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ANALYSIS USING A NEW INDICATOR BASED ON HIGH SKILLS USE

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"GRADUATE JOBS" IN OECD COUNTRIES: ANALYSIS USING A NEW INDICATOR BASED ON HIGH SKILLS USE

OECD Education Working Paper No. 144

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This working paper has been authorised by Andreas Schleicher, Director of the Directorate for Education and Skills, OECD.

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ABSTRACT

A recurring issue for education policy-makers is the labour market effect of the long-term global mass expansion of higher education, particularly on what is a "graduate job". The traditional assumption is that graduate jobs are virtually coterminous with professional and managerial occupations. A new indicator of graduate jobs, termed ISCO(HE)2008, is derived using task-based data drawn from the The Survey of Adult Skills, a product of the OECD Programme for the International Assessment of Adult Competencies (PIAAC). The new classification shows that several jobs in ISCO major group 3 "Technicians and Associate Professionals" are also classed as graduate jobs in many countries. Altogether, 27.6% of jobs are classified as graduate jobs in the 15 OECD country-regions for which we have data. Considerable variation in the proportion of graduate jobs is found across industries and countries and in the short period from 2011 to 2013, the proportion of graduate jobs has become more diverse across countries.

RÉSUMÉ

Un problème récurrent qui se pose aux responsables des politiques éducatives concerne l'effet que peut avoir sur le marché du travail la massification de l'enseignement supérieur à l'échelle mondiale, en particulier sur les emplois nécessitant un diplôme supérieur. Il est communément admis que ces emplois sont quasiment synonymes de professions intellectuelles, scientifiques et d'encadrement. Un nouvel indicateur des emplois nécessitant un diplôme supérieur, désigné sous le code CITP(HE)2008, est déterminé à partir des données relatives aux tâches tirées de l'Évaluation des compétences des adultes, lancée dans le cadre du Programme de l'OCDE pour l'évaluation internationale des compétences des adultes (PIAAC). La nouvelle classification montre que plusieurs emplois relevant du grand groupe 3 de la CITP, « Professions intermédiaires », sont également classés parmi les emplois nécessitant un diplôme supérieur dans de nombreux pays. Dans l'ensemble, 27.6 % des emplois sont classés comme emplois nécessitant un diplôme supérieur dans les 15 pays/régions de l'OCDE pour lesquels des données sont disponibles. On observe des variations considérables dans la part de ces emplois selon les secteurs et les pays et, sur la courte période allant de 2011 à 2013, le pourcentage des emplois nécessitant un diplôme supérieur est devenu de plus en variable d'un pays à l'autre.

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1. Introduction

A recurring issue for education policy-makers is the labour market effect of the long-term global mass expansion of higher education. Across North America, Europe and Asia, school leavers' educational aspirations have risen to the point that they are now more likely than not to proceed to tertiary education, and the consequences have for the last two decades been seen in the growing stocks of tertiary-educated labour in the workforce. Between 2000 and 2011 the proportion of the population (35-64 years old) with tertiary education had grown from 22% to 32% on average across OECD countries (OECD, 2013a), and the European Union has declared a common goal to reach a proportion of at least 40% graduates in the age-group 30-34 year-olds by 2020 (European Commission, 2014). By contrast, while the traditional destinations for graduates in professional and managerial occupations have expanded simultaneously, this has been to a much lower extent (Handel, 2012). If the large and ongoing rise of high-educated workers is to yield growth dividends and to meet new graduates' expectations for good jobs, the question arises: where are the jobs in which these graduates can adequately utilise their skills?

One way in which this question is typically addressed directly is through the lens of the concept of the "graduate job", and we take this approach here. Yet any such investigation begs the question as to how such jobs are defined and measured. Although the traditional notion of a "graduate job" in management or the professions lingers on in the language of elite HR recruiters from high-ranking universities and in the expectations of many students, we argue that there is need for a modern indicator which embraces a broader set of occupations and tasks, respecting the fact that, alongside the massification of higher education, there has been a prolonged period of skill-biased technological and organisational change and a globalisation of capital.

This approach to understanding graduate labour demand complements the conventional economic approach that focuses on the economic return to higher education. While in most countries the graduate wage premium has been maintained through recent periods of HE expansion (OECD, 2014), there is some evidence of growing heterogeneity in the returns, linked in part to overqualification[1] (Green and Zhu, 2010; Figueiredo et al., 2013). Below we use estimates of the wage premium to show the validity of a new classification in an international context, and how it compares with alternative traditional indicators.

For a modern graduate job indicator to be useful for understanding graduate labour markets around the world, it is essential that it be rooted in the character of the job's skill requirements, whilst taking the relative national position of graduates on the labour market into account. In this paper we develop and analyse a theoretically motivated, transparent and replicable classification of graduate jobs, using data from The Survey of Adult Skills, a product of the OECD Programme for the International Assessment of Adult Competencies (PIAAC). The Survey of Adult Skills (PIAAC) is an international survey of key skills, skills use and socio-economic background of the adult populations aged 16-65 years. Using a method developed and validated using the British Skills and Employment Surveys (Green and Henseke, 2014), we combine self-reported information on the qualifications needed to do the job competently with rich data on skill use at work and further drivers of country-specific higher education demands, to derive an indicator of graduate jobs. As our approach classifies ISCO 2008 minor groups, the classification can be easily applied within countries to other general purpose surveys where occupation is coded. It can also be used to deepen understanding of graduate labour demand from an international perspective.

The resulting classification - which we term "ISCO(HE) 2008" - displays a varied, country-specific picture of graduate jobs. The indicator shows that higher education is required for a considerable range of jobs, going beyond the traditional ones. The classification is thus quite distinct from the existing one, termed ISCO(1&2), which determines, through expert judgements, that only occupations in major groups 1

1. This term is synonymous with the term "overeducation" used by many authors.

and 2 qualify as graduate jobs, and then not quite all of them – amounting to 21.2% of jobs across the 15 OECD country-regions (including Cyprus[2]) in the purview of the Survey of Adult Skills (PIAAC). By contrast, we find that 27.6% of jobs across can be classified as graduate jobs, according to ISCO(HE) 2008 which is based on statistical analysis of high skills use.

The prevalence of graduate jobs varies considerably across countries, with relatively low proportions of graduate jobs in the Czech Republic, Japan and Germany, and relatively high proportions in Poland, the Netherlands and Norway. We find that these cross-national differences, over and above the industry structure and firm-size composition, are consistent as expected with differences in the relative qualities of graduates and other skilled labour. We also find that graduate job prevalence within countries is positively associated, as expected, with industry R&D intensity, firm size and public ownership.

This paper is structured as follows. In section 2 we develop the concept of graduate jobs, and put forward a simple framework for the determination of graduate jobs. Section 3 considers existing graduate jobs classifiers, and reviews the existing internationally comparative literature. It then introduces the Survey of Adult Skills (PIAAC), and describes the key indicators used in the classification. We derive the classifier in section 4 and examine its construct validity in section 5. Section 6 presents our findings from analyses of the prevalence of graduate jobs. Section 7 concludes and discusses some limitations. Annex A shows the occupations classified as graduate jobs across countries.

2. Concept and theoretical framework

The concept of a graduate job

Following (Green and Henseke, 2014) we can think of a graduate job as being one where most of the skills used are usually acquired in the course of higher education, including many of the activities surrounding it, and in the course of ensuing or coterminous periods of work. Graduate skills are generally thought to comprise a combination of subject-specific professional skills, cognitive skills such as problem solving, knowledge creation, information-processing and management skills, as well as planning and people skills to mobilise others and oneself (Allen and Van der Velden, 2011; Barone and Ortiz, 2011). Following on from this concept, a graduate is deemed overqualified if working in a non-graduate job.

It is not straightforward to determine the timing, source and substance of skill acquisition. Graduate skills are the outcome of the entire history of skill formation since childhood (Heckman, 2007). Besides the skills acquired through formal education at universities and colleges, the broader higher education experience itself contributes to the development of graduate skills. Leaving home, travelling, potentially studying abroad and encountering other people with different viewpoints contribute to the individual skill set with potential productive value in the labour market. Higher education provides not only subject-specific skills but also helps to develop generic skills such as giving presentations, independent learning,

2. Note by Turkey:

The information in this document with reference to "Cyprus" relates to the southern part of the Island. There is no single authority representing both Turkish and Greek Cypriot people on the Island. Turkey recognises the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of the United Nations, Turkey shall preserve its position concerning the "Cyprus issue".

Note by all the European Union Member States of the OECD and the European Union:

The Republic of Cyprus is recognised by all members of the United Nations with the exception of Turkey. The information in this document relates to the area under the effective control of the Government of the Republic of Cyprus.

delivering written documents on tight deadlines, solving complex problems and efficient learning strategies (Jackson, 2014).

Work placement including employment, internship or charitable work, either part-time during the course or full-time afterwards, is another potential source of skill formation. Students learn to apply taught skills productively at the workplace. Study-related work placement is often seen as key to secure employment (Crebert et al., 2004). Yet the prevalence of work placements varies considerably across countries: according to one recent study, for example, British, Spanish and Flemish graduates gathered much less work experience during higher education than graduates from the Netherlands or Germany (Allen and Van der Velden, 2011).

Family, friends and social networks can also contribute to skill development during higher education. Family background contributes to skill formation, potentially throughout life (Björklund and Jäntti, 2012; Björklund and Salvanes, 2011). However, its biggest effects on individual development usually precede university studies and might thus be related to access to higher education (Heckman, 2007; Chowdry et al., 2013). This effect gives rise to suggestions that higher education is just a signal of higher abilities rather than a genuine source of skill development (Wolf, 2002), though the evidence for this is slim (Aakvik et al., 2010; Kautz et al., 2014). Nevertheless a concept of graduate jobs is more convincing if it can differentiate between skill use and credentialism.

Further, some high-level skills can potentially be acquired through other sources than higher education. High quality vocational education and training (VET) systems can provide alternative access to skills required to carry out complex jobs. Consequently, for many tasks vocationally-educated labour may have a relatively high degree of substitutability for graduate labour. It is widely held that the quality of vocational education and training varies considerably between countries and regions. Thus, in countries where the quality of higher education is high *relative* to the quality of substitutable high-end vocationally-trained labour, there is likely to be a greater demand for graduate qualifications for a given task composition of jobs. Consequently, the prevalence of graduate jobs will change with labour market institutions and features of the education and training systems that influence the relative quality and price of graduates.

Our proposed skills-focused concept of graduate jobs differs from alternative approaches which focus either on occupational prestige (Ganzeboom and Treiman, 1996; Macmillan and Vignoles, 2013), or more specifically on the professions (Milburn, 2009; Allen and Van der Velden, 2011) or, in line with human capital theory, on whether higher education is especially highly-valued within that occupation by the labour market (Cardoso, 2007; Gottschalk and Hansen, 2003; O'Leary and Sloane, 2014).[3] These alternative classifications overlap with ours: for example skills usage, occupational prestige and pay are usually higher for "professional" occupations and so these occupations will be classified as graduate jobs under all approaches. The different outcomes arise with other major groups (mainly, managers and associate professional/technical occupations). Yet in our approach, concentrating on the functional side of jobs, skills use, allows us to identify graduate jobs based on the tasks people carry out during their work and whether they require higher education to do so competently. This classification approach has the most direct connection to the theoretical concept.

The distribution and trend of graduate jobs: Theoretical expectations

The question posed in our introduction – the motivation for developing a modern graduate jobs indicator – concerned how labour markets have adjusted in the 21st century to the upskilling of labour forces around the world through the massification of higher education, alongside the ongoing rising

3. See Green and Henseke (2014) for a critique of these alternative approaches.

demand for high-skilled labour. There are concerns in both western and Asian nations that the supply of graduate labour is outstripping the numbers of graduate jobs (e.g. Cedefop, 2012). For example, the state of the United Kingdom graduate labour market has come under increased scrutiny recently (Elias and Purcell, 2013; Green and Henseke, 2014; O'Leary and Sloane, 2014). A better understanding of graduate jobs should help to inform policy makers about upcoming challenges.

Notwithstanding that technological and organisational change is partly endogenous in the long-run, depending on skills supplies and relative prices, we start from the presumption that the distribution and trends of graduate jobs will reflect demand. Theory implies that the demand for graduates depends, first, on the extent to which high skills are demanded in the economy and, second, on the extent to which higher-educated labour delivers high skills. Both these links could be expected to vary across countries/regions and over time.

The widespread shift towards high-skill jobs is not new; it has been ongoing for at least several decades (Handel, 2012). The main attributed global drivers have been technological and organisational changes, alongside the evolving global division of labour. The emphasis has mainly been on technological change (Acemoglu and Autor, 2011; Machin and Van Reenen, 1998; Van Reenen, 2011); ICT, especially, is held to have raised the productivity of graduate workers over the last 30 years or so. This skill-biased technological change (SBTC) is held to be the principle driver behind the growth in the demand for graduate labour.

Nevertheless, it is by no means certain that contemporary technological change is leading to an ongoing upgrading of jobs. An alternative contemporary and future scenario has been painted by certain commentators of a divergence of opportunities for graduate labour, with computerisation now leading to "digital Taylorism" and associated de-skilling of the bulk of graduate jobs, with only a minority of especially talented graduates from elite universities continuing to enjoy ever increasing favour in the labour market (Beaudry et al., 2013; Beaudry et al., 2014; Brown et al., 2011). Resolution of these contrasting predictions may only emerge as the future unfolds, but it remains useful to ask whether the distribution of graduate jobs in the current era is positively linked to technology, and work organisation.

While transferable technology is expected to be widely diffused, it is expected nevertheless that the pace of absorption varies according to the capacity of firms and their employees to absorb new techniques and processes (Zahra and George, 2002). Management skills and systems of work organisation are among the important factors influencing such absorptive capacity. Regions that become stuck in "low-skills" equilibria can exhibit sustained low levels of skills demand, while other regions move ahead (Giguère and Froy, 2009). Quintini (2014) has found substantive cross-country variation in skills utilisation levels, associated in part with variations in labour productivity.

Some cross-national/cross-regional variation in the demand for high-level skills, and thereby in the prevalence of graduate jobs, could therefore be expected. Equally SBTC leads to the expectation of a generalised increase over time in the prevalence of graduate jobs, though if counter-tendencies come to predominate the opposite expectation arises.

A second factor in the distribution of graduate jobs is the relative cost and availability of alternatively-educated, substitutable, high-skilled workers. At least some of the high-level skills could be acquired through vocational and work-based learning routes. What matters, therefore, is the quality of graduate labour relative to potential substitutes. In a country where high-skilled substitutable vocational labour is available, employers design fewer jobs *ceteris paribus* as graduate jobs. We expect there to be cross-country differences in the mapping from job skills to educational demands, reflecting the relative qualities and costs of graduate and vocationally-educated labour. This expectation contributes an additional reason for international variation in the use of graduate labour.

3. Data and skills use indicators

Existing indicators

Existing studies utilise diverse principles for deriving indicators of graduate jobs. Most frequently used is the simple traditional classification based on being coded in one of the first two major ISCO groups – Managers or Professionals. To recognise the need to modernise this classification by going beyond the traditional approach, recourse is sometimes made to the idea that graduate jobs are defined by what graduates do. While this approach can be delivered in a subtle way that takes account of the age structure of occupations, and allows for exceptions or niches to be identified as graduate jobs (e.g. Elias and Purcell, 2004), at least in its simplest form this supply-driven approach is subject to the criticism that it is tautological and of limited use for analytical purposes. To replace such an approach with a conceptually more satisfactory demand-driven perspective, expert-based classificatory mechanisms may be available (e.g. Elias and Purcell, 2013, for the United Kingdom) which deploy knowledge about the tasks involved in occupations to make judgements about whether they require graduate-level skills. Some of this knowledge can be gleaned from detailed job titles. Yet, expert-based classification methods remain somewhat subjective, are hard to replicate and update, and could not be extended to an internationally comparable classification except perhaps at enormous cost.

A further method has been to identify occupations as graduate jobs when there is evidence that graduates are offered a premium within that occupation (e.g. Gottschalk and Hansen, 2003). Rooted in an assumption about the competitiveness of labour markets where scarce skills are rewarded when demanded, this method has the merit of avoiding use of self-reported job assessments. Yet it has the disadvantage that it relies on gaining unbiased estimates of within-occupation returns, which is rendered nearly impossible by the fact that occupational selection and human capital returns are closely interlinked. Moreover, the method cannot then be utilised as a tool for analysing wage returns without, again, risking tautology. The wage-returns approach would also be questionable when applied in an international comparative perspective, because there is a large international diversity in the effects of labour market institutions on wages. Among existing indicators, only the traditional indicator and the supply-driven methods lend themselves to an international approach. But since neither of these seems remotely adequate in the context of the modern world, with changing skills demands rendering the traditional measure out of date, and rapidly growing graduate stocks covering supply-driven indicators with a thick layer of tautology. A better method is warranted, and one that does not simply add on further major occupational groups indiscriminately without considering the concept of what a graduate job is.

Before proceeding to our improved approach, it is worth noting that one or other of the above principles for defining graduate jobs also underpins some of the indicators of overqualification found in the literature. The negative consequences of overqualification and skills underutilisation such as wage penalties, reduced job satisfaction and potential reductions in further training are well documented (Leuven and Oosterbeek, 2011; Quintini, 2011a). However, relatively little is known about graduate skills utilisation from a comparative cross-country perspective. The lack of consistent international data sources on skill utilisation has made it for some time impossible to validly compare the incidence of underutilisation across multiple countries. For instance, the European Working Conditions Survey (EWCS) has started collect information on skills utilisation from 2005 onwards. But this data has to our knowledge not yet been applied to study the labour market of university graduates across (European) countries (see Quintini, 2011b for an analysis of skills mismatch in the employed labour force in general).

A study by (Croce and Ghignoni, 2012) uses the European Labour Force Survey to investigate overqualification amongst graduates who hold a degree of higher education in Europe between 1998 and 2006. The study relies on the so-called "statistical" measure of overqualification, where required education is given by the modal or median or mean education level held by workers in each occupation. Graduate

mismatch was worst in the Czech Republic, Germany and Austria with more than half of the graduate workforce in non-graduate jobs. Romania, Finland and Luxembourg were on the other end of the scale with a proportion of about 25% of mismatched graduates. The values for, for instance Italy, Spain and the United Kingdom were in between the extremes. In all, about 37% of graduates were overqualified in Europe at the turn of the millennium; the proportion slightly dropped to 35% in the middle of the 2000s. The authors conclude from a multivariate country-level analysis that overqualification reacts mostly to short-term business cycle fluctuations.

Yet so-called "statistical" measures of over-education have received much criticism (Hartog, 2000). They are based, not on skill requirements, but on the qualifications of the people doing the job. Educational expansion and the distribution of educational achievements in the workforce vary considerably across countries (Green, 2013). Therefore, the statistical method is poorly suited for international comparisons of trends in overqualification.

The REFLEX (Research into Employment and Professional Flexibility) survey has so far been the richest source of internationally commensurate information on labour market outcomes of graduates. Collected in 2005, REFLEX sampled data on the labour market trajectories of tertiary education graduates from 1999/2000 in 16 European countries and Japan. It built on an earlier survey over 12 countries, conducted in 1999-2000 entitled CHEERS (Careers after Higher Education: a European Research Study). REFLEX provides detailed information on multiple dimensions of job mismatch, the higher education experience, labour market history, current employment and the parental background (Allen and Van der Velden, 2011). A small but hugely informative literature has evolved around this study and has provided so far the most comprehensive insights into the state of graduate labour markets in Europe and beyond. Further international surveys based on REFLEX were later conducted in Eastern European countries ("HEGESCO") and in Latin America ("PROFLEX").

In all, 26% of the graduates were overqualified six months after they finished higher education according to the REFLEX data, but there was substantial variation between countries. In Spain, Italy and the United Kingdom more than 38% of recent graduates worked in jobs that did not require higher education, compared to less than 20% in France, Switzerland, Germany and Portugal. Five years after graduation the proportion of overqualified graduates had generally shrunk. The drop in overqualification was most pronounced in countries with initially high levels of mismatch. Germany, Switzerland and Japan were characterised by the highest persistency in average overqualification (Verhaest and Van der Velden, 2013). Variation in overqualification has been variously attributed to imbalances between the supply and demand for highly skilled labour, the quality and orientation of study programmes, skill heterogeneity within occupations, and the scarring effect of entering the labour market during a recession (Barone and Ortiz, 2011; Verhaest and Omey, 2009; Verhaest and Van der Velden, 2013).

Though the comparison is imperfect because populations did not entirely overlap, the figures for the proportions overqualified differed markedly from those reported by (Croce and Ghignoni, 2012). Not only was the incidence of overqualification lower in the REFLEX study despite applying to a younger population, but also the country ranking had swapped with graduates from Germany, Austria and the Czech Republic reporting the lowest proportion of overqualification. Such measurement diversity highlights the need for high quality data to track educational mismatch, especially across countries.

Overqualification is related to the concept of skills underutilisation. Overqualified workers are thought to utilise less of their skills than adequately matched graduates. However, the relation is far from perfect (Green and Zhu, 2010). The incidence of skills underutilisation varied between around 20% in Norway and Finland to almost 35% in Spain, the Czech Republic and the United Kingdom in the REFLEX data – roughly confirming the country ranking for the incidence of overqualification (Allen and Van der

Velden, 2011). The country ranking also holds when horizontal mismatch, i.e. the gap between field of study and the required job-specific skills, to the exploration of mismatch, was added to the picture.

While REFLEX provides arguably the best analyses to date regarding the international deployment of recent graduates, it is not really suitable for defining a graduate jobs classifier of occupations. Not only is it now a decade old, its findings apply only to the jobs of recent graduates, not to jobs in general. It could define, on an individual level, whether workers perceive themselves to be in graduate jobs, using the self-reported single-item measure of whether a graduate-level qualification is required for the job. It is argued elsewhere that workers are generally well suited to assess the skill and qualification requirements of their job.[4] But responses to a single item will carry errors, affected by individual's self-esteem or facets of the job that are unrelated to skills usage. If unrecognised, these errors would be conveyed to the resulting indicators. An indicator of whether graduate skills are required in an occupation should aim to be purged of such errors.

In the next section we develop such an indicator. Similar to methods in health economics which rid self-reported health from reporting error, the procedure uses indicators of high skills use to uncover the variation in the qualification requirements that are attributable to differences in high skills demands. The classification captures the use of graduate skills independently of the sources of skills. It does not rely on assumptions about the link between higher education and wages within occupations. The method avoids the use of hard-to-replicate expert judgements and deploys an observer-neutral classification procedure, based on relatively simple statistical classification methods, while not relying on single survey item responses. The result is a transparent and replicable procedure, and an indicator that is flexible enough to allow for country differences in graduate jobs and which can be consistently amended over time as technologies and workplaces evolve.

The Survey of Adult Skills (PIAAC)

We use data from The Survey of Adult Skills, a product of the OECD Programme for the International Assessment of Adult Competencies (PIAAC), which is an international survey that has been carried out in 33 countries and economies (OECD, 2013b). The fieldwork for the first round was conducted between 2011 and 2012 in 24 countries. The sample population is the respective national adult population aged 16 to 65 years. Overall, more than 120 000 people were assessed in three proficiency domains – literacy, numeracy and problem solving skills in "technology-rich environments" – and interviewed on topics covering use of skills at work and at home, the work experience, continuing training, and personal characteristics such as qualifications, family background or health. Around 5 000 interviews were carried out per country. A harmonised sampling procedure, a standardised questionnaire and shared classifications for industry, qualification and occupations ensured high comparability across countries.

The extent of data anonymisation in the public-use files differs from country to country, and affecting access to disaggregated occupation codes. At the time of the writing, only the German data has been made available as restricted use-file (Perry and Helmschrott, 2014). In all, we have information on detailed occupation codes for 15 countries: Belgium, Cyprus,[5] the Czech Republic, Denmark, France, Germany, Italy, Japan, Korea, the Netherlands, Norway, Poland, the Slovak Republic, Spain and the United Kingdom. This country selection covers various typed of education and training systems with varying trajectories in higher education. Data for Belgium and the United Kingdom are not nationally representative, but cover in case of the former Flanders and in the latter England and Northern Ireland.

4. There is no evidence of a substantial, systematic, bias in workers' self-assessments of their jobs, but there is a possibility of a small gender bias (Green and James, 2003).

5. See note 2.

Because of data quality concerns, we excluded the Russian Federation survey data from our analysis (OECD, forthcoming).

The Survey of Adult Skills (PIAAC) uses a complex sample design to achieve representativeness for the national target populations. To adjust for the sampling procedure, in the analyses that follow we make use of the provided probability weights to derive the correct standard errors for parameter estimates.

Skill indicators

The Survey of Adult Skills (PIAAC) data have already been utilised to derive novel measures of skills mismatch among all employees (Allen et al., 2013; Pellizzari and Fichen, 2013). In contrast to these studies, we are specifically concerned here with the utilisation of graduate skills in the labour market.

The indicator will classify minor group (3-digit) occupations, defined by the International Standard Classification of Occupations 2008 (ILO, 2012), according to whether they are graduate or non-graduate jobs. ISCO08 provides a consistent and internationally comparable framework to classify occupations, consisting of four hierarchical levels with increasingly detailed occupational groups. At the most detailed level it differentiates between 436 unit groups, which are structured into 130 minor groups and 43 sub-major groups. The top level is formed of 10 major groups: Armed Forces Occupations; Managers; Professionals; Technicians and Associate Professionals; Clerical Support Workers; Services and Sales Workers; Skilled Agricultural, Forestry and Fishery Workers; Craft and Related Trade Workers; Plant and Machine Operators and Assemblers; and Elementary Occupations.

ISCO08 groups these jobs according to the required skill level and skill specialisation as assessed by occupational experts. Jobs at the highest skill level usually demand high-level non-routine cognitive tasks such as problem-solving, decision-making and creativity drawing on an extensive knowledge base. According to ISCO documentation, most occupations in major group "1 Managers" and all occupations in "2 Professionals" utilise these high level skills. Since these skills are assumed to be normally acquired through higher education, these two groups are conceived as defining graduate jobs (European Commission, 2014). This classification forms a benchmark against which we will (below) compare our modern indicator of graduate job.

Before proceeding, it is important to note two limitations that potentially apply to any occupation-based classification of graduate jobs. Firstly, we need to assume that jobs within the basic unit (in this case, minor groups) are sufficiently homogenous in terms of skill levels to meaningful classify them as either graduate or non-graduate. Secondly, there is potential for measurement error in the occupational coding in any survey (Mathiowetz, 1992; Sullivan, 2009). Respondents might misreport their job titles or give ambiguous information, and there is the potential for ambiguity in the allocation of job titles to occupation. The problem could be exacerbated with international surveys as coding practices vary between countries. The distinction between managers and administrators (major groups 1 and 4) or professionals and associate professionals (major groups 2 and 3) can, for instance, be fuzzy (Handel, 2012). The PIAAC consortium has established safeguards at various stages of the survey design to ensure high quality and consistent occupational classification across countries. Members of the national survey teams received dedicated training to code occupations in the ISCO08 framework. Further, at least 50% of jobs had to be double coded. Potential coding conflicts were resolved by a member of the PIAAC consortium. The resulting distribution of occupations was checked against national labour force data. All participating countries passed the minimum quality criteria (OECD, 2013c).

The selected indicators are motivated by the concept of graduate jobs outlined in the section above. We have constructed multiple variables which will form the ingredients of the classification:

1. *Degree essential*: Employed respondents in The Survey of Adult Skills (PIAAC) are asked to assess the qualification required to get their current job. Because there may be credentialism – where a qualification is asked for, but not necessary for doing the job, respondents are also asked whether the required qualification is also needed to perform the job satisfactorily. The information is dichotomised according to the coding scheme in Table 1. Generally, higher education is required if a qualification at ISCED5A level or above is appropriate for the job. In cases where a master or doctoral degree is necessary to get but not essential to do the job, it is plausible to assume that a shorter higher education course will nevertheless be required to perform the job tasks satisfactory.[6,7]

Table 1. Coding of self-reported higher education requirements on the job

Higher education required to get the current job	Also needed to perform the current job	Higher education required to do the job
ISCED 6	Yes/ No	Yes (==1)
ISCED5A - Master	Yes/ No	Yes (==1)
ISCED5A - Bachelor	Yes	Yes (==1)
	No	No (==0)
<=ISCED5B	Yes/ No	No (==0)

1. *Degree essential (similar jobs)*: ISCO groups similar jobs in terms of required skill level and skill specialisation together. We exploit this construction principle to derive an indicator of the demand for higher education in jobs similar to the worker's current position. Observations within the same minor group (3-digit occupation) in the same country define the neighbourhood of similar jobs. The indicator is calculated as the average demand for higher education in the neighbourhood. Formally,

$$DN_i = \frac{1}{K(i)} \sum_{k=1}^{K} D_{k(i)},$$

where $k(i)$ described the set of observations within the same minor group and same country as job i, $D_{k(i)}$ captures the need for higher education to carry out job k in the neighbourhood of respondents i's job, and, finally, DN_i, represents the average demand for higher education in the neighbourhood of job i. The variable captures differences in the need for higher education over and above job tasks.

2. *3+ years of experience required*. Some graduate jobs potentially require prior work experience in addition to formal education. For certain high-skill jobs, for instance managerial positions, it is essential to have command over some firm-specific or industry-specific knowledge to do the job competently. Participants in The Survey of Adult Skills (PIAAC) report on how much related

6. There is an idiosyncrasy in the British data with respect to the relevant ISCED codes. Higher education is not further differentiated but instead subsumed into one category. We assume that a Bachelor degree will suffice to get most of the graduate jobs in Britain and treat the category accordingly within our coding scheme.

7. In Denmark and Flanders (Belgium), there were some graduate level jobs in sub-major group "95 Street and Related Sales and Service Workers". A closer inspection of the industry codes and the skill use on the job suggests that, despite the precautions by the PIAAC consortium, the occupations were most likely miscoded. Generally, we have excluded 127 observations in major groups 5-9 from the sample that stated higher education requirements and saw a substantial need of degree requirements in similar jobs on the ground of potential miscoding.

work experience is needed to get their current job. The variable is dichotomised and receives the value 1 if 3 or more years of experience are necessary to get the respondent's current job.

3. *Information processing skills.* The growing use of cognitive and people skills at work is often seen as key driver of the increasing demand for graduates. It is this combination of generic skills that sets graduate jobs apart from more routine jobs. Higher education provides the holder with a comparative advantage to perform these tasks effectively (Autor and Handel, 2013; Green, 2012). The Survey of Adult Skills (PIAAC) background questionnaire covers a comprehensive list of skill use at work in areas such as literacy (reading and writing documents), numeracy (calculation of budgets, usage of simple algebra), the level of computer use, problem solving, organising (own work and others), and communicating (presenting, teaching). In addition, the published Survey of Adult Skills (PIAAC) data files include broader skill use scales derived from combinations of a selection of the single items. The scales are derived by the PIAAC consortium using Item Response Theory. The single items capture the frequency with which each task is performed, ranging in four steps from "Less than once a month" to "Every day".

   We deploy a subset of the task items, a selection of the provided skill use scales and some related variables. Each variable is defined as a binary variable which is one if respondents perform a specific task at least weekly (for single task items) or fall into the highest category of the included PIAAC skill use scale, and zero otherwise. The items cover high-level numeracy, reading and writing as well as regular complex problem solving and high-level computer use.

4. *Orchestration skills.* Using the same principles, information on regular teaching, presenting, advising, influencing, negotiating, planning others and supervisor status are used to summarise the use of orchestration skills.

5. *Job autonomy.* Finally, we include a measure of job autonomy into the construction of the classification. Graduate jobs are thought to give the individuals a certain level of discretion over facets of the job. Autonomy is both a normative measure of graduates' job quality (Boccuzzo and Gianecchini, 2014; McGuinness and Sloane, 2011), but also a contributor to the skill requirements of the job. Planning one's own work, prioritising tasks, and regulating the pace of work requires skills. In all, it is an additional dimension that distinguishes graduate jobs from non-graduate jobs, which impose stricter routines and offer less discretion. The Survey of Adult Skills (PIAAC) data include items on self-planning and work flexibility. Work flexibility is assessed by four items on different facets of job autonomy with responses ranging from 1 "not at all" to 5 "to a very high extent". Job autonomy describes discretion over various job domains and is thus measured by a summary score that covers information on how flexible workers can set their tasks, determine how the work is done, the speed of work and working hours as well as the need to plan their own work activities and time. The single indicators are again defined as binary variables with values one if respondents report very high levels of discretion for each flexibility item or state that self-planning skills are required at least on a weekly basis.[8] The final score is calculated as the average over the included items.

8. With Cronbach's alpha for the resulting scale of 0.75, one could plausibly regard this scale as capturing a single latent construct of "high autonomy".

Table 2 summarises the descriptive statistics of these indicators for the pooled sample of 15 countries.

Table 2. Summary statistics (N=49 986)

Variable	Mean	Standard deviation	Min	Max
Degree essential	0.226	0.418	0	1
Degree essential (similar jobs)	0.226	0.287	0	1
3+ years of experience required	0.208	0.406	0	1
Information processing skills				
1. High level numeracy	0.153	0.360	0	1
2. High level reading	0.181	0.385	0	1
3. High level writing	0.180	0.384	0	1
4. Complex problem solving	0.341	0.474	0	1
5. High level computer use	0.128	0.334	0	1
Orchestration skills				
6. Regular teaching	0.286	0.452	0	1
7. Regular presenting	0.131	0.337	0	1
8. Regular advising	0.552	0.497	0	1
9. Regular influencing	0.472	0.499	0	1
10. Regular negotiating	0.352	0.478	0	1
11. Regular planning others	0.305	0.460	0	1
12. Supervising	0.138	0.345	0	1
Job autonomy scale	0.354	0.259	0	1
13. High level discretion: tasks sequence	0.208	0.406	0	1
14. High level discretion: how	0.201	0.401	0	1
15. High level discretion: speed	0.186	0.389	0	1
16. High level discretion: working hours	0.092	0.289	0	1
17. Self-planning	0.693	0.461	0	1
18. Self-organisation	0.742	0.438	0	1

Source: OECD (2016), *Survey of Adult Skills (PIAAC)* (Database 2012), www.oecd.org/site/piaac/publicdataandanalysis.htm.

Overall, we have close to 50 000 observations available to derive the classification. About 23% of respondents in the sample work in self-reported graduate jobs. A fifth of the respondents work in jobs that required long prior work experience. Complex problem solving is the most common required information processing skill; a bit more than a third of the respondents have to think about problems that require 30 minutes or longer to come to a solution on a weekly basis. High level computer use is the least frequent item among the cognitive skill use indicators. Many people might use computers but mostly for relatively low-level tasks. Among orchestration skills, regular advising and influencing were the most common items: about half of the sample uses these skills at least on a weekly basis at work. Potentially noteworthy, about 14% of job-holders have supervisor responsibilities. The mean value of the autonomy scale is 0.35. Around a fifth of respondents reported high level discretion over task sequence how work is done. Working hours was an area over which workers were least likely to have significant autonomy. In contrast, more than two-thirds of the workers in the sample planned their own work activities and again more than two thirds organised their own time.

This list of skill use measures is neither exhaustive nor will every graduate job necessarily demand high levels of each variable. We argue, however, that the defined variables capture different aspects of graduate jobs which, in combination, capture the non-routine cognitive and interactive-intensive characteristics that distinguish graduate from non-graduate positions.

To capture further systematic differences in the propensity for higher education demands over and above skills, we also consider age, age square, gender and country dummies covariates as additional covariates.

4. Constructing ISCO(HE) 2008

Classifier

The classification procedure builds on our earlier work (Green and Henseke, 2014). The main idea is to uncover the variation in the self-reported higher education requirements that can be attributed to the variables capturing high skills use and other systematic job and country-specific factors. The properties of the resulting classification are validated in section 5. We pool the available data into one international dataset.

The classifier is derived through a three-step procedure. Firstly, we estimate a latent "higher education requirement" score from the individual measures. Next we average the latent variable across minor group-country cells. And finally, we calculate for each country separately a threshold for the higher education requirement score, above which higher education is appropriate to do the job.

First, we estimate the following model:

$$\Pr(HE_i) = \Phi\left(\beta_j JSR_i + \gamma_j DR_{ij} + \delta_j X_i + u_j + \varepsilon_{ij}\right),$$

by running a probit regression of the self-reported graduate job indicator HE_i of individual i on the job skills requirement variables, JSR_i, the degree requirements in similar jobs DR_{ij}, which change by country j, socio-demographic controls X_i, and country fixed effects u_j. All parameters are allowed to differ between countries. Table 3 reports the average marginal effects of the job skills requirement variables on the latent demand for higher education over all included countries.

The probit regression represents an underlying latent variable model that captures the higher education requirements of a job. The model allows for country-specific mapping of job skill requirement to educational demands and other systematic differences in the prevalence of graduate jobs over and above the observed job skills. The objective is to retain the variation in the latent variable that is explained by the observed variables. Random reporting error is captured by the error term ε_{ij}.[9]

9. It is assumed, here, that self-reported educational requirements and the high skills use variables are not simultaneously affected by the same unobserved determinants, such as reporting behaviour or exerted work efforts.

Table 3. Average marginal effects of job requirement skills on latent higher education demands

Variable	AME/SE
3+ years of experience required	0.239***
	(0.0205)
High level numeracy	0.170***
	(0.0217)
High level reading	0.296***
	(0.0209)
High level writing	0.0296
	(0.0211)
Complex problem solving	0.249***
	(0.0181)
High level computer use	0.248***
	(0.0232)
Regular teaching	0.0385
	(0.0209)
Regular presenting	0.157***
	(0.0257)
Regular advising	-0.00878
	(0.0203)
Regular influencing	0.0980***
	(0.0215)
Regular negotiating	-0.0316
	(0.0207)
Regular planning others	-0.0181
	(0.0206)
Supervising	0.116***
	(0.0239)
Job autonomy scale	0.216***
	(0.0354)
Observations	49986

Notes: Standard errors statistics in parentheses; * p<0.05, ** p<0.01, *** p<0.001.

Source: OECD (2016), *Survey of Adult Skills (PIAAC)* (Database 2012), www.oecd.org/site/piaac/publicdataandanalysis.htm.

Generally, degree requirements increase with higher information processing and orchestration skills as well as with job autonomy. Information processing skills receive the largest weight. But job autonomy, professional communication skills (presenting, influencing) and supervisor status emerge as further important contributor to higher education requirements.

Differences in the demand for higher education over and above the observed job requirements are captured jointly by the degree requirement in similar jobs, the demographic controls and country effects. As argued these variables will reflect cross-national differences in the relative perceived quality and prices of graduates. To illustrate cross-country differences in the prevalence of graduate jobs, we predict the latent higher education requirement scores for jobs in occupational major groups one to four based on the observed degree requirements in similar jobs, age and gender in this group whilst job skills requirement are held constant at the sample means. Major groups one to four includes those jobs that potentially require higher education to be carried out effectively. The resulting figures will give country-specific estimates of the perceived relative quality of graduates. The calculating uses the provided survey weights to derive representative values. See Table 4 for the estimates.

Table 4. Adjusted mean demand for higher education at given job skills requirements over countries/ economies

Country/economy	Effect
Belgium (Flanders)	-0.524
Cyprus*	-0.356
Czech Republic	-0.495
Denmark	-0.597
France	-0.517
Germany	-0.667
Italy	-0.475
Japan	-0.515
Korea	-0.581
Netherlands	-0.445
Norway	-0.544
Poland	-0.306
Slovak Republic	-0.564
Spain	-0.486
United Kingdom (England/ Northern Ireland)	-0.599

Notes:

* See note 2.

Predicted graduate skills requirement score for jobs in major groups 1 to 4 with all skills use items set to the sample mean and non-task variables at their observed value. Calculation using the provided survey weights.

Source: OECD (2016), *Survey of Adult Skills (PIAAC)* (Database 2012), www.oecd.org/site/piaac/publicdataandanalysis.htm.

According to the estimates, the perceived relative quality of graduates over groups at the nearest substitutable level of qualification is smallest in Germany, the United Kingdom (England/Northern Ireland) and Denmark. At a given level of job skills, there was a clearly lower propensity to demand higher education for a given job compared with the other countries in the sample. In contrast, graduates in the Netherlands, Cyprus[10] and Poland seem to have a relatively large perceived advantage over the closest educational groups to perform complex jobs.

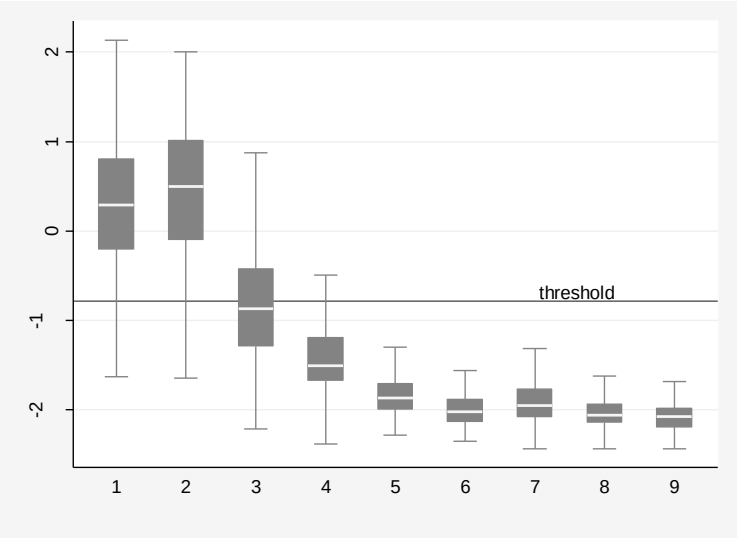
Next, we predict the *higher education requirements* as a weighted average of the explanatory job skill requirement variables and the non-task items with the item weights given by the estimated probit coefficients. As a first check, we found that almost 75% of the variation in the resulting *higher education requirements* score is explained by the ISCO08 minor groups, and that allowing for additional country differences increases the explained variance by only 2.8 percentage points. In other words, overall graduate skills requirements vary substantially between occupations and these patterns are very similar across countries.

In the second step, we average the score across minor group-country cells. For cells with fewer than four and no observations, we impute the resulting index with the average value from the 2-digit occupation. This affects 23% of all minor group-country cells. There is the risk that we impute from overly coarse occupational groups that do not properly reflect the educational requirements for the subsumed

10. See note 2.

minor-groups. However, further analysis shows that 2-digit occupations explain the variations in higher education requirement index well. In fact, the differences in explained variance compared to the full set of minor groups is only about five percentage points. In all, the procedure helps to reduce noise in the final classification. The distribution of the resulting Higher Education Requirement Index (HERI), illustrated in Figure 1, varies clearly across major groups. It is generally highest, as expected, among Managers (1) and Professionals (2), with Technicians and Associate Professionals (3) somewhat lower. Nevertheless, there are stark variations within the broad groups.

Figure 1. Box plot of the higher education requirement index by ISCO major groups 1-9 (excluding outliers and armed forces)



Notes: The box plot displays the distribution of the higher education requirement index. The upper and lower edges of a box represent the 75% and 35% Quartile, respectively. The median is given by the horizontal line within each box. The distance from the upper to the lower edge gives the Interquartile Range (IWR); a measure of dispersion. Finally, median plus and minus 1.5 IQR determine the position of the whiskers. Outliers are not reported. Data covers all 15 countries/economies.

Source: OECD (2016), *Survey of Adult Skills (PIAAC)* (Database 2012), www.oecd.org/site/piaac/publicdataandanalysis.htm.

In the final step, we run a k-medians cluster analysis in the pooled sample to partition jobs into a graduate and non-graduate group. The K-medians algorithm is more robust against outliers than the similar, well-established, K-means algorithm (Everitt et al., 2001). We impose a two-cluster solution. The algorithm assigns occupations to a cluster by minimising the distance between the occupation-specific HERI value and the cluster's centre. All occupations with a HERI score above the derived threshold are labelled "graduate jobs", whereas occupations below the threshold are referred to as "non-graduate" jobs. The resulting cut-point between graduate and non-graduate jobs is at -0.781. Its relative position is displayed in Figure 1.

Description of classification outcome

We term the resulting classification *ISCO(HE) 2008*. Across all country-regions, it results in 27.6% of jobs in the employed workforce being classified as graduate jobs.

This section will provide details, discusses potential idiosyncrasies between countries and examine variations in the relative quality of graduates as source for cross-national differences. The distribution of HERI by country and the proportion of graduate level minor groups are summarised in Table 5.

Table 5. Distribution of the higher education requirement index, the threshold between non-graduate and graduate occupations and the proportion of graduate level minor groups by country/economy

Country/economy	Number of minor groups	Proportion of graduate level minor groups (%)	Graduate skills requirement index		
			Min	Median	Max
Belgium (Flanders)	122	27.0	-2.208	-1.532	1.476
Cyprus*	121	47.1	-2.074	-1.079	1.881
Czech Republic	121	28.1	-2.256	-1.749	2.172
Denmark	126	34.1	-2.159	-1.457	1.599
France	125	35.2	-2.315	-1.656	1.616
Germany	121	31.4	-2.561	-1.823	1.733
Italy	124	41.9	-2.421	-1.175	2.137
Japan	124	33.9	-2.119	-1.526	1.723
Korea	125	38.4	-2.248	-1.265	1.745
Netherlands	120	34.2	-2.292	-1.543	1.408
Norway	121	40.5	-2.205	-1.632	1.577
Poland	125	46.4	-2.070	-1.153	1.920
Slovak Republic	123	36.6	-2.195	-1.517	1.813
Spain	124	39.5	-2.289	-1.301	2.002
United Kingdom (England /Northern Ireland)	121	38.8	-2.434	-1.546	1.409

Note: * See note 2.

Source: OECD (2016), *Survey of Adult Skills (PIAAC)* (Database 2012), www.oecd.org/site/piaac/publicdataandanalysis.htm.

The proportion of graduate level minor groups varies between 27% in Belgium (Flanders) and 46% or above in Cyprus[11] and Poland. Compared to the country-specific HERI distribution, the threshold between non-graduate and graduate occupations is relatively low in Poland, Cyprus[12] and the Czech Republic, and highest in Germany, the Netherlands and England/Northern Ireland. In other words, higher education is required for a narrower, potentially more skill intensive set of jobs in the latter countries, whereas in the former group higher education is appropriate for a wider range of jobs.

The full list of graduate and non-graduate occupations in each country is given in Annex A. While for most occupations the classification is decisive, at the margins there is ambiguity over whether higher education is appropriate to do the job competently or not. The ambiguity is hard, perhaps impossible, to avoid. The difference in HERI between the highest scoring non-graduate and lowest scoring graduate jobs is negligible; thus the step from non-graduate to graduate jobs is small and continuous. To give an impression of the grey area where higher education might be required but is not essential, we tested whether the occupation-specific HERI is significantly above the cut-point, and indicate which occupations fall in a grey area where the difference is not significant.

11. See note 2.

12. See note 2.

5. Validation

Is ISCO(HE) 2008 a valid indicator of graduate jobs? While its face validity is assured, in that it is based on the use of high skills, its operationalisation using the Survey of Adult Skills (PIAAC) data needs assessment.

We investigate in two ways. First, in this section we ask whether the outcome is distributed plausibly (that is, as expected) across major occupational groups. We also examine whether the implied relative quality of graduate labour varies across countries in ways that are consistent with the Survey of Adult Skills' (PIAAC) objective indicators of relative quality, measure by the literacy and numeracy of the country's graduates and other workers. Second, in the next sub-section we investigate how well the indicator predicts expected outcomes for individuals.

The aggregate distribution of graduate jobs across occupations, and the implied distribution of graduate labour quality

Does the overall spread of graduate occupations among major groups appear *prima facie* plausible? The classification broadly confirms ISCO's mapping of higher education to the first two major groups, but also suggests that the definition is too rigid at least for some countries where occupations outside of this narrow group require higher education (see Figure 1). Specifically, 90% of the minor groups in major group 1 and 93% in major group 2 are classified as graduate-level jobs across countries. However, in contrast to ISCO, about 43% of the minor groups in major group 3 are also graduate jobs. Further, there is a small but non-negligible proportion of graduate-level occupations in major groups 4 "clerical support workers". Thus, in at least some countries employers require graduates to do these jobs competently.

The distribution of graduate and non-graduate occupations in ISCO(HE) 2008 varies across countries, as allowed for in the classification procedure. Taking, first, managers, the classification of jobs within this major group is largely stable across countries. For example, Managing directors and chief executives or business services and administration managers are graduate jobs everywhere. But there is variation with respect to sub-major group 14 "Hospitality, Retail and Other Services Managers". Hotel and restaurant managers are classed as graduate jobs in some countries, for example Poland, but not in others, for example the United Kingdom. Variations within major group 2 appear to stem on one hand from differences in training requirements for nurses and primary school teachers and on the other from different qualification demands to perform jobs as "Creative and performing artists".[13] Overall, the country differences are most pronounced in major group 3. None of the included minor groups requires a university degree in every country, but every occupation is appropriate for graduates in at least one country. Occupations such as "331 Financial and mathematical associate professionals", "333 Business services agents", "335 Regulatory government associate professionals" or "351 Information and communications technology operations and user support technicians" are graduate jobs in the majority of countries: this observation alone illustrates the significant error that can be made by treating managers and professional as the only graduate jobs. By contrast, "312 Mining, manufacturing and construction supervisors", "313 Process control technicians" or "342 Sports and fitness workers" are classified as graduate jobs in only a few cases. Overall, at least some of the "Technicians and Associate Professionals" occupations are graduate jobs in every country.

13. There is the risk that the variation in graduate occupations among Health Professionals is partly the result of our imputation procedure. The low frequency minor groups "223 Traditional and complementary medicine professionals", "224 Paramedical practitioners" and "225 Veterinarians" receive the average HERI value from the corresponding sub-major group, which is dominated by the large minor-groups "222 Nursing and midwifery professionals" and "226 Other health professionals". This constellation is specific to Health Professionals.

While the coefficients in the first step can vary between countries, the threshold between graduate and non-graduate job is identical across countries. The rationale is that once the relative quality of graduates is taken into account, graduate jobs should map to the same levels of higher education requirements. We have hypothesised that the differences in the distribution of graduate jobs over and above job skills reflect perceived differences in the relative quality of graduates. Employers in a country with an excellent VET skills system are likely to be able to substitute workers with non-graduate qualifications satisfactorily to the same job that, in another country, might require graduate-level skills. In the following, we test this hypothesis using the skills proficiency information on literacy and numeracy skills in PIAAC.

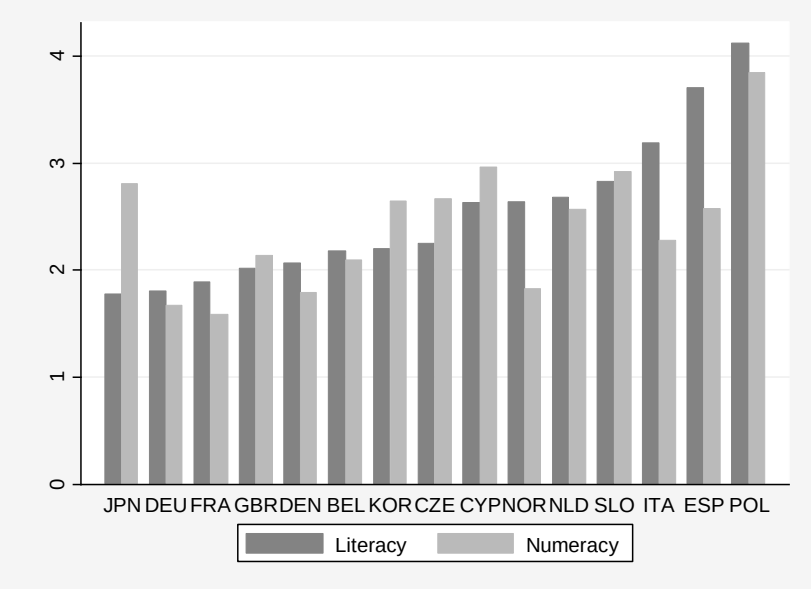
Based on the PIAAC skills data, the OECD distinguishes between five proficiency levels. At levels four and five, individuals are thought to be cable of integrating information from various sources, make complex inferences and evaluate models and concepts (OECD, 2013b). For each country, we calculate the proportion of graduates with skills at level four and above over the proportion of people at the same proficiency levels in the qualification group that is the closest feasible substitute to graduates.

Education and training system across OECD countries differ in the access to professional qualifications at post-secondary level or above (ISCED4B or ISCED5B) and the pathways from there into higher education. These specificities will shape individual educational choices. In effect, there are large differences in the uptake of non-academic post-secondary qualifications between countries. For example, less than 4% of the adult population in the Netherlands, 1% in Italy and virtually nobody in the Slovak Republic held a non-academic degree at post-secondary level or above in 2011. In contrast, more than 20% of the adult population in Japan, Denmark or Belgium (Flanders) graduated with a professional degree at post-secondary level or above. Thus, in the former group of countries, the closest feasible substitute to graduates from higher education are most likely those that finished upper secondary education, whereas in the remaining countries professional post-secondary education is likely to be the closest educational substitute.

Figure 2 depicts the objective relative quality of graduates in literacy and numeracy skills over their closest substitute between countries. The country rankings in the two skill domains are similar but not identical. The spearman rank correlation coefficient is 0.49. Overall, graduates were more likely to have high-skill levels, but the advantage varies. In terms of literacy, the relative quality of graduates was smallest in Japan, Germany and France and largest in Italy, Spain and Poland. With respect to numeracy skills, graduates in France, Germany and Denmark had the smallest relative advantage, whilst the gap was largest in the Slovak Republic, Cyprus[14] and Poland.

14. See note 2.

Figure 2. Relative quality of graduates over the closest educational group



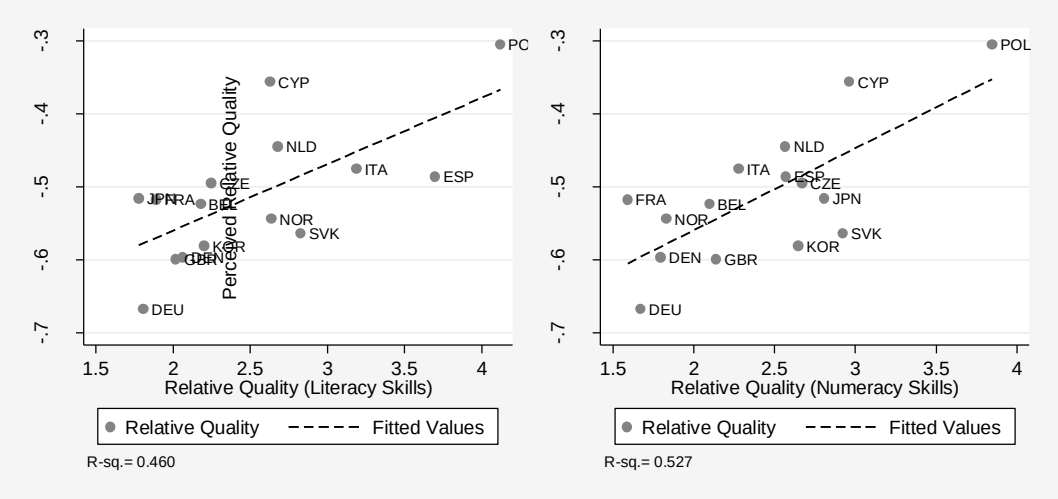
Notes: For Cyprus see note 2. Proportion of graduates at skills level 4 or above over the proportion of people at the same proficiency levels at ISCED3 (Italy, the Netherlands, the Slovak Republic) or ISCED4 and ISCED5B (remainder of the countries).

Source: OECD (2016), *Survey of Adult Skills (PIAAC)* (Database 2012), www.oecd.org/site/piaac/publicdataandanalysis.htm.

Next, we correlate the objective relative quality of graduates with the estimated perceived quality displayed in Table 4. The scatterplots in Figure 3 reveal clearly positive associations between both measures of relative quality. Cross-national differences in the relative proficiency of graduates in literacy skills explain 46% of the variation in the estimated demand for graduate jobs over and above jobs skills. Relative differences in numeracy proficiency account for 52.7% of the variation in the dependent variable. Together both measures are jointly significant (p=0.004) and can explain 60.7% of the variation in the perceived quality of graduates (adjusted R-sq.=54.1%). Thus, variations in the prevalence of graduate jobs over and above job skills can be clearly attributed to differences in the relative quality of graduates. Still, some countries such as Cyprus[15] or the Slovak Republic are situated somewhat off the regression line. Other determinants such as regulations, attitudes towards higher education, systematic credentialism, or the relative wage of graduates might have an influence on the perceived relative quality beyond generic competencies.

15. See note 2.

Figure 3. Perceived and objective relative quality of graduates between countries



Note: For Cyprus see note 2.

Source: OECD (2016), *Survey of Adult Skills (PIAAC)* (Database 2012), www.oecd.org/site/piaac/publicdataandanalysis.htm.

In all, HERI and resulting distribution of graduate jobs follows sensible patterns. Differences in the prevalence of graduate jobs can be attributed to variation in the relative quality of graduates, even if other factors, such as relative prices, may also play a role.

Outcomes for graduates

ISCO(HE) 2008 presents, as shown above, a *prima facie* plausible distribution of graduate jobs across major occupations, with few anomalies, and suggests that modern graduate jobs should be defined more broadly than is implied by the traditional definition.

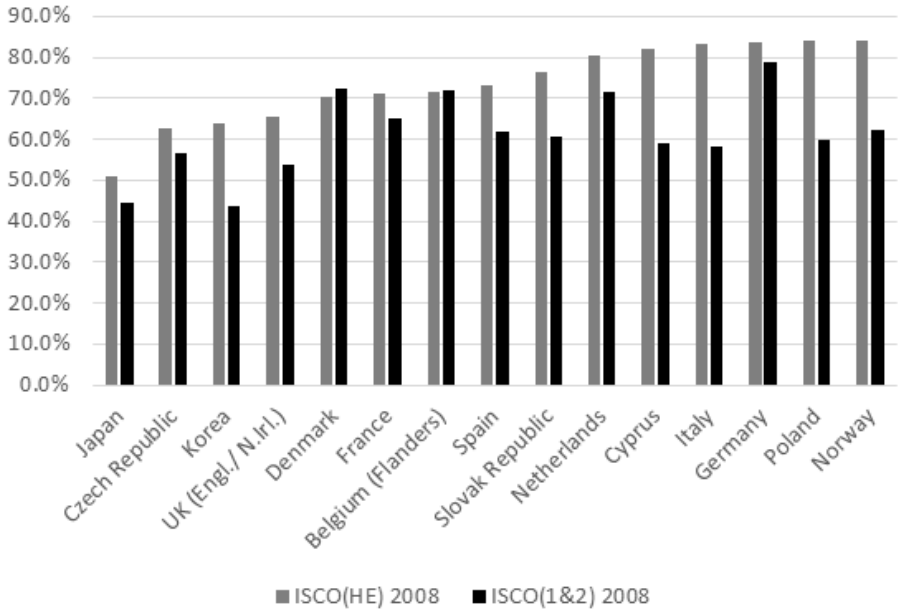
In this sub-section we examine the criterion validity of the indicator, by investigating the association of the indicator with expected outcomes. We analyse the deployment of graduates in graduate jobs in the employed labour force, and the connections between graduate job classification and three labour market outcomes: wages, job satisfaction, and training. We compare the performance of ISCO(HE) 2008 against traditional definitions, which we term ISCO(1&2) 2008 and ISCO(RM) 2008. The former classifies the first two major groups (except for sub-major group 14) as graduate jobs, and other groups as non-graduate, in every country. The latter is based on what graduates do; a minor group is deemed a graduate job if the majority of workers hold a degree from higher education. This corresponds to the often applied method of realised matches in the overqualification literature that has been advocated by (Verdugo and Verdugo, 1989) and is still applied to measure overqualification (e.g. Boll and Leppin, 2014). Minor groups are classified country-by-country.

Deployment of graduates and non-graduates

Do graduates get to work in graduate jobs? Even though matching of skilled workers to skilled jobs will be imperfect, one would expect a valid indicator of graduate jobs to reflect the matching process. Overall, we find that roughly 68.7% of graduates worked in a graduate job according to ISCO(HE) 2008, significantly above the 57.2% implied by ISCO(1&2) 2008. The flipside is that according to ISCO(HE) 2008 relatively more non-graduates worked in graduate positions than in ISCO(1&2) 2008. The proportion is small though; only about 14.2% of non-graduates were active in graduate jobs based on ISCO(HE) 2008. The figure of matched graduates puts our classification results in between the findings by (Croce and

Ghignoni, 2012) and the estimates based on REFLEX data (Verhaest and Van der Velden, 2013). The derived proportion of matched graduates for Britain is similar but not identical to earlier findings for all tertiary-level graduates (Green and Henseke, 2014).

Figure 4. Proportion of graduates in graduate jobs across countries/economies by classification



Notes: For Cyprus see note 2. Base: Employed labour force who had finished their initial cycle of education.

Source: OECD (2016), *Survey of Adult Skills (PIAAC)* (Database 2012), www.oecd.org/site/piaac/publicdataandanalysis.htm.

The proportion of matched graduates varies across countries (see Figure 4). In most countries more than 70% of graduates worked in graduate jobs. Japan, the Czech Republic, Korea and the United Kingdom are at the bottom, whereas Germany, Norway and Poland have the largest proportion of matched graduates according to ISCO(HE) 2008. The corresponding proportion of mismatched graduates are larger than the figures based on REFLEX data and the resulting country rankings are only loosely related. However, REFLEX measured the proportion of overqualification among a cohort of young graduates and not the whole graduate workforce. Interestingly, the gap in the proportion of matched graduates between ISCO(HE) 2008 and ISCO(1&2) 2008 varies considerably across countries. In Denmark, Belgium and Germany, our modern and the traditional classifier produce very similar proportions of graduates in graduate jobs, whilst there is a considerable gap between both figures in Korea, Italy, Cyprus,[16] Norway and Poland.

Labour market outcomes of matched and mismatched graduates

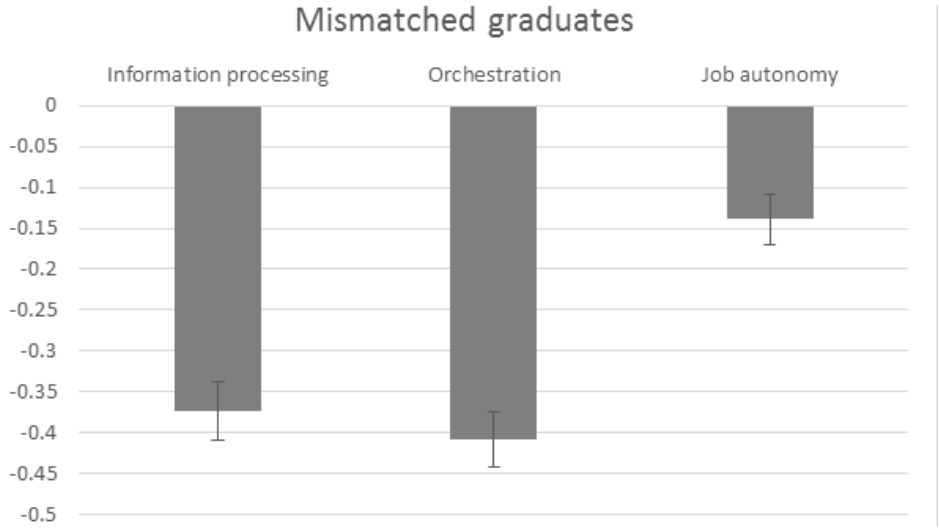
If ISCO(HE) generates a plausible picture of the deployment of graduates in graduate jobs, how well does it predict expected labour market outcomes? The better the classification, the more accurately it should predict these outcomes. Comparisons with the traditional classifier of graduate jobs (to be termed "ISCO(1&2)2008") based on ISCO major groups 1 and 2, and with a classification based on realised matches ("ISCO(RM)2008") can establish whether there is a gain in adopting ISCO(HE)2008 rather than these existing classifications.

16. See note 2.

First, it might be argued that occupations subsume multiple, not necessarily homogenous jobs, and that the job-holder determines the skills used, not the nature of the job. It is just conceivable that graduates in non-graduate occupations perform high-level jobs that are not properly captured by the occupational classification. To check this possibility, we compared skills use within skill-groups, according to whether they were in a graduate job or not. We ran linear regressions of the average over required information processing skills, the average orchestration skills and autonomy scales on a variable that distinguishes between matched and mismatched graduates, including also controls for gender, age, sector and country dummies. The sample is restricted to working age adults, who finished their initial cycle of education and worked in an occupation within what we have called the "risk zone", where the potential for misclassification is strongest, that is, in major occupational groups where occupations are likely not to fall all in one category (1, 2, 3, and 4). Matched graduates are the reference category. The skills use scale and the job autonomy scale are standardised for each country to mean zero and standard deviation of one.

Figure 5 depicts the results on the variable of interest. The estimation results confirm that there is heterogeneity in skill use by educational level and job type: mismatched graduates use significantly less skills at work and have lower job autonomy than matched graduates. The differences particularly in average job skills are sizeable and correspond to .35 to .4 standard deviations units.

Figure 5. Skill use on the job compared to matched graduates in the risk zone



Notes: The reference category is matched graduates (graduates working in graduate jobs defined by ISCO(HE) 2008. The sample is restricted to people who finished their initial cycle of education and work in "risk zone" occupations. Controls included for gender, age, sector and country.

Source: OECD (2016), *Survey of Adult Skills (PIAAC)* (Database 2012), www.oecd.org/site/piaac/publicdataandanalysis.htm.

Next we analyse how well ISOC(HE)2008 predicts individual labour market outcomes. We expect graduates in graduate jobs to earn higher wages, to have fewer reasons to be dissatisfied with their job, and to receive more training than graduates in non-graduate jobs. These outcomes are captured as follows:

- *Log Hourly Wages:* The natural logarithm of the hourly earnings including bonuses for wages and salary earners, converted to PPP-USD. Values in the 1% and 99% percentile have been removed to protect against potential distortions from outliers. Previous empirical evidence and theoretical arguments suggest that mismatched workers earn less than matched workers with the same level of education.

- *Low Job Satisfaction:* Question on job satisfaction with values ranging in five steps from 1 "Extremely satisfied" to 5 "Extremely dissatisfied". Low job satisfaction is defined as a binary variable that distinguishes satisfied (categories 1 and 2) from non-satisfied workers (responses 3, 4 and 5). Mismatched workers are more likely to express dissatisfaction with their job (Allen and Van der Velden, 2001; Cabral Vieira, 2005).

- *Long Training:* Binary variable that receive the value one if workers participated for more than five days in non-formal job-related training in the 12 months before the interview. A value of zero is assigned if workers had either participated in non-formal job-related training for five days and less or not at all in the last 12 months. The association between further training and mismatch status has seen much less scrutiny. But recent research suggests that further training is embedded into jobs and increases with skill use (Allen and de Grip, 2012; Mohr et al., 2015). As graduate jobs are more skill intensive, we expect matched graduates to engage more frequently in long training.

The top panel of Table 6 reports the results from linear regressions of the outcome variables on the set of covariates and the ISCO(HE)2008 classification of jobs for the total group of employed graduates. The bottom panel summarises the findings for graduates in the risk zone. We compare the results against the traditional classifier and the realised-matches classifier.

Table 6. Labour market outcomes of matched over mismatched graduates, by classification method

	Log hourly wages			Job dissatisfaction			Long non-formal training		
	ISCO (HE) 2008	ISCO (1&2) 2008	ISCO (RM) 2008	ISCO (HE) 2008	ISCO (1&2) 2008	ISCO (RM) 2008	ISCO (HE) 2008	ISCO (1&2) 2008	ISCO (RM) 2008
Total workforce									
Graduate Job	0.344	0.301	0.283	-0.101	-0.0985	-0.0764	0.0793	0.0540	0.0512
	(0.0128)	(0.0110)	(0.0119)	(0.0129)	(0.0108)	(0.0123)	(0.0136)	(0.0111)	(0.0116)
N	12 073	12 073	12 073	15 330	15 330	15 330	14 471	14 471	14 471
R-sq	0.396	0.386	0.378	0.058	0.059	0.054	0.045	0.042	0.041
Risk zone: ISCO major groups 1, 2, 3, 4									
Graduate Job	0.263	0.222	0.199	-0.0869	-0.0835	-0.0582	0.0702	0.0384	0.0351
	(0.0148)	(0.0117)	(0.0124)	(0.0149)	(0.0121)	(0.0128)	(0.0161)	(0.0116)	(0.0129)
N	10 799	10 799	10 799	13 597	13 597	13 597	12 797	12 797	12 797
R-sq	0.396	0.395	0.386	0.053	0.055	0.051	0.039	0.036	0.036

Notes: Results from linear regressions of the three outcomes (log hourly wage rate, job dissatisfaction and long job-related non-formal training) on the binary graduate job indicator, age, age squared, a gender dummy, set of dummies for public and not-for profit work organisations, a foreign-born dummy and a full set of country dummies. The sample is restricted to workers with completed higher education who finished their initial cycle of education.

Source: OECD (2016), *Survey of Adult Skills (PIAAC)* (Database 2012), www.oecd.org/site/piaac/publicdataandanalysis.htm.

The results confirm that working in graduate jobs is associated with a significant pay premium, a smaller probability to express dissatisfaction with the job, and a higher probability to engage in long job-related non-formal training. The findings hold both in the total sample as well as in what we have called the "risk zone". ISCO(HE)2008 outperforms ISCO(RM)2008 and performs better or at least as well as ISCO(1&2)2008. The absolute values of the estimated coefficients and figures for R squared are generally larger than for the other two classifications.

Further validation regressions (not shown here) in the sample of graduates working in jobs in major groups 3 or 4 confirm the superior performance of our modern classifier to explain the stylised facts of overqualification. Even in this contested group of occupations, graduates that work in graduate jobs

according to ISCO(HE)2008 earned on average 18.9% more than mismatched graduates. If we had used the realised-matches classifier ISCO(RM) 2008 the estimated pay premium of matched graduates would have been 16.5%.

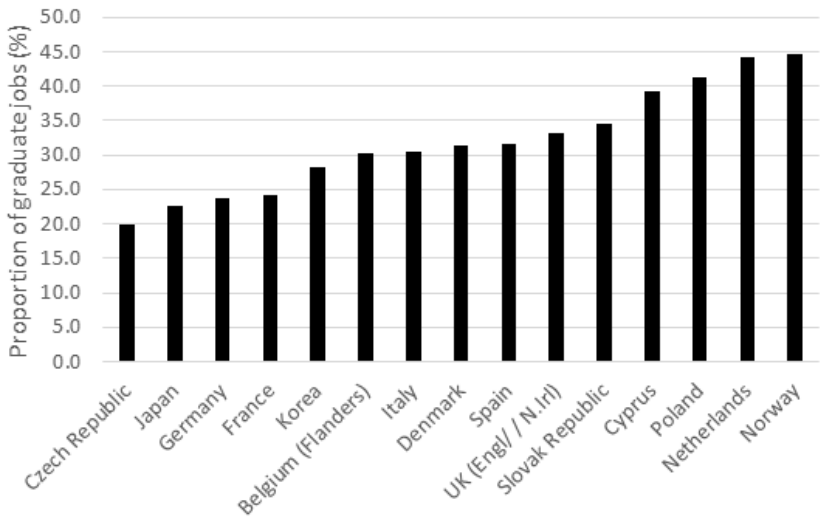
In all, the graduate jobs classifier ISCO(HE)2008 meets multiple validation criteria, and does so better than the realised-matches classifier ISCO(RM)2008 and better than or as well as traditional ISCO(1&2) 2008. Graduates in non-graduate jobs defined via ISCO(HE)2008 use lower skills at work, earn less, are more likely to be unsatisfied with their job and participate less in long training than matched graduates. The results hold in the total sample, the risk zone and a sample restricted to major groups 3 and 4. Differences in the prevalence of graduate jobs in the risk zone can be attributed to objective differences in the relative quality of graduates. Our approach is thus an improvement over existing practice. It is a data-driven, transparent and replicable indicator that is based on a theoretical concept of graduate jobs. It develops a more nuanced picture of graduate jobs for international comparison by taking country-specific features of the graduate labour market into account. By exploiting self-reported qualification requirements and the frequency of certain, well-defined tasks at work, we were able to test the proposed ISCO mapping of qualification levels to occupations across multiple countries. Our results suggest that the range of graduate jobs in ISCO is often too narrowly focused on traditional professional positions. In most countries, graduate jobs encompass a broader field of occupations.

6. The distribution of graduate jobs

Distribution across countries

As can be seen in Figure 6 and Table 7 (first column), the prevalence of graduate jobs varies considerably across countries, according to ISCO(HE)2008, consistent with the expectations discussed in section 2. There is a group of countries – consisting of the Czech Republic, Japan, Germany, and France – with a distinctly lower proportion of graduate jobs than the remaining countries. It is lowest in the Czech Republic, Japan, Germany and France (20-24%) and almost double that in Poland, the Netherlands and Norway (41-44%).

Figure 6. Proportion of graduate jobs in OECD countries/economies, 2011



Notes: For Cyprus see note 2. Base: Employed labour force who had finished their initial cycle of education.

Source: OECD (2016), *Survey of Adult Skills (PIAAC)* (Database 2012), www.oecd.org/site/piaac/publicdataandanalysis.htm.

To some extent, this pattern of cross-country variation might reflect measurable structural factors that affect the demand for high-skilled labour, principally the different industrial compositions and the intensity of technological change as indicated by the intensity of R&D activities relative to gross value added. To capture these effects, we ran a saturated linear regression of our graduate job indicator on full sets of firm size, industry and sector dummies weighted by the provided sampling weights. The resulting gap between observed and predicted proportion of graduate jobs by country provides a measure of country-specific idiosyncrasies that might relate to underlying differences in the relative quality of graduates or production technology.

Using these findings, the second column of Table 7 shows the "surplus", that is, the extent to which in each country the prevalence of graduate jobs deviates from the predicted demand due to the industrial structure and firm-size distribution. The surplus varies between -7.7% (CZE) and 12.6% (POL). One can see for example that the Czech Republic or Germany have a relatively large negative surplus, implying that the low prevalence of graduate jobs has little to do with the industrial structure. The value range between the smallest and largest surplus is, at 20.3 percentage points, only around 4.5 percentage points below the range of observed proportions of graduate jobs across countries.

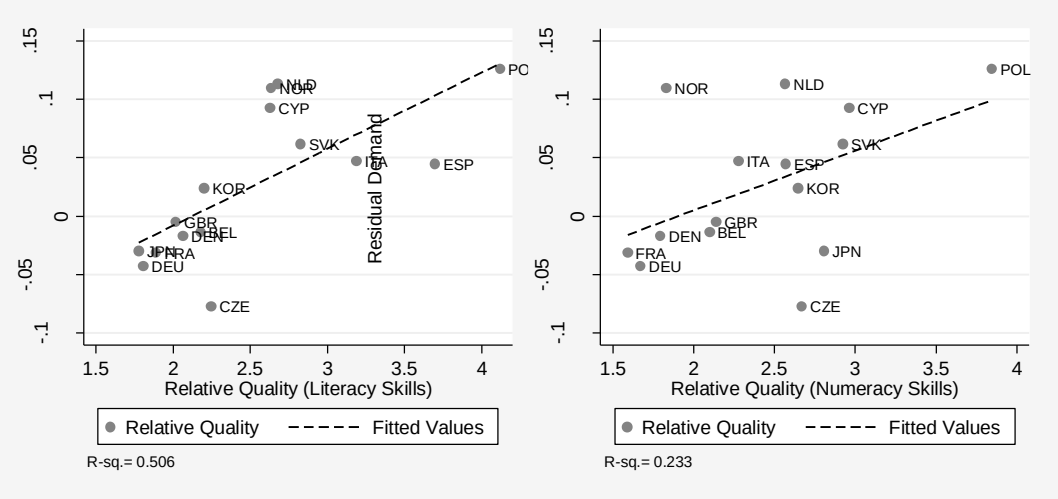
If it is not down to industry structure, to what extent can one account for the considerable cross-country differences in the use of graduate labour? As noted above, vocational and academic skills are, to a certain extent, substitutes (Card and Lemieux, 2001; Fitzenberger and Kohn, 2006). But, not only HE systems, also VET systems across the OECD vary hugely, with consequences for the relative quality of university graduates compared to the closest substitutable educational level (Eichhorst et al., 2015). Similarly, labour market norms and institutions affect the way skills are formed through work experience. Depending on the overall institutional design of the labour market and the education systems as well as the general expectation of the population, VET systems are associated with outcomes ranging from "dead-end track and second-choice education" (Eichhorst et al., 2015) to a valuable alternative to higher education.

Germany, in particular, is noted for its effective "dual" apprenticeship system, including high-level vocational skills for a sizable minority of the labour force; while Japan's internal labour markets are held to be efficient vehicles for in-work acquisition of high-level skills (Koike and Inoki, 1990). Such factors should be part of the explanation for why both Germany and Japan show low proportions of graduate jobs.

In fact, the differences in residual demand for graduate jobs correlate with the estimated perceived relative quality differentials across countries (see Table 4 for estimates of the perceived relative quality). The spearman rank correlation between residual demand and perceived quality is 0.51 and statistically significant at below the 10% level.

Figure 7 suggests further that not only the perceived quality but also the objective relative quality of graduates correlates with the residual demand. Both quality measures are jointly significant and account for 50.8 % (adj R-sq.=42.6%) of the variation in the residual demand for graduate jobs between countries. Thus, a clear fraction of the unexplained cross-national variation in the demand for graduate jobs is down to the relative position of graduates in the skills spectrum. In countries where graduates are the key source for high-level skills – Poland being a prime example – the relative quality of graduates relative to alternative labour is also high. Where the relative quality of graduates is low, however, as for example in Germany and France, graduate jobs are less numerous. Yet there are exceptions, such as Norway, where demand is high but relative quality low.

Figure 7. Association of the residual demand for graduate jobs and the relative quality of graduates



Note: For Cyprus see note 2.

Source: OECD (2016), *Survey of Adult Skills (PIAAC)* (Database 2012), www.oecd.org/site/piaac/publicdataandanalysis.htm.

One might ask whether, in the face of the disruptions of the Great Recession and ongoing trends, this cross-national distribution of graduate jobs is changing over time. To study such change comprehensively will require repeated surveys of skill requirements. Nevertheless, structural change in the composition of occupations is likely to be a major source of change in the prevalence graduate jobs. In the short run one can usefully ask: how is the distribution of graduate jobs changing, conditional on no change in jobs classification.

The third column in Table 7 uses available information from the European Labour Force Survey (ELFS) to give a snapshot of change in the prevalence of graduate jobs. Owing to the adoption only in 2011 of the ISCO 2008 classification, the analysis is only available from that date, and applies only to European countries. The period 2011-13 was one of slow recovery from recession, and might be expected to signal a slow resurgence of lower-skilled jobs; while the long-term trend has been for growth in skilled jobs in most countries. In fact, expansion of high skills employment is not universal. As can be seen, rather than Germany or France catching up with the prevalence of graduate jobs elsewhere, both were falling further behind. Meanwhile, most of the high graduate job countries, with the exception of the Slovak Republic, exhibited increases.

Table 7. Proportion of graduate jobs by country/economy

Country/economy	Observed (%)	Surplus (%)	Change 2011-13
Czech Republic	19.8	-7.7	2.04**
Japan	22.6	-3.0	
Germany	23.8	-4.3	-1.81**
France	24.1	-3.1	-0.81**
Korea	28.2	2.4	
Italy	30.3	-1.4	1.81**
Spain	30.4	4.7	0.53**
Belgium	31.4	-1.7	1.32**
Denmark	31.6	4.5	0.46
UK (England./ Northern Ireland)	33.2	-0.5	0.34
Slovak Republic	34.5	6.2	-1.99**
Cyprus*	39.3	9.2	0.31
Poland	41.3	12.6	
Netherlands	44.2	11.3	2.13**
Norway	44.7	10.9	1.49**
Average (weighted)	27.6		

Notes: * See note 2. "Observed" is the proportion of jobs that are graduate jobs [derived from the Survey of Adult Skills, (PIAAC); "Surplus" is the country-average residual from a saturated linear regression of graduate job status on fully interacted sets of industry dummies, sector dummies and workplace size dummies. "Change 2011-13" is the percentage change in the proportion of graduate jobs in the employed labour force, derived from the European Labour Force Survey between 2011 and 2013. ** p<0.05.

Source: OECD (2016), *Survey of Adult Skills (PIAAC)* (Database 2012), www.oecd.org/site/piaac/publicdataandanalysis.htm.

The variable role of R&D intensity in the demand for graduate skills

In addition to cross-country variation, the variation within countries can usefully be studied to examine the importance of technology. In particular, further insight into the distribution of graduate jobs can be obtained by investigating variations in the strength of its association with R&D intensity. If, as suggested above, the disposition of graduate jobs may reflect the relative quality of higher education and of vocational sources of high-skilled labour, so might also its relationship with R&D. As with the intercept term, the association between graduate jobs and R&D intensity is likely to be affected by the relative quality of 'generalists' university graduates over other types of qualification, such as VET.

To investigate this, we ran regressions allowing the R&D coefficient to vary across countries, and the key results are shown in Table 8 below. The findings re-confirm that, with the odd exception (Korea), graduate jobs are significantly more common in R&D intensive industries conditional on the other covariates. But, the estimated coefficients vary between 0.002 in Korea to 0.08 in Poland. In other words, industries with a one percentage point greater R&D intensity had between 0 and 8 percentage point larger probability to employ individuals in a graduate job. Notably, Germany and Japan, two countries with relatively good work-based systems for high-skill acquisition, also show a low coefficients linking R&D intensity with graduate jobs. At the other end of the scale, the largest coefficient is for Poland (0.08), which is further indicative evidence that the VET programmes in that country may be rather poor relative to the quality of its university programmes.

Table 8. The association of R&D intensity with the prevalence of graduate jobs within countries/economies

Country/economy	ISCO(HE) 2008		
	Coef.		S.E.
Belgium (Flanders)	0.025	***	0.004
Cyprus*	0.044	***	0.013
Czech Republic	0.047	***	0.01
Denmark	0.025	***	0.002
France	0.017	***	0.002
Germany	0.012	***	0.003
Italy	0.021	**	0.007
Japan	0.009	***	0.001
Korea	0.002		0.002
Netherlands	0.009	***	0.002
Norway	0.03	***	0.004
Poland	0.08	***	0.019
Slovak Republic	0.046	**	0.017
Spain	0.028	***	0.006
United Kingdom (England/ Northern Ireland)	0.03	***	0.005

Notes: * See note 2. Linear probability model of graduate job indicator on industry and country-specific R&D Intensities. Industry level variable are from 2010 (2009 for Japan). Parameters displayed are the country-specific coefficients of R&D intensity. A set of firm-size dummies, dummies for public and not-for-profit sector, a dummy for a non-service-sector-workplace, age and age squared, foreign-born, and a gender dummy are included as controls. Standard errors statistics are shown in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source: OECD (2016), *Survey of Adult Skills (PIAAC)* (Database 2012), www.oecd.org/site/piaac/publicdataandanalysis.htm.

The remaining coefficients (not shown in the table) suggest further significant determinants of the graduate jobs demand besides R&D intensity. Workplaces in the public and charitable sector had a greater prevalence of graduate jobs than the private sector. Further, there appears to be significantly lower need for graduate jobs in non-service than in service industries. The prevalence of graduate jobs differed also by establishment size. Both ends of the spectrum (freelance job at the bottom end, and large workplaces with more than 250 employees at upper end) were more likely to require graduate jobs than small or medium-sized workplaces. Finally, there are socio-demographic differences: women and people born abroad were generally less likely to work in graduate jobs.

7. Conclusion

In this study we have derived a novel, data-driven and international indicator of graduate jobs, using a combination of self-reported required education, task data and further determinants of national demand for higher education in the labour market. The proposed procedure is transparent and replicable. It does not rely on expert judgement and is thus applicable to other countries and could track occupational upgrading wherever the required skills use data is available.

The resulting classifier ISCO(HE) 2008 is conceptually valid since it is grounded in the utilisation of high-level skills on the job. It takes potential cross-national differences arising from the varying relative quality of graduates into account, and the implied relative qualities are internationally correlated reasonably well with the relative proficiency scores of graduates and others. Further statistical tests show that the indicator explains the labour market outcomes of mismatched graduates – wage penalty, job dissatisfaction and lower participation in training – at least as well and usually better than the traditional delineation of graduate jobs as being drawn from occupations in ISCO 2008 major groups 1 and 2, and better also than an indicator based on realised matches within occupations.

The analyses based on ISCO(HE) 2008 show that graduate skills are essential in more than a narrow set of traditional professional and management jobs. Overall, 27.6% of jobs in the countries examined are graduate jobs, including many in ISCO major group 3. Yet there are considerable differences across countries:

- The proportion of graduate jobs in the labour market was lowest in the Czech Republic, Japan and highest in Poland, the Netherlands and Norway.

- Within countries technology intensity, establishment size and public ownership raise the proportion of graduate jobs, with the pattern largely consistent across countries. However, variation in industry structure and firm-size composition explains little of the differences between countries in the prevalence of graduate jobs.

- The demand does, however, reflect the country-level relative quality of HE, as opposed to non-HE routes to high-skill acquisition. The Survey of Adult Skills (PIAAC) data on literacy and numeracy proficiency of graduates and others corroborates this conjecture.

Potential caveats need to be noted. First, it is challenging to classify occupations and qualifications across countries into an internationally comparable taxonomy. Considerable efforts were made in PIAAC to ensure internationally commensurate classification, but some ambiguity remains. Second, our classification approach relies on the decomposition of the self-report qualification requirements into a component that can be attributed to the variation into more objective skill use indicators, further systematic determinants of HE demand, and an unobserved component that is assumed to summarise measurement and reporting error. In doing this, we assume that work tasks are exogenous to the individual worker, but this might not necessarily fully hold, especially for graduates who normally enjoy some autonomy over how they conduct their work. Third, a dichotomous classification system is likely to entail grey areas where the classification decision is close: Annex A lists those occupations in each country where the difference from the threshold is potentially within survey sampling error margins (there are not many of these). Moreover, the considerable simplification of a dichotomous graduate/non-graduate job classification is likely to be of value only in a meso- or macro-social context, and inevitably does not discriminate among heterogeneous graduate jobs.

With the above caveats in mind, potential uses of a graduate jobs indicator include application by HR professionals in careers guidance for HE students and graduates, and employability assessments of HE institutions (and sub-groups within them), in addition to its potential role in analysing high-skill labour markets. Such analyses can be conducted both between countries using The Survey of Adult Skills (PIAAC) and within countries using other data sets with decent sample sizes, wherever occupation has been appropriately coded.

To address further the functioning of graduate labour markets following the universal massification of higher education, the match between graduates and graduate jobs needs to be examined. A key feature of the graduate job concept behind ISCO(HE) 2008 is that it does not derive from job-holders' own qualification level. Consequently, among graduates the classifier allows us to define an overqualified or overeducated graduate as a graduate in a non-graduate job, without recourse to assumptions about how job skills are distributed within occupational groups. In forthcoming research, we utilise ISCO(HE) 2008 to analyse the international pattern of graduate overqualification.

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ANNEX A: LIST OF GRADUATE JOBS

This Annex lists occupation minor groups which are, at least in some countries, classified as graduate jobs. Shaded cells indicate that the skills requirements of the job are above or below the national threshold but the difference is not statistically significant at the 5% level.

Table A.1. Graduate jobs in major groups 1-4 (1 = graduate job, 0 = non-graduate job)

ISCO08 minor group	BE	CY[1]	CZ	DE	DK	ES	FR	IT	JP	KO	NL	NO	PL	SK	UK
111 Legislators and senior officials	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1
112 Managing directors and chief executives	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
121 Business services and administration managers	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
122 Sales, marketing and development managers	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
131 Production managers in agriculture, forestry and fisheries	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1
132 Manufacturing, mining, construction, and distribution managers	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1
133 Information and communications technology service managers	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
134 Professional services managers	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
141 Hotel and restaurant managers	1	1	0	0	0	0	0	1	1	0	0	0	1	0	0
142 Retail and wholesale trade managers	1	1	0	0	1	0	1	1	1	1	0	0	1	1	0
143 Other services managers	1	1	1	0	1	1	1	1	1	1	1	0	1	1	1
211 Physical and earth science professionals	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1
212 Mathematicians, actuaries and statisticians	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
213 Life science professionals	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
214 Engineering professionals (excluding electrotechnology)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
215 Electrotechnology engineers	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
216 Architects, planners, surveyors and designers	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
221 Medical doctors	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Table A.1. Graduate jobs in major groups 1-4 (1 = graduate job, 0 = non-graduate job) (*continued*)

ISCO08 minor group	BE	CY[1]	CZ	DE	DK	ES	FR	IT	JP	KO	NL	NO	PL	SK	UK
222 Nursing and midwifery professionals	0	1	0	1	1	1	1	1	0	0	1	1	1	1	1
223 Traditional and complementary medicine professionals	0	1	0	1	1	1	1	1	0	1	1	1	1	1	1
224 Paramedical practitioners	0	1	0	1	1	1	1	1	0	1	0	1	1	1	1
225 Veterinarians	0	1	0	1	1	1	1	1	0	1	1	1	1	1	1
226 Other health professionals	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1
231 University and higher education teachers	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
232 Vocational education teachers	0	1	1	1	1	1	1	0	1	1	1	1	1	1	1
233 Secondary education teachers	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
234 Primary school and early childhood teachers	0	1	1	1	0	1	1	1	1	0	1	1	1	1	1
235 Other teaching professionals	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
241 Finance professionals	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
242 Administration professionals	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
243 Sales, marketing and public relations professionals	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
251 Software and applications developers and analysts	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
252 Database and network professionals	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
261 Legal professionals	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
262 Librarians, archivists and curators	0	1	1	1	1	1	1	1	1	0	1	1	1	1	1
263 Social and religious professionals	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1
264 Authors, journalists and linguists	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1
265 Creative and performing artists	0	1	0	1	1	0	1	0	0	1	0	0	0	0	1
311 Physical and engineering science technicians	0	1	0	0	0	0	0	0	1	1	1	1	1	0	0
312 Mining, manufacturing and construction supervisors	0	0	0	0	0	0	0	1	0	0	0	1	1	1	0
313 Process control technicians	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0
314 Life science technicians and related associate professionals	0	1	0	0	1	0	1	0	1	0	1	1	1	0	1
315 Ship and aircraft controllers and technicians	0	0	0	0	0	0	1	0	1	0	0	0	1	0	0
321 Medical and pharmaceutical technicians	0	1	0	0	0	0	0	1	0	0	1	1	0	0	0
322 Nursing and midwifery associate professionals	0	1	0	0	0	0	1	1	0	0	0	1	1	0	1
323 Traditional and complementary medicine associate professionals	0	1	0	0	0	0	0	1	0	0	0	1	1	0	1

Table A.1. Graduate jobs in major groups 1-4 (1 = graduate job, 0 = non-graduate job) (*continued*)

ISCO08 minor group	BE	CY[1]	CZ	DE	DK	ES	FR	IT	JP	KO	NL	NO	PL	SK	UK
324 Veterinary technicians and assistants	0	1	0	0	0	0	0	1	0	0	0	1	1	0	0
325 Other health associate professionals	0	1	1	0	0	0	0	1	0	0	0	1	1	0	1
331 Financial and mathematical associate professionals	1	1	0	0	0	1	1	1	1	1	1	1	1	0	1
332 Sales and purchasing agents and brokers	1	0	0	0	0	1	0	1	0	0	1	0	1	0	0
333 Business services agents	0	1	0	1	0	0	1	1	0	1	1	1	1	1	0
334 Administrative and specialised secretaries	0	1	0	1	1	1	0	1	0	1	0	0	1	1	0
335 Regulatory government associate professionals	0	1	0	1	1	1	0	0	1	1	1	0	1	1	1
341 Legal, social and religious associate professionals	0	1	0	0	0	1	0	1	0	1	0	1	1	0	0
342 Sports and fitness workers	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0
343 Artistic, cultural and culinary associate professionals	0	1	0	0	0	1	0	1	0	0	0	1	1	0	0
351 Information and communications technology operations and user support technicians	1	1	1	0	0	1	1	0	1	1	0	0	1	1	0
352 Telecommunications and broadcasting technicians	1	1	0	0	1	1	0	0	0	0	0	0	1	1	0
411 General office clerks	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0
412 Secretaries (general)	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
413 Keyboard operators	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
421 Tellers, money collectors and related clerks	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
422 Client information workers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
431 Numerical clerks	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
432 Material-recording and transport clerks	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
441 Other clerical support workers	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0

1. Note by Turkey:

The information in this document with reference to “Cyprus” relates to the southern part of the Island. There is no single authority representing both Turkish and Greek Cypriot people on the Island. Turkey recognises the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of the United Nations, Turkey shall preserve its position concerning the “Cyprus issue”.

Note by all the European Union Member States of the OECD and the European Union:

The Republic of Cyprus is recognised by all members of the United Nations with the exception of Turkey. The information in this document relates to the area under the effective control of the Government of the Republic of Cyprus.

Source: OECD (2016), *Survey of Adult Skills (PIAAC)* (Database 2012), www.oecd.org/site/piaac/publicdataandanalysis.htm.