 50 to 65 year old workers that this group differs between countries with regard to various characteristics. There are different employment rates ranging from 59% in Belgium to 76% in Germany (see Table 4). Also the educational structure of this group varies from country to country. In Belgium and especially in Spain the share of workers with low education (ISCED 0-2) is higher than in the other countries (see Table 5). These national differences can have an influence on skill utilization and the effects of utilization on earnings, though the theoretical direction of this influence is not clear.

Table 4: Employment rates 2015 per country

	25-49	50-64
<b>Austria</b>	<b>88,7</b>	<b>62,9</b>
<b>Germany</b>	<b>87,6</b>	<b>76,3</b>
<b>Belgium</b>	<b>86,1</b>	<b>59,0</b>
<b>Spain</b>	<b>88,5</b>	<b>66,7</b>
<b>United Kingdom</b>	<b>86,1</b>	<b>72,1</b>
<b>EU 28</b>	<b>86,0</b>	<b>66,5</b>

Source: Eurostat

<sup>10</sup> <sup>10</sup> For details on model specifications and control variables see chapter „Regression analysis“.

Table 5: Education structure of older workers (50-65) 2015 per country

	Austria	Germany	Belgium	Spain	United Kingdom	EU28
ISCED 0-2	14,8%	10,6%	25,5%	47,8%	20,6%	23,6%
ISCED 3/4	55,6%	60,2%	37,1%	21,9%	40,6%	48,4%
ISCED 5-8	29,6%	29,0%	37,4%	30,3%	37,4%	27,7%
Missing		0,1%			1,4%	0,3%
Total	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%

Source: Eurostat

## Different skill formation systems and institutional settings

In order to judge the skill mismatch results in a broader context, it is necessary to shed light on two key institutional frameworks, namely the economic and education system, as those frameworks may influence the national extent of skill level and skill use and therefore, as a matter of consequence, also the skill mismatch level.

When taking a look at the relevance of a national economic system, one must consider that companies must resolve coordination problems in order to succeed – managing industrial relations, gaining access to finance, securing a properly trained workforce or dealing with suppliers and clients (Casey, 2004). A well known study in this context by Hall and Soskice (2001) highlights two ideal-typical models of capitalism (see also table 6): In liberal market economies (LME), firms coordinate their activities through competitive market arrangements. In coordinated market economies (CME) firms rely more on non-market relationships for coordination.

The United Kingdom is a prime example of LME. Corporate finance focuses on the sale of equity shares, requiring managers to be attentive to current corporate earnings. Education and training emphasize general, hence transferable, skills. Inter-firm networks are discouraged by the regulatory structure (i.e., antitrust). Innovations are treated as proprietary, allowing windfall profits to be reaped from new technologies, and putting a premium on being a “first mover”. Against this background, Hoffman (2003) argues that it makes more or less no sense for the workforce to acquire job-related skills beside their general qualifications. Confronted with a “hire and fire” strategy of many companies, it turns out to be more efficient to invest in broader skills to ensure flexibility in the labour market. When Allen, Levels & van der Velden (2013) examined the relationship between national economic system and skill mismatch level in their cross-country skill mismatch study, they conclude that skills may be used more fully, i.e. in direction of overutilization, in liberal market conditions with few institutional or organizational barriers.

Germany and Austria are examples of economies that represent the coordinated market economies (Casey, 2004). Firms have access to “patient capital” through major banks or other corporations. Banks hold seats on the boards of directors and companies are linked through dense business networks. This allows the sharing of technological and organizational know-how. Corporate managers rarely have full freedom to shape corporate strategy as the structure of corporate governance and the dominant business ethos demands consensus decision-making, including labour. Industrial relations are governed by industry-wide coordinated bargaining, equalizing wages across skill-levels (generally at a high level) and encouraging a committed and stable labor force.

On the contrary to the LME, the workforce is more engaged to acquire job-specific skills, because the job security (based on employment protection and labour legislation) is higher and it also minimizes the risk for the employee and employer to lose its investment (i.e. qualification in case of employee and costs in case of employer) by a “hire and fire” strategy (Hall/Soskice, 2001).

Hall and Soskice (2001) assign Spain and Belgium also to the group of countries that represent coordinated market economies. However, the initial education system is different from Austria and Germany, because in Austria and Germany there is an apprenticeship system on a broad level in place, that particularly demands and fosters a close collaboration between the representatives of companies on the one hand (chamber of commerce), the representatives of workforce on the other hand (i.e. chamber of work) and the state authorities in the middle of those two stakeholder.<sup>11</sup>

Spain and Belgium, on the contrary, possess a school-based vocational education and training (VET) system which focuses on providing both basic competencies and broad work-related skills that can be utilized in several occupational fields and branches. However, graduates from those educational pathways usually need some extra-time for on-guided-training at the workplace. Moreover, the entire labor market is not as regulated and stratified as in apprenticeship countries.

Table 6: Overview of various institutional settings

Name of countries	UK	Spain	Belgium	Austria	Germany
Typ of capitalism <sup>1)</sup>	Liberal	Coordinated	Coordinated	Coordinated	Coordinated
Typ of welfare state <sup>1)</sup>	Liberal	Conservative	Conservative	Conservative	Conservative
Labor market policies <sup>1)</sup>	minimum income protection	good income protection	good income protection	good income protection	good income protection
Orientation of the initial education system <sup>2)</sup>	General education system	School-based VET	School-based VET	Apprenticeship VET	Apprenticeship VET
Share of 25-34 year-olds with tertiary attainment (%), 2016 <sup>3)</sup>	52	41	44	40	31
Share of 25-34 year-old low level of education attainment (%), 2016 <sup>3)</sup>	13	35	17	11	13
Expected Skill mismatch level	High	High	Medium	Low	Low

Q: 1) Hall & Soskice, 2001 / Hefler & Markowitsch, 2014, 2) Statistik Austria, 2013, 3) OECD, 2017

The apprenticeship countries (AT and GER) usually comprise of a closely related system between educational pathways and occupational demands. Certain occupations have restricted access, which means that those jobs are restricted to particular educational certificates for being employed. The curricula of these educational pathways are closely coordinated between economic demand and educational supply and focus more on the provision of work-related skills than on general skills (Stöger et al, 2017). Given the close coordination between employment and education system, we expect a higher share of skill match in Germany and Austria compared to the UK.

Belgium has a highly standardized and stratified education system on the one hand and it is characterized as a CME on the other hand. Therefore we would also expect a higher skill match level compared to the UK.

As Spain has an above-average share of lower educational attainment within its population (35% of adults have only a low level of educational attainment) we would also expect a higher skill mismatch level compared to Germany, Austria or Belgium, because many employees need to perform jobs with higher skill demands.

Looking into our empirical results (see table 7), we observe that the various skill match percentages in the five countries are distributed as we have expected it, even though the differences between the figures are very small. Germany and Austria have the highest proportion by 85% respectively 86% share of matched employees, while UK represents the very end of the list with 82%. The difference

<sup>11</sup> Allmendinger (1989) and Muller & Shavit (1998) give a precise overview how levels of standardization and stratification provide different matching opportunities between supply and demand on the labour market.

between Austria and UK and also Germany and UK is statistically significant. As expected, Spain has a lower share of matched people compared to Austria, Germany and Belgium.

When looking into the empirical results of Flisi et al. (2014), who developed various occupational mismatch measures by means of PIAAC data, it is noticeable that their results are largely in line with our findings: Austria and Germany have the highest proportion of well-matched people (38% resp. 39%), while UK (and surprisingly Belgium) show the lowest share of skill match (32%). As Flisi et al. (2014) measured skill mismatch by four indicators with different methods, the absolute figures cannot be compared with our analyses.

Table 7: Share of skill match

<b>Name of countries</b>	<b>UK</b>	<b>Spain</b>	<b>Belgium</b>	<b>Austria</b>	<b>Germany</b>
Share of skill match in % (own calculations)	82	82	84	85	85
Share of skill match in % (Flisi et al., 2014). It refers to those individuals who are not mismatched in any of four indicators developed.	32	35	32	38	39

With regard to age and the share of over- versus underutilization we can observe that the young cohort in UK (25-49) shows the highest share of overutilization (9,3%) among the analyzed countries, while the old cohort (50-65) in UK (12,9%) has the second highest rate of overutilization after Spain (13,2%). As a possible explanation we agree with Allen, Levels & van der Velden (2013) and assume that the dominance of a particular institutional setting in the UK (liberal capitalism, flexible labor market and a general education system) may be beneficial for an overutilization of skills. Particularly at the beginning of an occupational career, an open and flexible employment system may offer not-predetermined job opportunities with potentially demanding skill requirements for young employees from various backgrounds, while a highly standardized and stratified system like in Austria or Germany does not foster a flexible (over)-utilization of skills.

## Conclusions

The assumption we were starting with, that older workers underutilize their skills, is not supported by our analysis. It is even the other way around. Older workers have in general lower skills than younger workers<sup>12</sup> but overutilize their skills more. So the potential risk to lose their skills would be higher for younger workers with less (skill) demanding jobs.

The highest rate of underutilization for literacy and numeracy is observed in Belgium (Flanders), which points to a less effective use of skills and possible negative effects on productivity and on the skills itself. In England, Northern Ireland and also Spain the overutilization rates are quite high in comparison to the other countries, which points to a fuller use of the available human capital. The results for England/Northern Ireland are consistent with the expectation that skills are more fully used under competitive market conditions with few institutional or organizational barriers. Germany and Austria show a slightly higher rate of well-matched workers.

The relationship between age and skill utilization (literacy) is still significant in all countries except England and Northern Ireland when controlling for many other variables in a multiple regression analysis. Educational mismatch shows also a strong relationship to skill utilization. An underqualified person tends to overutilize its skills and an overqualified person tends to underutilize its skills. Another relevant variable when looking on skill utilization is the skill level of the job. Workers in high skilled jobs tend to overutilize their skills more than workers in low skilled jobs.

We find similar effects of skill mismatch on income as in prior studies. Skill overutilization leads in general to a wage premium compared to well matched workers. Skill underutilization results in a wage penalty. These effects are relatively high in England, Northern Ireland and Spain. Also in Germany and Austria skill utilization is significantly related to income, in particular the wage penalty for skill underutilization is quite high. The situation in Belgium looks a bit different. Here the relationship between skills mismatch and income is very low or even not significant.

We observe that in some countries skills are more overutilized than in others, and that some countries underutilize a large pool of skills. These national differences can be partly explained by different national skill formation systems and different institutional settings, though the influence of these national differences on skills, skill mismatch and their relationship to labor market outcomes is at this point not clear.

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<sup>12</sup> This can be caused by age effects (e.g. cognitive decline) and cohort effects (e.g. years spent in education or quality of education)

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## Annex 1

Table 8: Literacy skill mismatch

		Underutilization	SE	Adequate utilization	SE	Overutilization	SE
Austria	25-49	8,5	0,8	85,0	1,1	6,4	0,9
	50-65	6,7	1,2	83,3	1,7	10,0	1,3
	Total	8,1	0,7	84,6	1,0	7,3	0,7
Germany	25-49	7,1	0,7	85,9	1,0	7,0	0,8
	50-65	5,2	0,9	84,3	1,5	10,6	1,4
	Total	6,4	0,5	85,4	0,8	8,2	0,7
Flanders (Belgium)	25-49	12,6	0,9	83,5	1,0	3,8	0,5
	50-65	6,2	1,1	86,3	1,7	7,5	1,1
	Total	10,7	0,7	84,4	0,8	4,9	0,4
Spain	25-49	10,4	0,9	82,0	1,2	7,7	0,7
	50-65	6,2	1,5	80,5	2,4	13,3	2,0
	Total	9,4	0,7	81,6	1,0	9,0	0,7
England/Northern Ireland (UK)	25-49	8,1	0,9	82,6	1,2	9,3	0,9
	50-65	6,7	1,2	80,4	1,8	12,9	1,5
	Total	7,7	0,7	82,0	1,0	10,3	0,7

Source: PIAAC 2012

Table 9: Numeracy skill mismatch

		Underutilization	SE	Adequate utilization	SE	Overutilization	SE
Austria	25-49	11,3	0,9	83,2	1,0	5,5	0,6
	50-65	9,0	1,3	86,3	1,8	4,6	1,0
	Total	10,7	0,8	84,0	0,9	5,3	0,5
Germany	25-49	9,6	0,9	82,9	1,0	7,5	0,7
	50-65	6,1	1,0	86,0	1,6	7,9	1,2
	Total	8,5	0,7	83,9	0,9	7,6	0,7
Flanders (Belgium)	25-49	17,3	1,1	79,7	1,2	3,0	0,5
	50-65	12,6	1,5	82,7	1,7	4,8	1,0
	Total	15,9	0,8	80,6	0,9	3,5	0,4
Spain	25-49	5,8	0,7	83,8	1,0	10,5	1,0
	50-65	2,9	0,9	83,8	2,1	13,3	1,9
	Total	5,1	0,6	83,8	0,9	11,1	0,8
England/Northern Ireland (UK)	25-49	8,2	0,8	79,6	1,2	12,2	1,0
	50-65	6,8	1,2	83,8	1,7	9,4	1,3
	Total	7,8	0,6	80,8	1,0	11,4	0,8

Source: PIAAC 2012

## Annex 2

To be exact the extend of skill use at work was measured by questions on the frequency of skill use at work. Following table shows item names and content.

scale	item name	Item content	
Literacy	G_Q01a	Skill use work - Literacy - Read directions or instructions	
	G_Q01b	Skill use work - Literacy - Read letters memos or mails	
	G_Q01c	Skill use work - Literacy - Read newspapers or magazines	
	G_Q01d	Skill use work - Literacy - Read professional journals or publications	
	G_Q01e	Skill use work - Literacy - Read books	
	G_Q01f	Skill use work - Literacy - Read manuals or reference materials	
	G_Q01g	Skill use work - Literacy - Read financial	
	G_Q01h	Skill use work - Literacy - Read diagrams maps or schematics	
	G_Q02a	Skill use work - Literacy - Write letters memos or mails	
	G_Q02b	Skill use work - Literacy - Write articles	
	G_Q02c	Skill use work - Literacy - Write reports	
	G_Q02d	Skill use work - Literacy - Fill in forms	
	Numeracy	G_Q03b	Skill use work - Numeracy - Calculating costs
		G_Q03c	Skill use work - Numeracy - Use or calculate fractions or percentages
G_Q03d		Skill use work - Numeracy - Use a calculator	
G_Q03f		Skill use work - Numeracy - Prepare charts graphs or tables	
G_Q03g		Skill use work - Numeracy - Use simple algebra or formulas	
G_Q03h	Skill use work - Numeracy - Use advanced math or statistics		

For each item the five answer options reached from “Never” to “Every day”.