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EDUCATIONAL MISMATCH IN EUROPE AT THE TURN OF THE CENTURY: MEASUREMENT, INTENSITY AND EVOLUTION

RAFAEL MUÑOZ DE BUSTILLO[1]

SUDIPA SARKAR

RAQUEL SEBASTIAN

JOSÉ-IGNACIO ANTÓN

Department of Applied Economics

University of Salamanca (Spain)

ABSTRACT

Purpose. The purpose of this paper is to present the stylized facts of over-education among European graduates over time (1998-2013), paying special attention to the measurement issues.

Design/methodology/approach. The authors use two different sources, the Programme for the International Assessment of Adult Competencies 2012, and the European Union Labour Force Survey 1998-2013, with two different aims. We employ the first one to make a detailed analysis of the different forms of measuring over-education and its implications in terms of the result obtained. The analysis of the second one responds to study the evolution and characteristics of over-education in Europe.

Findings. In first place, the paper provides evidence of the high level of sensitivity of the level of measured over-education to the type of methodology used. Such difference is even higher when we focus on skills *versus* educational mismatch. The work also shows how with all their shortcomings, the measures of over-education used in the analysis point to the existence of convergence in over-education levels among the European countries of the sample (only interrupted by the crisis), in a context of reduction of over-education rates in many countries.

Practical implications. Researchers should be particularly careful when estimating over-education, because of the strong implications in terms of the so different results obtained when choosing between competing methods.

Originality/value. The analysis abound in the implications of the use of different methodologies of estimating over-education in terms of both size and ranking among European countries. The production of long-run and updated estimates of over-education for a large sample of countries using a homogenous database and different estimation methods.

Keywords. Over-education, Europe, mismatch measurement, higher education, skills, gender, age.

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[1] Corresponding author: Rafael Muñoz de Bustillo. E-mail: bustilo@usal.es. Address: Departamento de Economía Aplicada, Facultad de Derecho, Campus Miguel Unamuno, s/n. 37007 Salamanca (Spain). Phone: +34 923 294500 ext. 3125. We thank two anonymous referees for comments on an earlier version of the manuscript. Financial support of the Eduworks Marie Curie Initial Training Network Project (PITN-GA-2013-608311) of the European Commission's 7th Framework Programme is gratefully acknowledged. José-Ignacio Antón also thanks the financial support from the NORFACE research project 'GIWeS-Globalisation, Institutions and the Welfare State'.

Paper type. Research paper.

1. Introduction

The existence of a potential gap between workers' educational attainment and the "skills" actually used at their jobs has been a major concern of social scientists since the 1970s. There is a large body of literature highlights the implications of the gaps between the jobs' education requirements and the workers' actual educational attainment.[2] Under-education can have a negative impact on the aggregate output, as either high-productivity jobs remain vacant or they are filled with workers whose performance in those jobs is lower than optimal. Over-education, a much more common situation that is the focus of this article, might have very relevant consequences as well. For the economy as a whole, it means that part of the time and resources used in education is not effectively employed in the production process, which diminishes the societal rate of return of these investments. At the worker's level, the literature suggests that over-education has negative effects on wages—therefore, lowering returns to education— and job satisfaction, being a potential source of turnover and frustration. As argued by Borghans and Grip (2000), the pervasive presence of this phenomenon in the European labour markets questions the policy of promotion of further investment in education of many developed countries (including the European Union, EU) to improve competitiveness.[3]

The contribution of this paper to the existing literature on over-education and mismatch is associated with the measurement of these phenomena across the European Union during the period 1998–2013. Exploiting the Programme for the International Assessment of Adult Competencies (PIAAC) and the European Union Labour Force Survey (EU-LFS), it aims to present a detailed outlook of over-education in Europe employing different methodological approaches (realized matches, job analysis, skill mismatch and subjective assessment) and focusing on different demographic groups (females, young and old workers, foreigners). Our work makes two contributions. The first

[2] See the excellent surveys of Sloane (2003), McGuinness (2006), Leuven and Oosterbeek (2011) and McGuiness *et al*. (2018).
[3] See, for example, chapter I of the *Innovation Union Competitiveness Report 2013* (European Commission, 2014).

one is presenting a detailed assessment of over-education across Europe and from 1998 to 2013. Even if most of the issues covered in our article have been analysed in previous works, we use different methodologies that are applied in a homogenous way (using the same indicators and targeting the same groups of workers) to different databases, which allows the reader to compare the performance of different approaches without resorting to other studies with methodological differences. In the second place, we emphasize the use of different methodological approaches and database: particularly, we also employ the job analysis approach for assessing over-education, almost absent in most of the recent studies.

The rest of the work unfolds in five sections as follows. The second section presents a brief literature review focused on the most relevant and recent comparative studies and those dealing with the implications of using different measures. Section 3 reviews alternative ways to estimate mismatch, using either objective methods or instruments based on workers' self-assessment and based on either education or skills. In the fourth section, we describe the main databases employed in our analysis, the Programme for the International Assessment of Adult Competencies (PIAAC), carried out by the Organisation for the Co-operation and Economic Development (OECD) and the European Labour Force Survey (EU-LFS), a data source based on national surveys and administered by Eurostat. Section 5 presents and discusses the main results of the analysis in two different areas: the impact of the method of estimation of mismatch on the results regarding tertiary over-education in 30 European countries and the evolution and characteristic of over-education. The last section summarizes the main conclusions of the paper.

2. LITERATURE REVIEW

As mentioned above, the mismatch between the educational attainment and skills of workers and those actually required for performing their jobs have been a topic of interest since the pioneering works of Freeman (1975) or Duncan and Hoffman (1981). The literature has rapidly expanded since then in several directions: the quantification of the phenomenon under different methodologies, the individual and aggregate determinants of mismatch and the consequences of this issue on workers' labour market outcomes. In

parallel, an impressive number of studies at the national level have appeared in the academic literature and this topic has become a source of concern for international organisations like the EU and the OECD. The excellent surveys of Hartog (2000), Sloane (2003), McGuinness (2006), Leuven and Osterbeek (2011), Quintini (2011) and McGuiness *et al*. (2018) cover systematically most of this literature. These comprehensive reviews suggest that the methodology for measuring education and skill mismatch matters, yielding low correlations between the incidence using different methodologies. However, the impact of overeducation on labour market outcomes seems to be quite consistent, irrespective of the method employed.

Nevertheless, comparative cross-country studies or explorations of the evolution of the incidence of mismatch or over-education over time are scarcer. With the exceptions of Huber *et al*. (2010), Muñoz de Bustillo and Antón (2012) and Landesmann *et al*. (2015)—all of them focused on the incidence of over-education among foreign workers in the EU—, the bulk of this comparative research literature employs the realised matches and subjective approaches. As it is explained in more detail in the next section, these methodologies are based on workers' perceptions and the representative skill or education level by occupation, respectively. The so-called job analysis approach (based setting the educational requirements of occupations considered as appropriate before) is almost missing in those works. The body of comparative research employs multiple data sources: the EU-LFS (Huber *et al*., 2010; European Commission, 2012; McGuinness *et al*., 2015, 2017 and 2018; Boll *et al*., 2016b), the European Union Statistics on Living Conditions (Davia *et al*., 2017), the European Community Household Panel (Wasmer *et al*., 2007), the European Social Survey (Aleksynska and Tritah, 2013), the Adult Education Survey (Nieto *et al*., 2015), the PIAAC (Flisi *et al*., 2017; Pellizari and Fichen, 2017), the REsearch into employment and professional FLEXibility data (Verhaest and van der Velden, 2013; Meroni and Vera-Toscano, 2017), the Higher Education as a Generator of Strategic Competences data (Verhaest *et al*., 2017; Ortiz and McGuinness, 2018) and large multi-country web surveys (Visintin *et al*., 2015). Overall, these works suggest the existence of many differences in the incidence of over-skilling and over-education across countries, with the influence of economic and household variables far from having a constant impact across Europe. This previous evidence also points out (again) to different patterns of over-

education across countries over time rather than not a common trend, although it is worthy to highlight the existence of convergence in over-education rates. A low demand of highly educated workers, the labour market share of foreign-born workers, a low quality of education, the employment protection (but only for women), the oversupply of highly skilled labour and an academic and or general orientation of the educational system are some of the factors that are found to be positively correlated with over-education at the aggregate level. The main message of studies using the PIAAC data is that education and skill mismatch are clearly different phenomena.

As mentioned in the introduction, this work aims to contribute to the existing literature on the measurement of over-education and mismatch. First, although we cover a large number of topics analysed by previous works, we make use of a homogenous and comparable methodology allowing comparing the performance of the different approaches and databases. Secondly, among the different methodologies used for exploring over-education, we also employ the job analysis approach, almost missing in the recent empirical studies. In this respect, our results reveal the existence of substantial differences depending on the methodology applied.

3. MEASUREMENT OF EDUCATIONAL AND SKILL MISMATCH

Before proceeding with our analysis of mismatch in Europe, it is important to reflect on the concept of mismatch, with emphasis on over-education, and the different approaches of measurement. When social scientists talk about employment match, or mismatch, they are thinking about the correspondence (or lack of it) between the productive capabilities of the worker and the demands of the job. Often such productive capabilities are expressed in terms of educational needs/requirements, although it is not uncommon to refer to them in terms of skills requirements. In this regard, it is important, firstly, to differentiate between skills and knowledge (usually coded in educational levels), the former related to the ability of using knowledge and applying it in a given context. As argued by Organisation for Economic Co-operation and Development (OECD, 2013), although related, "*direct measures (skills) and educational qualifications do not appear to measure the same*

underlying traits" (p. 105), nor should we expect similar results when measuring one or the other.

There are two general approaches to measure the level of correspondence between productive capabilities of the employee, proxied by his or her level of educational attainment, and the educational level required to perform that job properly (Leuven and Oosterbeek, 2011). The comparison of existing and required level would in turn allow classifying a given employee as over-educated, matched or under-educated.

The first approach, of an objective nature, consists in comparing the actual level of education of the workers with an objective measure of the education needed. Two strategies have been used to operationalize this approach. According to the first one, known in the literature as *job analysis* (JA), a systematic evaluation of the tasks performed in a given occupation is done in order to assign a skill/educational level to each occupation. According to the JA approach, those workers doing that job with more or less level of education than the level required for that job are considered as over- or under-educated, respectively.

Professional job analysts evaluate the job titles of the occupational classification and decide the required level of qualification and skills needed to perform the tasks under the job. A well-known example is the Dictionary of Occupational Titles (DOT) of the US, which contains an indicator for educational requirements in the form of the General Educational Development scale.[4] However, these sorts of detailed catalogue of skills and occupations are not available for many countries. Therefore, researchers often have to resort to some of the simplified objective approaches proposed, like the ones suggested by the OECD (2007) or the International Labour Organization (ILO, 2012). The latter approach, which we follow in this paper, considers three different types of occupations based on their skills requirements (according to the International Standard Classification of Occupations, ISCO), which are matched to the educational levels (according to the International Standard Classification of Education, ISCED) as showed in Table 1.[5]

[4] DOT was replaced by the O*Net in 1998
[5] The one suggested by the OECD (2007) is very similar but based on ISCO-88. It is used, for example, by Muñoz de Bustillo and Antón (2012) and we employ it when using the EU-LFS

Table 1. Mapping of ISCO-08 levels to ISCED-97 levels of education.

ISCO-08 skill level	ISCED-97 levels of education
Managers, Professionals, Technicians and Associate Professionals	Second stage of tertiary education, first stage of tertiary education
Clerical Support Workers, Services and Sales Workers, Skilled Agricultural, Forestry and Fishery Workers, Craft and Related Trades Workers and Plant and Machine Operators, and Assemblers	Post-secondary non-tertiary education, upper secondary level of education, lower secondary level of education
Elementary Occupations	Primary level of education

Source: ILO (2012).

The second strategy, known as *realized matches* (RM), is of a statistical nature and consists in defining the required education level as a function of a measure of central tendency of the educational level of the workers, job, comparing afterwards the education of the employees with such benchmark. This approach considers the fact that there is a distribution of required level of education for a particular occupational group. Therefore, it

estimates the required level of education using a central tendency measure of the distribution. The mean or the modal level of education is used as the required level of education for the job. One considers that there is educational mismatch if the actual education of the worker is greater than this threshold.[6]

In this paper, based on databases that include education as a categorical variable coded using the ISCED classification, we use the mode of education by occupation as the "required" level of education for each job. This approach has an a priori assumption of symmetry between over- and under-education. The critiques have suggested using mode rather than mean to estimate the required level of education given the asymmetry between over- and under- education if measured by mean level of education (Mendes de Oliveira *et al.,* 2000). In addition, the mode is less sensitive to outliers as well as technological changes (Sloane, 2003). Aiming to evaluate the sensitivity of the results to the use of the median or the mode, we employ both approaches in the analysis. However, this approach is suitable for measuring educational mismatch rather than measuring skill mismatch. Measurement of skill mismatch needs particular information on individual skills and abilities in their current job.

The third approach -of a subjective nature and known in the literature as *self-assessment* (SA) approach- consists in asking the workers about the educational requirement set by the firm to get the job or the level required for this job according to their view and to compare it with their actual level of education. A variation of this approach is to ask workers directly whether they are over-educated, under-educated, or matched. Finally, another way is to ask them if they are using their skills sufficiently in the job or if they require more training to cope up with the tasks performed in the job. These questions are more important to estimate the skills mismatch, something that is completely different from educational mismatch. Recent literature has largely relied on worker's self-assessed approach, particularly, for skills mismatch (Dolton and Vingoles, 2000; Green and Zhu, 2010; Boll *et al*., 2016a).

[6] If the variable capturing the level of education is accurate and continuous –like years of education-, one can use the average years of education plus one or two standard deviations.

In this research, we compute two indicators that we can only apply to one of our databases (the PIAAC). The first measure is based on the comparison between the level of education required for the job according to the worker and the actual level of education – being the worker over-educated if the latter is higher than the former- (SA1). The second measure (SA2) is linked to skills and considers that a worker is over-skilled- if he or she reports to have the skills to cope with more demanding duties than those required in his or her current job. It also considers that he or she does not need further training in order to cope well with his or her present duties.[7] In this case, it is more precise and appropriate to talk about over-skilling than over-education. It is worth mentioning that the EU-LFS does not include any variable that allows implementing any subjective approach. Hereafter, we use the term over-education to refer to all the definitions with the exception of SA2. More details on the specific variables used to operationalize these definitions are provided in Section 4.

Finally, it is worth mentioning here that, given that in the EU-LFS, for the most part of the analysed period, there are only three educational categories for many years (low, medium and high education), the analysis focuses on individuals with higher education.

4. DATABASES

In this work, we make use of two different databases that include information on education and labour market characteristics. The first one is the Round 1 of the Programme for the International Assessment of Adult Competencies (PIAAC), a survey carried out by OECD in 24 countries in 2012. The main aim of this survey is to provide an analysis of the level and distribution of skills being used at the workplace. The data sample contains 166,000 observations of adults aged between 16 and 65 years old. Around a third of the people reports high education. The survey includes an assessment of skills and information on the personal and labour market characteristics. Particularly, it includes information on the educational background and occupation and the workers are asked whether their education and skills are appropriate to perform their current job. In order to apply the JA approach and the RM approach, we use the usual variables of occupation (coded through the ISCO

[7] Regarding this issue, it is worth mentioning that, according to the PIAAC, a majority of workers report that the level of education required by the firm is actually the one they think is required for the job.

classification) and education (available through ISCED). In order to implement the definitions of over-qualification (over-education and over-skilling, respectively) using the SA1 and SA2 methodologies, we resort to the following three questions:

— "*Still talking about your current job: If applying today, what would be the usual qualifications, if any that someone would need to GET this type of job*?"
— "*Do you feel that you have the skills to cope with more demanding duties than those you are required to perform in your current job?*"
— "*Do you feel that you need further training in order to cope well with your present duties?"*

As mentioned, the first question is used for the SA1 definition, while a worker is considered as over-skilled using SA2 if he or she responds positively to the second question and negatively to the third one.

The second source of data of this research is the European Labour Force Survey (EU-LFS), administered by Eurostat. It consists in a compilation and homogenization of national labour force surveys carried out by the European statistical authority. In this research we focus on the data from 1998 to 2013, period where we can find the required degree of detail in the information on workers' occupational status variable and there is no substantial methodological (e.g., a new occupational classification) change in the variables of interest. It includes information of the labour market status of more than 1.5 million individuals in the 28 European Union countries, Switzerland, Norway, Iceland, Turkey and Macedonia. The last three countries and Malta (with the variable occupation only available at the 1-digit level) are not included here. Specifically, this data source contains information on the personal and labour market characteristics of individuals, including education and occupation, coded through ISCO-88 and ISCED-97, respectively. Overall, in each year, the EU-LFS contains around 1.5 million observations, with around one third with high education.

As mentioned, given the limitations of the education variable in the EU-LFS (coded into three categories for a large part of the analysed period), we focus only on employed

individuals between 16 and 65 years old with higher education. Data are processed using Stata 14.2.

5. RESULTS

5.1. COMPARING DIFFERENT METHODOLOGIES

Although as it often happens in economic analysis, the availability of data leaves very few degrees of freedom when choosing the type of indicator, we consider important to explore to what extent using one or other indicator can lead to different conclusions in terms of the quality of the matching process. In order to see the level of consistence of the different matching indicators we look at the results from the application of different definitions (reviewed above) to the PIAAC survey. For space reasons, we circumscribe the analysis to over-education (or over-skilling in the case of SA2) hereafter.

This database allows us to compute four different types of mismatches for 17 EU countries or territories, Norway, Russian Federation, South Korea and Japan. We present the incidence of over-education (and over-skilling) only for the people with tertiary education (Table 2). This allows us to compare the results of the different countries without interferences due to the different composition of the labour force in terms of educational attainment. According to the JA approach, the percentage of over-educated workers varies from 12 to 47%, Norway being the lowest in the incidence of over-education and Korea being the country with the highest share of over-educated workers. When using the RM approach based on the mode, it is remarkable that the range of estimations is wider (17-69 %) and there is a substantial change in the position of countries in the rankings. The selection of the median instead of the mode in the RM approach has a smaller impact on the results with fewer changes of countries in the ranking and a reduction in the range of results (the lowest range in all methods). The SA1 approach reveals lower levels of over-education compared to the RM. Last, the incidence of over-skilling (SA2) is very high in this approach. For instance, around 70 % of employees in England and Northern Ireland report to have the skills to cope with more demanding duties than those they consider required to perform in their current job and do not need further training in order to cope

well with their present duties. Table 3 shows the correlations between the incidence of over-education (and over-skilling in the case of SA2) at the individual level under the different alternatives for measurement. It becomes clear that not only are the results obtained using different methodologies quite different, but the pairwise correlation between the indexes is almost non-existing, with the exception of the two different cases of the RM approach.

A glance at these results is enough to realize that the methodology used to measure over-education matters in terms of the intensity of the phenomenon. With the exception of Korea and Spain, the difference between the maximum and minimum values estimated is quite large, in the 40-72% range. Another clear result is the strong difference existing in all countries between the indicators of over-education and the indicator based on skills. In this regard, it is clear that when we measure the level of skill match and education match we are measuring to different things.[8] A recent paper by Pellizzari and Fichen (2017) dwells on the issue of the high rates of skills over-qualification estimated from PIAAC, by resorting to a method inspired in the realized matches approach. These authors use the available data of numerical and literacy skills of the workers to calculate the level of over or under-qualification in terms of different skills. When using this metric (comparison of the skills of the workers with the estimated skills requirements), the results change dramatically as regarding both numeracy and literacy skills 75% of workers are considered well matched and only 16% over-skilled.[9] Summing up, the analysis performed shows the high level of sensitivity of the results obtained in terms of the quality of the matching process in the countries of the sample to the type of methodology used for measuring it. This issue should be part of further research and deserve greater attention in the future.

Table 2. Percentage of over-educated and over-skilled workers (with tertiary and more education) according to different methodologies (2012)

[8] In this regard, it is convenient to indicate that the high-recorded levels of over-skilled workers of PIAAC might be specific from this survey. Other sources, such the European Working Conditions Survey 2015, with very similar question ("*I have the skills to cope with more demanding duties*"), offer a much lower percentage of over-skilled workers: an EU average of 29%.

[9] Well-matched workers are those with skills between a minimum and a maximum level defined at the level of the job (occupation or, if allowed by the data, occupation and industry). The minimum and the maximum correspond to the lowest and highest levels of assessed skills of workers who neither feel they could do a more demanding job nor feel the need of further training.

	JA	RM (mode)	RM (median)	SA1	SA2
Austria	16.6	---	---	37.1	38.6
Cyprus	32.5	69.1	63.7	38.6	57.6
Czech Republic	18.3	45.1	55.3	38.6	38.8
Denmark	17.6	60.0	63.2	24.8	61.4
Estonia	26.9	---	---	51.9	40.0
Finland	23.3	---	---	21.0	52.5
France	21.8	52.2	54.2	30.9	55.9
Germany	24.0	45.8	45.4	30.6	38.8
Ireland	35.3	51.9	64.0	47.2	66.8
Italy	18.0	62.9	61.1	30.6	59.1
Japan	43.2	54.0	57.9	50.6	9.4
Korea	46.6	55.9	47.9	40.1	58.1
Netherlands	15.1	53.4	57.4	28.4	64.3
Norway	12.0	44.2	51.6	30.1	57.1
Poland	19.7	22.2	29.1	33.2	33.0
Russian Federation	42.8	16.7	25.3	38.4	57.1
Slovak Republic	14.7	37.5	37.5	30.8	56.7
Spain	36.9	51.1	58.2	39.2	50.9
Sweden	14.2	38.9	62.6	30.8	52.3
England (UK)	35.5	46.6	59.5	41.5	67.7
Northern Ireland (UK)	32.8	42.7	54.1	36.4	72.0
Flanders (Belgium)	19.2	49.2	54.9	18.8	58.9
Total	35.1	41.7	46.6	38.9	44.6

Notes: JA: job analysis; RM: realized matches; SA1: workers' self-assessment regarding the education needed compared to education required; SA2: workers' self-assessment regarding their skills in relation to those required to perform the job. Austria, Finland and Estonia do not contain the ISCO 2-digit classification of current jobs.

Source: Authors' analysis from PIAAC.

Table 3. Correlation between the different measures of over-education and over-skilling at the individual level (2012).

	JA	RM (Mode)	RM (Median)	SA1	SA2
JA	1.000	0.026	-0.076	0.628	-0.055
RM (mode)		1.000	0.822	0.017	0.148
RM (median)			1.000	0.068	0.215
SA1				1.000	-0.341
SA2					1.000

Source: Authors' analysis from PIAAC.

The implications of these wild differences in over-education in the countries of the sample would be of less importance if there was one method clearly superior to the others when addressing the issue of educational mismatch. Unfortunately, it does not seem so. It has been a long debated issue in the literature which of these measures is superior for the measurement of educational and skill mismatch. Nevertheless, the answer is far from clear. In the words of Groot and Maassen van den Brink (2000): "*All of the definitions have their drawbacks and limitations"* (p. 150).

Regarding the JA, this measure does not consider the fact that there can be a distribution of educational requirements for different jobs under a broad occupational category. So, assigning one single level of educational qualification to a particular occupation would lead to over or under estimation of mismatch. Also, the modification of the tasks in an occupation due to technological changes over time may require different skills to perform the job. This phenomenon cannot be captured by this approach unless it is revised timely. Moreover, the utilization of job analysis to derive educational needs of jobs has the problem of being available for a limited number of countries. This can be a problem as educational needs for a given job might be country specific if different countries have different capital-labour ratios, different technologies or even different organization structures. Moreover, such types of analysis are expensive and time consuming to make and as result are not updated as often as it would be desirable (Hartog, 2000). Another disadvantage is the lack of consensus on the conversion of the General Educational Development scale to years of schooling.

The use of RM has been criticized because of the potential impact on the results of the supply side of the market, *i.e.* the overall increase in educational attainment in a given country in a context of little or no structural employment change might lead to a supply driven increase in the modal educational level of many jobs. In such cases, the use of the RM method will interpret such increase in terms of an increase in requirements, even if the jobs are roughly the same and have the same "true" requirements, leading to a misinterpretation (underestimation) of the level of over-education. Figure 1 shows the increase in the share of population 25-64 with tertiary education in the EU27. It represents how such type of dynamic has been present in Europe from 2000 to 2015, with an average

increase of the share of population with tertiary degrees of 54% (and more than doubling in countries such as Austria, Poland or Portugal).

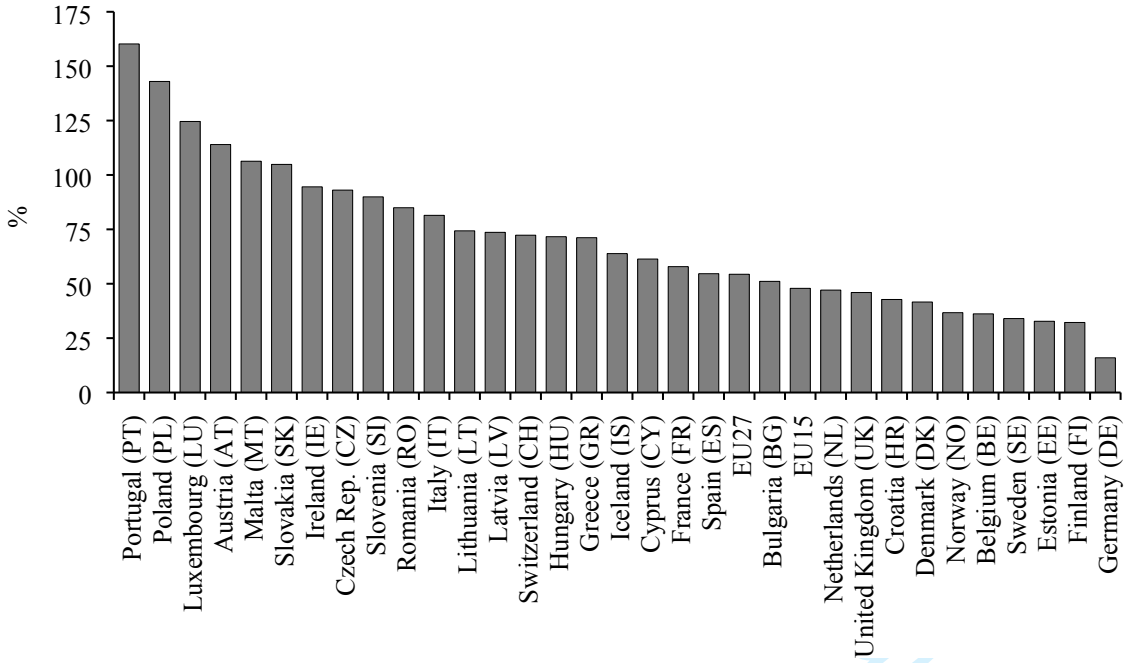
JA and SA share other criticisms such as the issue of considering only the level of education and not the type of education. A worker might be properly matched in terms of the level of education he or she has received but the type of education might be completely different than the one required by the job. [10] In this regard, the literature on mismatch distinguishes between two different types of mismatch: the so-called *vertical* and *horizontal* mismatch. The former refers to the correspondence between the level of education of the worker and the level of education (or skills) required by the job, and the later to the correspondence between the type or field of education of the worker and that required by the job. In this regard, we can have properly matched situations in terms of level, but not in terms of type of field of study and vice versa. Although the approach to the study of horizontal mismatch can employ the same methodologies than vertical mismatch, there are fewer studies on this type of mismatch (Nordin *et al*., 2010), may be due to the higher information requirements. In what follows we will focus on vertical mismatch.

Finally, self-assessed measures have also been criticized on different grounds. In first place, the results are not robust to changes in the way the question is posed, for example, required education to get the job versus needed education to do the job (Green *et al.* 1999). In second place, according to Sloane (2003), SA suffers from the subjectivity problem; some individuals may easily overstate the requirements of their job to raise the status of their position (Hartog, 2000), or they may simply reproduce actual hiring standards. This causes problems if actual schooling levels in the labour force increase over time, and employers adjust hiring standards but the jobs themselves have not changed. In third place, workers might lack of benchmarks against to which judge the educational requirements (McGuinness, 2006). Last, it can lead to conflicting evaluations by workers holding identical jobs and schooling levels (Mendes de Oliveira *et al.* 2000).

[10] One possible way to deal (if partially), with this issue is to consider mismatch at the level of the field of study (when a worker, trained in a particular field, works in another field). According to the analysis of PIAAC data of Montt (2017), around 40% of workers are not matched by field at their qualification level. See also Robst (2007) for the US.

All in all, van der Velden and van Smoorenburg (1997) favour SA approach compared to JA approach, some others (Hartog and Oosterbeek, 1988; Sloane, 2003) have criticised SA approach suggesting that it may lead to an upward bias. In contrast, Sloane (2003) and Hartog (2000) consider JA as the superior method comparing the merits of the three measures. However, as the JA measures are available only for some specific years, so SA measure has been used widely due to the availability of the information. In absence of data related to JA and SA approaches, RM approach has been adopted in some studies.

Figure 1. Growth in the share of population in the age group 25-64 with tertiary education (2000-2015).



Note: Croatia: since 2002; Lithuania and Malta, since 2001; Austria, since 1999.
Source: Authors' analysis from EU-LFS (Eurostat data).

5.2. THE EVOLUTION OF OVER-EDUCATION IN THE EUROPEAN UNION 1998-2013

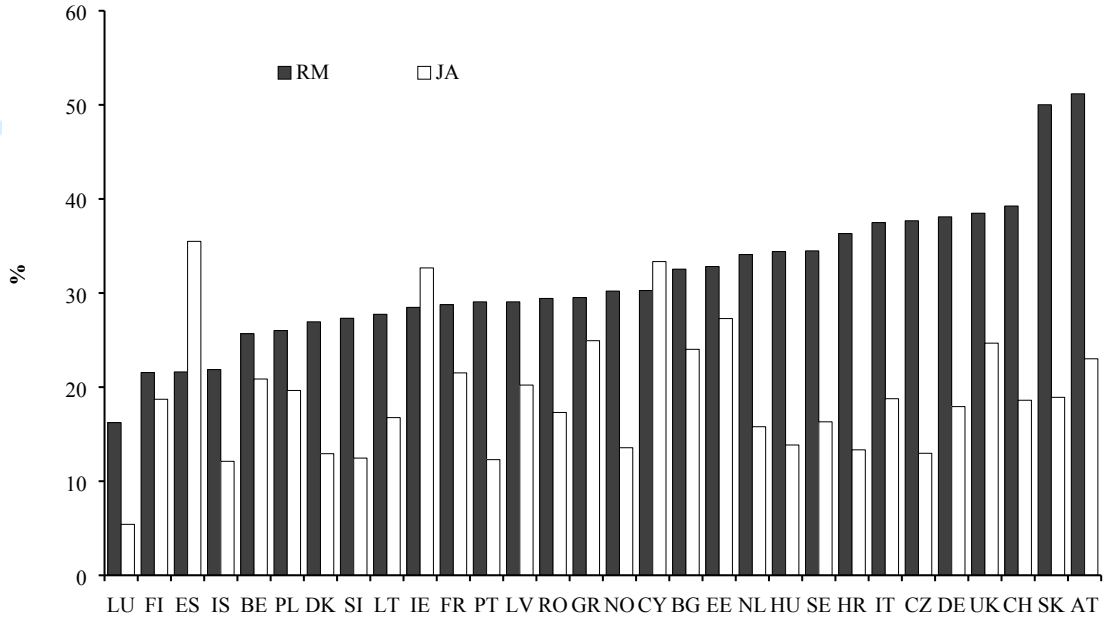
As mentioned above, often, for good or bad, the decision regarding the type of indicator to be used when estimating educational mismatch for a group of countries through time is taken by the availability of data. That is the case when measuring education mismatch in

the long run for a large number of EU countries. For a given year and a large group of countries, as we have seen in previous section, there is a rich source to address the issue of mismatch homogeneously from different angles (PIAAC). The same is true for many countries, but using their own, not necessarily comparable, sources.[11] However, if we want to study the size and evolution of over-education in the EU during a relatively long period of time (1998-2013 in our case) we find ourselves limited to the use of the European Union Labour Force Survey, which allows the estimation of over-education from only two of the above-mentioned methods, the JA and the RM.

Figure 2 reproduces the estimates of the 2013 over-education rate for 30 European countries according to the JA and RM methods. Two things stand out from the analysis of the figure. The first one is the existence of a significant rate of over-education of as much as 32% in average of the country rates according to the RM method, and 19% according to the JA method. The second element worth mention is the high discrepancy between the results obtained by the two methods. In all countries, with the exception of Spain, Ireland and Cyprus, over-education rates according to the RM approach are higher (as much as twice in the case of Luxemburg). Thus, the use of one or other estimation method has profound implications in terms of the intensity of the phenomenon analyzed. This is especially worrisome as the country wise correlation between the two methods is almost non-existing (0.09 for 2013 and 0.07 for the whole period). For this reason, the conclusions drawn from the comparative analysis of the importance of over-education in the different European countries will be quite different when using one method or the other.

Figure 2. Percentage of over-educated workers in 30 European countries according to the JA and RM methods (2013).

[11] See, for example Verhaest and Omey (2010) for the Flemish school leavers in their first job.



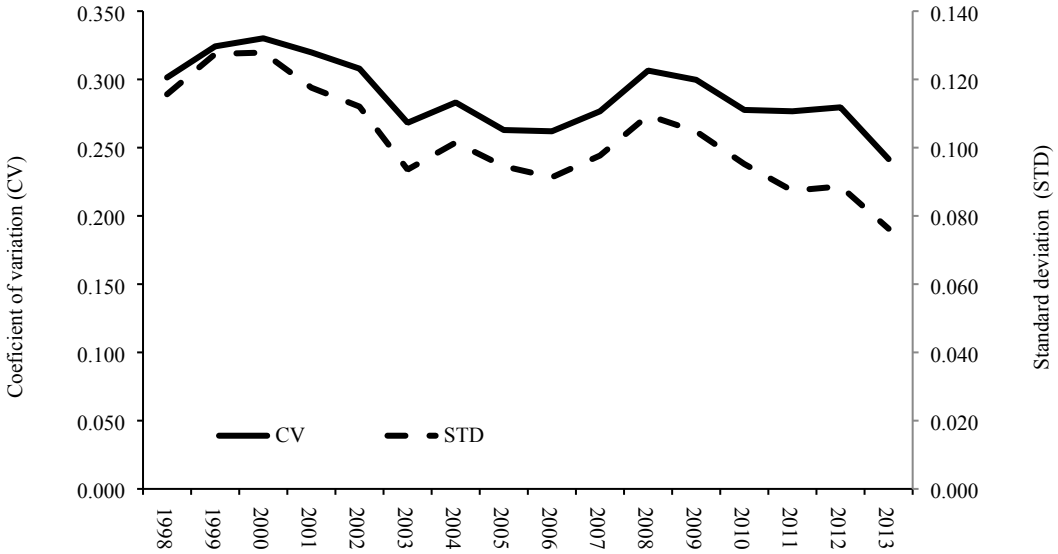
Source: Authors' analysis from EU-LFS.

Another stylized fact of over-education, as measured by the two methods used in this section, is the high level of variation and instability of the estimated rates through time. As we can see in Tables 4 and 5, where we reproduce JA and RM over-education rates, in most cases there are significant year-by-year changes in the rates estimated. Such changes are difficult to explain by changes in the fundamentals behind the rates (changes in the structure of employment and in the educational attainment of labour force), at least in the short run.

This highly unstable over-education rate shown is nevertheless compatible with a general reduction of its incidence according to the RM approach in the period 2000-2013 in most countries. The situation is less clear when looking at the evolution of the JA over-education rates. Thus, we can say with McGuinness *et al*. (2017) that there is not a general pattern of increase in over-education in all European countries. A closer look at the time patter of over-education in Europe shows that there has been a process of convergence of over-education rates during the period, both in terms of absolute and relative distance between the national rates, with the exception of the years of the Great Recession that show

a diverging pattern, probably related with the also unequal impact of the crisis in terms of destruction of employment in the countries of the sample (Figure 3).[12]

Figure 3. Convergence of the incidence of over-education in Europe according to the RM (mode) approach (1998-2013).



Source: Authors' analysis from EU-LFS.

[12] The analysis of the dispersion of over-education rates for the same period using JA method produce similar results in terms of existence of convergence. Similar conclusions are reached when using the RM method with the median.

Table 4. Percentage of over-educated workers in 30 European countries according to the RM (mode) approach (1998-2013)

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
AT	0.507	0.667	0.671	0.655	0.606	0.477	0.576	0.541	0.530	0.527	0.537	0.526	0.520	0.525	0.585	0.512
BE	0.302	0.343	0.294	0.315	0.303	0.321	0.286	0.294	0.304	0.299	0.317	0.312	0.295	0.279	0.249	0.257
BG			0.322	0.372	0.364	0.362	0.370	0.364	0.359	0.356	0.376	0.378	0.393	0.310	0.310	0.325
CH	0.486	0.478	0.484	0.477	0.500	0.496	0.493	0.483	0.482	0.494	0.500	0.500	0.524	0.395	0.384	0.392
CY		0.462	0.469	0.449	0.333	0.332	0.338	0.328	0.322	0.324	0.320	0.326	0.338	0.303	0.282	0.303
CZ	0.610	0.614	0.605	0.586	0.483	0.465	0.461	0.457	0.465	0.490	0.505	0.495	0.428	0.360	0.349	0.377
DK	0.406	0.371	0.376	0.272	0.321	0.304	0.295	0.305	0.312	0.326	0.334	0.328	0.319	0.275	0.266	0.269
DE		0.494	0.503	0.497	0.515	0.488	0.496	0.476	0.463	0.464	0.468	0.470	0.454	0.347	0.373	0.381
EE	0.414	0.527	0.502	0.317	0.491	0.512	0.387	0.353	0.292	0.296	0.363	0.295	0.330	0.330	0.319	0.328
ES	0.375	0.275	0.383	0.383	0.386	0.291	0.375	0.300	0.295	0.273	0.289	0.277	0.260	0.226	0.217	0.216
FI	0.163	0.164	0.231	0.220	0.209	0.210	0.209	0.201	0.249	0.244	0.204	0.202	0.202	0.155	0.162	0.215
FR	0.365	0.371	0.381	0.384	0.390	0.396	0.404	0.405	0.415	0.416	0.436	0.304	0.293	0.377	0.286	0.288
GR	0.308	0.323	0.343	0.336	0.340	0.354	0.336	0.344	0.357	0.363	0.284	0.287	0.281	0.276	0.286	0.295
HR					0.404	0.373	0.385	0.389	0.387	0.403	0.384	0.371	0.363	0.391	0.371	0.363
HU	0.380	0.418	0.402	0.385	0.392	0.376	0.385	0.417	0.414	0.414	0.447	0.434	0.434	0.335	0.348	0.344
IE		0.366	0.268	0.305	0.311	0.322	0.321	0.334	0.345	0.356	0.358	0.348	0.345	0.333	0.274	0.285
IS		0.348	0.264	0.209	0.212	0.271	0.202	0.280	0.223	0.217	0.209	0.271	0.258	0.200	0.233	0.219
IT	0.326	0.330	0.395	0.382	0.392	0.385	0.436	0.467	0.497	0.498	0.505	0.509	0.522	0.470	0.465	0.375
LT	0.285	0.346	0.347	0.308	0.410	0.295	0.378	0.307	0.317	0.290	0.230	0.267	0.190	0.181	0.271	0.277
LU		0.186	0.195	0.206	0.148	0.143	0.225	0.258	0.205	0.174	0.188	0.167	0.235	0.174	0.172	0.162
LV	0.440	0.442	0.596	0.584	0.553	0.411	0.537	0.564	0.402	0.528	0.556	0.514	0.407	0.255	0.267	0.291
NL	0.419	0.417	0.443	0.448	0.446	0.339	0.372	0.390	0.368	0.365	0.377	0.372	0.383	0.343	0.347	0.341
NO	0.507	0.502	0.329	0.328	0.332	0.370	0.356	0.374	0.226	0.220	0.212	0.193	0.199	0.314	0.334	0.302
PL	0.264	0.247	0.221	0.255	0.270	0.278	0.287	0.373	0.383	0.401	0.353	0.359	0.374	0.357	0.351	0.260
PT	0.214	0.209	0.266	0.259	0.225	0.256	0.222	0.254	0.267	0.279	0.318	0.297	0.280	0.273	0.279	0.291
RO								0.260	0.259	0.266	0.268	0.292	0.283	0.241	0.267	0.294
SE	0.350	0.350	0.347	0.273	0.265	0.266	0.267	0.279	0.294	0.300	0.306	0.318	0.330	0.325	0.333	0.345
SI	0.334	0.288	0.307	0.280	0.277	0.273	0.252	0.243	0.274	0.294	0.271	0.270	0.292	0.266	0.281	0.273
SK	0.603	0.594	0.615	0.482	0.441	0.503	0.496	0.492	0.499	0.439	0.533	0.541	0.472	0.463	0.500	0.500
UK		0.483	0.286	0.328	0.236	0.247	0.250	0.256	0.251	0.274	0.266	0.260	0.283	0.395	0.356	0.385

Source: Authors' analysis from EU-LFS.

Table 5. Percentage of over-educated workers in 30 European countries according to the JA approach (1998-2013)

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
AT	0.089	0.221	0.214	0.195	0.209	0.180	0.246	0.213	0.227	0.229	0.227	0.217	0.217	0.231	0.235	0.230
BE	0.215	0.207	0.219	0.207	0.232	0.228	0.216	0.221	0.221	0.220	0.228	0.227	0.223	0.220	0.215	0.209
BG			0.154	0.160	0.167	0.182	0.190	0.186	0.206	0.199	0.200	0.194	0.210	0.224	0.232	0.240
CH	0.213	0.208	0.205	0.225	0.236	0.223	0.234	0.220	0.221	0.224	0.229	0.223	0.227	0.193	0.186	0.186
CY		0.320	0.316	0.314	0.317	0.316	0.322	0.314	0.319	0.321	0.320	0.326	0.326	0.323	0.334	0.333
CZ	0.060	0.059	0.057	0.066	0.068	0.056	0.059	0.057	0.058	0.059	0.075	0.077	0.079	0.120	0.123	0.130
DK	0.139	0.118	0.112	0.107	0.132	0.134	0.135	0.140	0.136	0.144	0.148	0.143	0.144	0.132	0.128	0.129
DE		0.236	0.235	0.231	0.235	0.222	0.225	0.216	0.208	0.209	0.213	0.207	0.200	0.126	0.178	0.179
EE	0.260	0.256	0.240	0.264	0.263	0.274	0.253	0.274	0.258	0.265	0.276	0.255	0.229	0.246	0.269	0.273
ES	0.336	0.345	0.350	0.341	0.348	0.352	0.339	0.356	0.353	0.358	0.334	0.325	0.327	0.352	0.357	0.355
FI	0.226	0.205	0.192	0.177	0.192	0.188	0.188	0.179	0.178	0.180	0.174	0.180	0.176	0.199	0.195	0.187
FR	0.165	0.170	0.179	0.181	0.185	0.186	0.194	0.197	0.207	0.203	0.213	0.215	0.203	0.206	0.203	0.215
GR	0.146	0.177	0.191	0.188	0.175	0.198	0.183	0.183	0.187	0.189	0.199	0.202	0.195	0.238	0.245	0.249
HR					0.126	0.097	0.116	0.112	0.123	0.132	0.113	0.103	0.107	0.130	0.130	0.133
HU	0.084	0.099	0.083	0.096	0.093	0.092	0.093	0.095	0.102	0.104	0.114	0.112	0.121	0.130	0.143	0.138
IE		0.249	0.246	0.253	0.261	0.266	0.273	0.288	0.311	0.328	0.327	0.318	0.311	0.326	0.312	0.327
IS		0.126	0.130	0.097	0.107	0.127	0.119	0.128	0.122	0.110	0.085	0.091	0.089	0.098	0.116	0.121
IT	0.118	0.125	0.141	0.148	0.148	0.158	0.120	0.137	0.139	0.140	0.151	0.155	0.168	0.192	0.195	0.188
LT	0.402	0.414	0.415	0.210	0.223	0.243	0.237	0.240	0.228	0.212	0.201	0.195	0.169	0.155	0.154	0.168
LU		0.034	0.040	0.031	0.023	0.023	0.050	0.048	0.032	0.034	0.040	0.031	0.045	0.047	0.044	0.054
LV	0.168	0.168	0.154	0.181	0.178	0.227	0.197	0.197	0.164	0.159	0.180	0.173	0.164	0.193	0.210	0.202
NL	0.105	0.102	0.114	0.115	0.110	0.108	0.135	0.148	0.133	0.137	0.134	0.135	0.148	0.165	0.164	0.158
NO	0.168	0.164	0.171	0.180	0.180	0.152	0.158	0.155	0.152	0.141	0.134	0.122	0.123	0.135	0.148	0.136
PL	0.073	0.078	0.061	0.085	0.109	0.115	0.119	0.137	0.147	0.155	0.162	0.163	0.176	0.190	0.190	0.196
PT	0.080	0.076	0.097	0.084	0.097	0.113	0.110	0.120	0.120	0.137	0.147	0.138	0.137	0.119	0.121	0.123
RO								0.085	0.087	0.089	0.094	0.110	0.112	0.124	0.145	0.173
SE	0.147	0.147	0.144	0.113	0.111	0.121	0.123	0.136	0.142	0.144	0.148	0.145	0.151	0.159	0.161	0.163
SI	0.068	0.060	0.080	0.067	0.068	0.061	0.068	0.058	0.069	0.076	0.071	0.075	0.087	0.095	0.116	0.125
SK	0.083	0.066	0.072	0.072	0.064	0.082	0.081	0.089	0.087	0.095	0.098	0.093	0.100	0.143	0.173	0.189
UK		0.188	0.191	0.217	0.212	0.214	0.222	0.222	0.217	0.237	0.233	0.233	0.252	0.241	0.237	0.247

Source: Authors' analysis from EU-LFS.

If we focus on the RM approach and classify the countries of the sample in 3 categories -low, medium and high tertiary over-education rates (low, medium and top third of the distribution)-, most countries (Table 6) show reductions in their over-education rates, with only 3 countries: Poland, Romania and the UK presenting growing rates.

Table 6. Evolution of incidence of over-education by country using the RM approach

	Decreasing	Stable	Growing
Low (16.2-27.7%)	LU, ES, IS, BE, DK, SI, LT,	FI, IE	PL
Medium (28.5-36.3%)	FR, LV, GR, CY, EE, NL, HU, HR	SE, PT, NO BG	RO
High (37.5-51,2%)	CZ, DE, CH SK, AT	IT	UK

Notes: Groups defined by position in lower, middle and upper thirds of the distribution. The analysed period is roughly 1998-2013.Stable is defined as a variation under the 10 % with respect to base year +/- 10%.

Source: Authors' analysis from EU-LFS.

This diversity of over-education rates should not come as a surprise when considered against the multiple causality of over-education stressed by the literature, going from supply dynamics (Groot and Maassen van den Brink, 2000) or Employment Protection Legislation (Di Pietro, 2002), to unemployment benefits systems (Verhaest *et al*., 2017) or the economic cycle (McGuinness *et al*., 2018), among others.

Although, theoretically, we should find lower over-education rates as we move up the age cohorts, as time allows both for a better matching (changing firms) and a faster upward mobility of over-educated workers in a given firm, the data shows the existence of a more nuance relation that expected, with different countries showing different over-education-age profiles (Table 7). Three different patterns have been detected from the analysis of the EU-LFS data 2013: a U-pattern (with over-education decreasing with age until mid-age and increasing afterwards); a decreasing shape (according to which over-education decreases with age throughout all the working life) and an L-pattern (with over-education decreasing with age up to a certain point and then remaining relatively stable). Table 7 reproduces the allocation of the European countries of the sample to the three

different patterns and present three canonical examples of such patterns with over-education rates estimated according to the JA method.[13]

Although, according to some theories (Frank, 1978), women are supposed to show greater levels of over-education (lower degrees of freedom when deciding where to work due to higher work-life balance constrains), the picture suggested by the data are far from being clear in this respect.[14] Once again, the type of approach used to measure over-education matters. For 2013, using JA over-education rates is true that women are more over-educated than men in 2/3 of the countries (with a maximum difference in Italy, 175 versus 100 for men). In contrast, when we use RM the result changes, as in 2/3 of the countries women have lower over-education rates. The highest position is now taken by Germany (with 153 versus 100 for men).

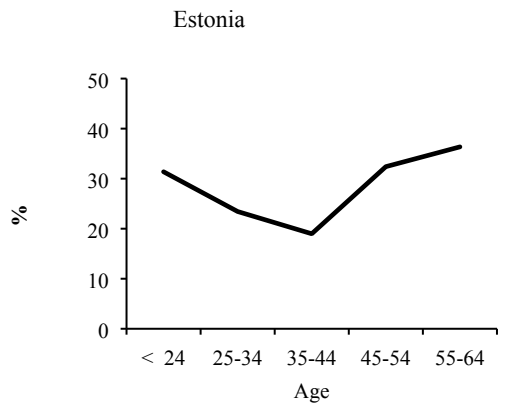
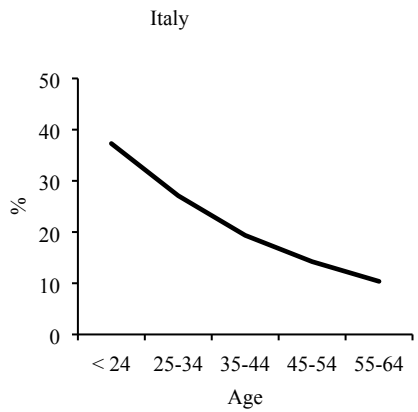
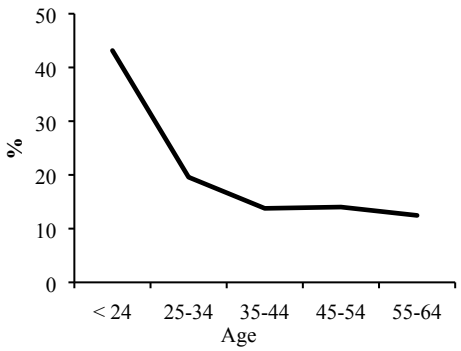
As we can see in Table 8, in most countries the different over-education rates of women and men using the RM approach are not explained by the different gender-age composition of working population. In 10 countries, female over-education rates are lower in all age groups while in other 4 are roughly similar (lower than 10 % difference). Last, only in Germany female workers suffer higher over-education rates regardless of age. In the rest, the incidence of over-education by gender varies between cohorts. A majority combines lower or similar over-education rates depending on the age cohorts. A smaller number combines similar or higher over-education rates depending on the cohorts. That is the case of the UK, with similar over-education rates for younger cohorts and higher for older cohorts.

This result is certainly puzzling, as in most countries the percentage of females with tertiary population in employment is higher than male (23% higher for the EU28). Paradoxically, Germany is one of the few countries where the percentage of females with tertiary education in employment is lower than the percentage of males (8% lower).

[13] In this case, the relation is robust to changes in the method with very few countries showing different patterns as a result of changing estimation method. The detailed results by gender are not presented here because of the scarcity of space but are available from the authors upon request.

[14] For an updated account of the determinants of over-education in a large number of EU countries with the EU-LFS, see Boll *et al*. (2016b).

Table 7. Patterns of relation between rates of over-education and age in Europe (2013).

	Patterns		
	U-shape	Decreasing	L-shape
Countries	Austria, Germany, Denmark Estonia, Finland, Latvia	Belgium, Bulgaria, Cyprus, Spain, France, Greece, Croatia, Ireland, Iceland, Italy, Luxembourg, Portugal, Romania, Slovenia, Slovakia	Switzerland, Check Republic, Hungary, Lithuania, Netherlands, Norway, Poland, Sweden, United Kingdom
Canonical example (2013)			

Source: Authors' analysis from EU-LFS.

Table 8. Female over-education rates compared to male by age cohorts using the RM (mode) approach

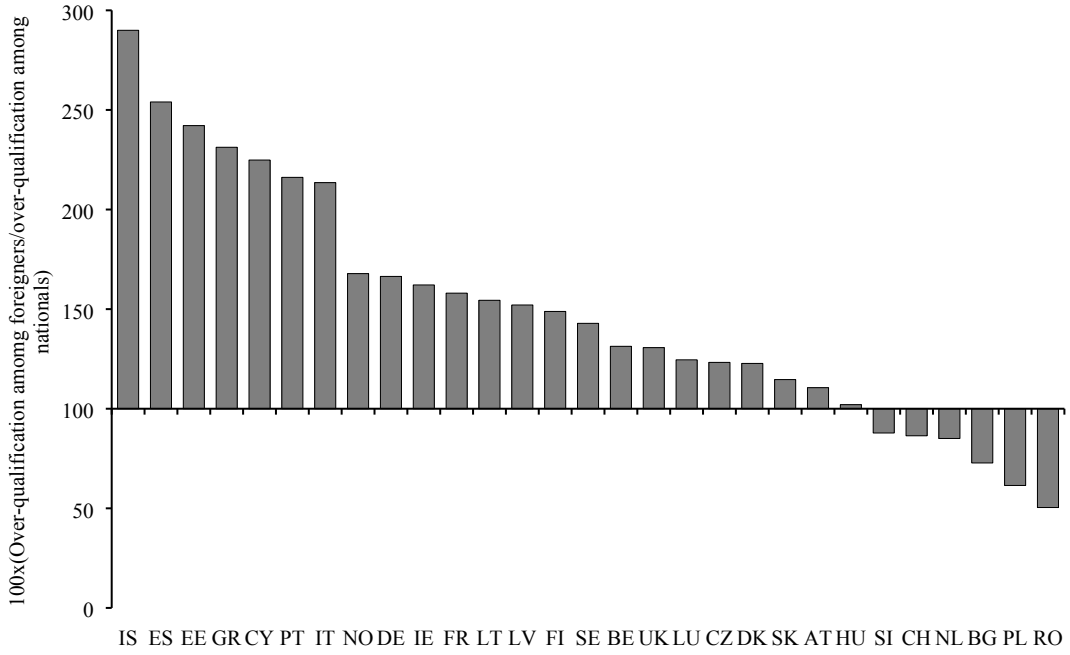
	All	Less tan 25 years old	25-34 years old	35-54 years old	More than 54 years old
Females < Males	AT, BG, DK, GR, HR, NO, SE	BE, CY, FI, CZ, FR, SK,	BE, LT, ES, EE	CZ, FI, LT, LV, PL, SK, ES, EE	CZ, LT, FI, LV, FR, PL, HU, PT, SI, FR, IT, ES, EE,
Females ≈ Males *	CH, IE, RO	LV, PL, SI, UK, IT, HU, ES, EE	CY, FR, IS, LU, LV, NL, PL, PT, SI, SK, UK, IT	BE, IS, LU, SI, FR, PT, IT	BE, IS, SK
Females > Males	DE	IS, LU, LT, NL, PT	CZ, FI, HU	CY, LU, NL, UK, HU	CY, LU, NL, UK

Note: F ≈ M: Less than 10% difference in over-education rates.

Source: Authors' analysis from EU-LFS.

The last item we analyse in our descriptive review of over-education rates according to different variables is the role played by nationality. How are foreigners vis a vis nationals regarding over-education rates? As expected (Muñoz de Bustillo and Antón, 2012), in all but a small number of countries immigrants show higher rates of over-education than nationals (Figure 4). This is especially true for some of the "new" immigration countries such as Spain or Greece where it is not unusual to find RM over-education rates among immigrants twice as high or higher than among nationals and even higher when using JA. In contrast, "classic" immigration countries such as Sweden, France or the UK show lower differentials (around 30-60%).

Figure 4. Over-education among foreigners in Europe according to the RM approach (2013).



Source: Authors' analysis from EU-LFS.

6. CONCLUSIONS

The analysis presented in these pages shows how the estimates of mismatch used in the literature at cross-country level are very sensible to the method of estimation of mismatch and even, within a method, to the year used. Based on PIAAC data, we have seen that the estimation of the incidence of over-education by both objective and subjective approaches differs wildly. Moreover, these differences widen up if we focus our analysis of mismatch in skills instead of level of formal education. Regarding this last issue, it has become clear that when we look at skills and education we measure different things. The analysis performed from the EU-LFS, and on a larger set of European countries for the period 1998-2013 -although this time limited to only two different measures of over-education- has led to a similar conclusion: the method matters.

In any case, the analysis of the EU-LFS has allowed us to present, although cautiously, what we could consider the stylized facts of over-education in Europe. Firstly, a large proportion of European workers with tertiary education have a level of education that

is higher than the one required for performing the job. Secondly, the size of over-education is contingent on the method of estimation of the education required. Overall, the estimates based on the statistical determination of the education required for the job (RM approach, especially when using the median) produce higher over-education rates than the so-called job analysis approach. Moreover, mismatch indicators are very poorly correlated (McGuiness, 20178). In the third place, in contrast to the general belief that the incidence of over-education has grown over time, our trend analysis for the period 1998-2013 does not find an overall increasing pattern of the over-education rate; quite the opposite. Fourthly, during last decade and a half, Europe has witnessed a process of convergence (both absolute and relative) in over-education rates. This result is at odds with the idea of a "disappearing middle" class of jobs in a context of growing rates of tertiary education attainment. The fifth conclusion is that the position of women in comparison with men in terms of over-education rates is contingent of the country, age cohort and method of estimation. Sixthly, the same is valid regarding the profile of over-education by age, with some countries showing a continuous decreasing trend, other a decreasing trend up to certain age and an increasing trend afterward, and others a decreasing relation that turns stagnant after mid age. Lastly, in all countries immigrants have higher over-education rates. Such difference is especially high in new immigration countries such as Spain.

One of the paths for further research suggested by our results has to do with exploring in depth the reasons for the so impressive discrepancies in the proportion of over-educated graduates when using different methodologies. For this purpose, probably, more detailed and precise information is required (for instance, proper dictionaries of occupations for the JA approach should be developed).

We would like to conclude this paper with one reflection about over-education that is often left outside of the mainstream debate on the issue. It is clear that one of the aims of education is to increase human capital and facilitate the growth of productivity and output. Nevertheless, to assume that this is the sole purpose of education we have to adopt an extremely narrow and reductionist view of education. Following Sen's analysis of education it can be argued that education has an instrumental role in improving people's capacity to participate in decision making process at different levels of society,

readdressing social inequalities and transforming society (Rajapakse, 2016). In this sense, it could be argued that over-education (as defined in this paper) is not necessarily bad, at least as long as the external positive effects of over-education are higher than the opportunity cost of producing such levels of over-education, as we would be contributing to the development of better societies.

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