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The causes and consequences of field-of-study mismatch: An analysis using PIAAC

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THE CAUSES AND CONSEQUENCES OF FIELD-OF-STUDY MISMATCH: AN ANALYSIS USING PIAAC

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ABSTRACT

Field-of-study mismatch occurs when workers educated in a particular field work in another. It is conceptually distinct from qualifications or skills mismatch, although a part of qualifications and skills mismatch results from graduates from a particular field having to downgrade to find work in another field. Some studies have identified labour market dynamics related to field-of-study mismatch, but few (if any) have sought to directly understand the interplay between labour supply factors (the types of skills brought to the workplace) and the labour demand factors (the types of skills demanded by employers) in field-of-study mismatch. Using data from the Programme for International Assessment of Adult Competencies' Survey of Adult Skills (PIAAC), this paper shows that although students may choose to specialise in a particular field, it is not solely up to them to actually work in that field. In accordance with assignment theories, both the degree of saturation of a particular field in the labour market and the level of generic skills of a particular field predict the occurrence of field-of-study mismatch, highlighting that mismatch is the result of both labour supply- and demand-side factors. The paper then evaluates the costs to individuals – in terms of wages, risk of being out of work and job satisfaction. Findings suggest that the costs of field-of-study mismatch may only be high in terms of individual earnings when it is associated to qualification mismatch. For economies, field-of-study mismatch, when associated with qualifications mismatch, can amount to important costs, meriting the attention of policy makers to better aligning course places to skill needs or by encouraging skill transferability across fields.

RÉSUMÉ

L'inadéquation du domaine d'études se produit lorsque des travailleurs, formés dans un domaine particulier, travaillent dans un autre domaine. Conceptuellement, elle se distingue de l'inadéquation des compétences ou des qualifications, même si, une part de ces dernières se produit lorsque les diplômés d'un domaine d'étude doivent se déclasser pour trouver un emploi dans un autre domaine. Certaines études ont montré que la dynamique du marché du travail est liée à l'inadéquation du domaine d'études, mais peu (ou pas) ont directement tenté de comprendre la relation entre les facteurs d'offre de travail (les types de compétences amenées par les travailleurs sur le lieu de travail) et les facteurs de demande de travail (les types de compétences demandées par les employeurs), dans l'inadéquation du domaine d'études. En utilisant des données du Programme pour l'Évaluation Internationale des Compétences des Adultes (PIAAC), ce document montre que même si les étudiants ont la possibilité de choisir de se spécialiser dans un domaine particulier, ils ne sont pas seuls responsables de pouvoir effectivement travailler dans ce domaine. Conformément aux théories sur les choix d'orientation, tant le degré de saturation d'un domaine sur le marché du travail que le degré de compétences génériques du domaine d'études, prédisent l'apparition d'une inadéquation du domaine d'études, soulignant que cette dernière est le résultat de facteurs liés à la fois à l'offre et à la demande de travail. Le document évalue ensuite les coûts, pour les individus, en termes de salaires, de risque d'être sans travail et de satisfaction au travail. Les résultats suggèrent que les coûts de l'inadéquation du domaine d'études peuvent être élevés au niveau individuel que lorsqu'elle est associée à l'inadéquation des qualifications. Pour les économies, l'inadéquation du domaine d'études, quand elle est associée à l'inadéquation des qualifications, peut signifier des coûts importants, méritant l'attention des décideurs politiques en ajustant mieux les places vacantes dans les programmes d'études aux besoins de compétences, ou en encourageant les transferts de compétences.

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1 Introduction

1. Field-of-study mismatch occurs when a worker, trained in a particular field, works in another field (e.g. a worker trained in the law, business and social sciences field works in the services sector, or, as Sloane (2003) illustrates, that of an English major working as a statistician). Conceptually and empirically, field-of-study mismatch is distinct from qualifications or skills mismatch in that a worker may be matched to the job in terms of the key information-processing skills possessed (skills match) or the quantity of schooling received (qualifications match) but not by the *type* of schooling received (Robst, 2008; Sloane, 2003, Quintini, 2011a). Although field-of-study mismatch is one of the reasons behind qualifications mismatch (e.g. if there is no work in their particular field, job-seekers may have to downgrade to find a job), only a part of field-of-study mismatch can be considered qualifications mismatch (Quintini, 2011a; Ortiz and Kucel, 2008). Box 1 provides more details on the theory behind field-of-study mismatch.

2. Even if field-of-study mismatch does not entail a qualification mismatch, it is worthy of attention for several reasons. First, several individuals enter a field-of-study with the expectation to pursue a career in that field and, if mismatched, workers face the disappointment of unmet expectations. Mismatched workers by field may also be more likely to earn a lower salary compared to their matched peers. They are also less likely to be satisfied in their work. A large part of the wage penalty that field-of-study mismatched workers experience, but certainly not all, is more related to the need of many mismatched workers to downgrade (i.e. qualifications mismatch) than to the fact that they are working in another field (Robst, 2008). A small part of the penalty is related specifically to the mismatch by field-of-study after accounting from any resulting qualifications mismatch. The size of the penalty also varies by field-of-study (Robst, 2007a; Chevalier, 2012).

3. For employers, the consequences that field-of-study mismatch brings on workers translate into lower levels of productivity, higher on-the-job-search for other jobs and, potentially, higher turnover (Wolbers, 2003). Hiring mismatched workers also has direct consequences to employers stemming from the need to train workers for field-specific skills that the mismatched workers do not bring with them (Nordin, Persson et al, 2010). Lastly, for the economy as a whole, field-of-study mismatch involves the (costly) provision of field-specific skills in formal training that will not be used by workers in their mismatched job, the need to train workers for the field-specific skills required in their job as well as the aggregated losses in productivity.

4. In studying field-of-study mismatch, the literature has generally ignored how skill supply and skill demand dynamics influence mismatch (see Box 2). A first contribution of this paper is to provide measures of field saturation and the transferability of skills – as proxies of skill demand and supply, respectively – from each field and link them to the likelihood of field-of-study mismatch. A worker is mismatched by field of study if he works in a group of occupations (occupational group) unrelated to his/her field of study (see Annex 2). A field is saturated in the labour market when there are more graduates in the corresponding occupational group relative to the jobs available in the occupational group; if there are few jobs available in an occupational group, workers are forced to search elsewhere for a job. Field saturation is estimated, as described in section 3.1.1, by the ratio of the number of graduates from a particular field to the number of workers in the corresponding occupational group. A field provides transferable skills when workers can work in different fields without having to downgrade. It is determined by the generality/specificity of the skills provided in the field's formal training and the degree to which employer value skills from other fields. Each field of study's skill transferability is estimated by the proportion of workers working in another occupational group that are not mismatched in terms of skills or qualifications. These measures provide a first approximation at the relative contribution of broader demand and supply factors in predicting field-of-study mismatch.

Box 1. **The theory behind field-of-study mismatch**

Hartog (2000) uses human capital, job-competition and assignment theories to frame overqualification and the relationship to wages. This framework can be applied to field-of-study mismatch. From a human capital theory perspective, firms will adapt their production process to changes in the relative supply of labour. Under human capital theory, any mismatch, including field-of-study mismatch, is temporary and firms will adjust their demand and productive process to the available stock of human capital. Although temporary under human capital theory, mismatch can be prolonged and costly for individuals. Job-competition theory provides an alternative framework to human capital theory. Job-competition theories argue, in contrast, that workers line up in the hiring queue – according to their educational credentials and field of study, or other criteria relevant to employers for the purposes of sorting job-seekers for the available vacancies – but it is the characteristics of the job that determines the productivity of the job, not the human capital stock of the employee. In the job competition model, field-of-study mismatch is a result of employers in a particular occupational group requiring more workers than available in the corresponding field, thus having to draw workers from further down the queue, reaching those that come from different fields. In job competition theory, field-of-study mismatch can also result from employers downplaying field-of-study as a relevant signal in the hiring process. Importantly, as workers' productivity depends on the characteristics of the job, in job competition theory there should be no wage penalty associated with field-of-study mismatch (or any other type of mismatch thereof).

While human capital theories predict that mismatches are temporary (and firms adapt to labour supply) and job-competition theories predict that there are no wage penalties associated with mismatch (and workers adapt to labour demand), empirical evidence supports a third, intermediate model: assignment theory. In it, the productivity of a job and the allocation process depends on both demand and supply factors (Sattinger, 1993). They specify that workers' income or utility maximisation guides workers to choose particular jobs over others, but, in equal importance, jobs or groups of occupations available to workers and the mechanism that assigns workers to jobs need to be considered. Thus, for a particular job, certain workers will have more advantages (as a result of their general and job/field-specific skills acquired in formal training) than others; but these jobs may or may not be available to them, possibly pushing them to choose other jobs or fields instead. Assignment theories predict that productivity (and wages) will depend on the quality of the match between the job and the worker, and that the likelihood of a field-of-study match will depend on both the skill demand in a particular occupational group and the supply of workers from the corresponding field.

Assignment theories thus predict, and these predictions are born out in the mismatch literature, that mismatched workers by field-of-study will suffer a wage penalty by virtue of their lower productivity (i.e. their lack field-specific skills) or higher costs (i.e. need to acquire field-specific skills) than their well-matched peers, and that, as workers acquire experience in the field of their jobs (and field-specific skills), the quality of the match between their skills and their job requirements will improve and so will their wages relative to their well-matched peers (Nordin, Persson et al., 2010).

A mismatched worker will not be able to use his/her field-specific skills on the job and their employers will not reward these skills. Field-of-study mismatched workers are thus expected (and do in general) earn lower salaries when compared to their well-matched peers (Robst, 2007a; Wolbers, 2003; McGuinness and Sloane, 2011), even after accounting for skill heterogeneity (Nordin, Persson et al., 2010) or qualification mismatch (Robst, 2008). Assignment theories predict that the wage penalty will vary across fields as certain workers will be more likely to be hired in occupations that have higher levels of pay. The variability in pay and field-of-study mismatch wage penalty may even promote mismatch: as some occupations pay higher wages (e.g. finance) workers trained in other fields (e.g. physics) may prefer to be mismatched to enjoy higher salaries. Results from this paper show, however, that, on average, there are more penalties than rewards associated to field-of-study mismatch. The negative relationship between numeracy skills and mismatch, shown in Figure 4, supports the assumption that workers do not voluntarily choose mismatch.

These individual costs aggregate to the economy as total output depends on the aggregation of how each worker performs the job, which, in turn, is affected by the quality of the match between workers and their jobs (Sattinger, 1993). The general costs of mismatch are not restricted to the loss in productivity as it implies other costs, such as the provision of field-specific skills that will not be used, the need to provide field-specific skills in training (in- or off-the-job) or the costs associated to unemployment if mismatched workers are more likely to be laid off by their employers.

Sources: Hartog, J. (2000), "Over-Education and Earnings: Where Are We, Where Should We Go?", *Economics of Education Review,* 19(2), pp. 131-147; McGuinness, S. and P. Sloane (2011), "Labour Market Mismatch among UK Graduates: An Analysis using REFLEX Data", Economics of Education Review, 30(1), pp. 130-145; Nordin, M., I. Persson and D. Rooth (2010), "Education-Occupation Mismatch: Is there an Income Penalty?", Economics of Education Review, 29(6), pp. 1047-1059; Robst, J. (2008), "Overeducation and College Major: Expanding the Definition of Mismatch between Schooling and Jobs", The Manchester School, 76(4), pp. 349-368; Robst, J. (2007a), "Education and Job Match: The Relatedness of College Major and Work", Economics of Education Review, 26(4), pp. 397-407; Sattinger, M. (1993), "Assignment Models of the Distribution of Earnings", Journal of economic literature, 31(2), pp. 831-880; Wolbers, M.H.J. (2003), "Job Mismatches and their Labour-Market Effects among School-Leavers in Europe", European Sociological Review, 19(3), pp. 249-266.

Box 2. **Field-of-study mismatch and skill supply and demand**

Field-of-study mismatch can be understood as an assignment problem. Job assignment theories (see Box 1) suggest that the process of allocation of workers to jobs needs to consider both the supply and the demand of workers to understand field-of-study mismatch, motivating some researchers to verify how firm characteristics relate to mismatch. Wolbers (2003) finds, for example, that field-of-study mismatch is more common among workers in small firms, those in the private sector and among those under part-time or temporary contracts.

Despite the evidence of association between firm characteristics and field-of-study mismatch, and the fact that assignment theory suggests that field-of-study mismatch results from both labour demand and supply factors, research on field-of-study mismatch has ignored broader labour market characteristics in the understanding of field-of-study mismatch. Robst (2007a, 2007b) acknowledges that accepting a job on another field-of-study depends on both supply and demand factors. Supply factors include the transferability of skills acquired in formal training in the particular field (with those degrees that have a higher emphasis on the provision of general skills – as opposed to job/field/occupation-specific skills –being more likely to promote out-field employment). Pay and promotion, career interests, working conditions, job location, family-related reasons and other preferences a worker has for different job characteristics are other supply-side factors predicting field-of-study-mismatch. Demand factors driving field-of-study mismatch refer to the fact that a job in the related occupational group is not available.

Previous studies, however, have not included these supply and demand attributes in the analysis. The general/specific orientation of the formal training received has been evaluated qualitatively and rather subjectively by mentioning that training in fields like the humanities are more general-oriented than those in health and welfare while observing that, coincidentally, field-of-study mismatch is higher among the former than the latter (Robst, 2007a) or by respondent self-reports of the nature of the training received (Verhaest, Sellami and van der Velden, 2013). But demand factors may explain the occurrence of this mismatch as well, as the availability of jobs in the humanities may be lower, relative to the number of graduates, than those in the health and welfare professions. The relationship between demand and mismatch has yet to be empirically tested. The joint occurrence of the transferability of skills in a given field and the demand for workers in that field has not been tested empirically, as most field-of-mismatch studies typically ignore the broader labour market context in which field-of-study mismatch takes place. A first exception is Wolbers (2003), who finds that mismatch is more common among workers who enter the labour market in a context of economic recession, pointing to broad demand factors, but does not analyse field-specific demand. The theoretical likelihood of the relationship between the labour market context and the likelihood of field-of-study mismatch is even clearer by acknowledging that employers rank field-specific knowledge as the most important attribute in determining a prospective workers' employability (Humburg, van der Velden et al., 2013), so the lack of employers in a particular field (irrespective of graduates' individual characteristics) will hinder graduates' employability because their field of specialisation is not aligned with the market demand for that field. A second exception to the consideration of labour market conditions in predicting mismatch is Verhaest, Sellami and van der Velden (2013) and Verhaest and van der Velden (2013) who find that business cycles explain the likelihood of overeducation, that skill transferability explain the likelihood of both qualification and field-of-study mismatch. They also find a relationship between the labour market context (employment protection legislation, level of unemployment benefits and union bargaining power) and the likelihood of mismatch.

Sources: Humburg, M., R. Van der Velden and A. Verhagen (2013), The Employability of Higher Education Graduates: The Employers' Perspective, Brussels: Publications Office of the European Union; Robst, J. (2007a), "Education and Job Match: The Relatedness of College Major and Work", Economics of Education Review, 26(4), pp. 397-407; Robst, J., (2007b), "Education, College Major, and Job Match: Gender Differences in Reasons for Mismatch", Education Economics, 15(2), pp. 159-175; Verhaest, D. S. Sellami and R. van der Velden (2013), *Differences in Horizontal and Vertical Mismatches across Countries and Fields of Study*, Studie-en Schoolloopbanen, Brussels; Verhaest, D. and R. van der Velden (2013), "Cross-Country Differences in Graduate Overeducation", *European Sociological Review*, Vol. 29, No. 3, pp 642-653; Wolbers, M.H.J., (2003), "Job Mismatches and their Labour-Market Effects among School-Leavers in Europe", European Sociological Review, 19(3), pp. 249-266.

5. A second contribution of this paper is to attempt to estimate the cost of field-of-study mismatch at the aggregate level in addition to providing the most up-to-date and internationally comparable estimates of its impact on individual wages, job satisfaction and unemployment risk.

6. To sum up, this paper 1) characterises field-of-study mismatch in the context of other forms of mismatch (namely skill and qualification mismatch); 2) provides field-specific measures of the saturation of that field in the labour market and the transferability of skills for each field; 3) estimates the relative effect of each of these broader demand and supply factors in predicting field-of-study mismatch; 4) estimates the consequences of field-of-study mismatch to workers in terms of wages, satisfaction and unemployment risk; and 5) estimates the system-level costs of field-of-study mismatch.

2 How much field-of-study mismatch is there? How much of it is qualification or skills mismatch?

7. This paper follows Wolbers's (2003) and Quintini's (2011b) normative approach to the measurement of field-of-study mismatch in a cross-national context, whereby each education degree is categorised in one of nine fields and each ISCO-3 digit occupation is matched to one or more fields. In PIAAC[1], respondents were asked "What was the area of study, emphasis or major for your highest level of qualification? If there was more than one, please choose the one you consider most important"[2] with respondents asked to select one of nine field categories: i) general programmes, ii) teacher training and education science, iii) humanities, languages and arts, iv) social sciences, business and law, v) science, mathematics and computing, vi) engineering, manufacturing and construction, vii) agriculture and veterinary, viii) health and welfare and ix) services[3]. Respondents are also asked an open question about their job title and their responsibilities in the job (both for their current job or the one they last held, if they are currently unemployed or out of the labour force). These descriptions are used to derive each respondent's ISCO-08 3-digit occupation. Using Quintini's (2011b) coding strategy, updated for ISCO-08 codes, each occupation is assigned to one of the nine fields of study. Whenever a worker reports having studied in a field that is different than the field(s) that correspond to his/her occupation, the worker is considered to be mismatched by field of study. The coding that assigns each occupational code to the corresponding field or fields of study is available in Annex 2. Under this coding scheme, certain occupations may be matched to more than one field, as a particular occupation may be a relevant destination for graduates from different fields (e.g. an author, journalist or linguist (ISCO-08 code 264) is considered to be matched to his/her field of study if they graduated from the "Humanities, languages and arts" or "Social sciences, business and law" fields). Box 3 discusses different approaches to measuring field-of-study mismatch.

8. Figure 1 (and Table 1 in Annex 3) in Annex 3) shows the rates of field-of-study mismatch across participating countries. On average across the 22 countries, 39% of workers are working in a field that is different from their field of study. In all countries the rate of mismatch is close to or above 25%. Field-of-study mismatch is most common in Australia, England/N. Ireland (UK), Italy, Japan, Korea and the United States, where more than 45% of workers are mismatched. Field-of-study mismatch is lowest in Finland, at 23%, Germany, at 26% and Austria, at 28% (Box 4 compares these results from PIAAC with those estimated from other surveys).

9. In any dynamic economy some level of mismatch is expected and the cross-country comparison allows for an international benchmarking without specifying what minimum level is attainable or desirable. Some of this mismatch is frictional and results from workers accepting jobs in which they are mismatched by field of study as they search for the job that best fits their skills and interests; mismatch also results from the

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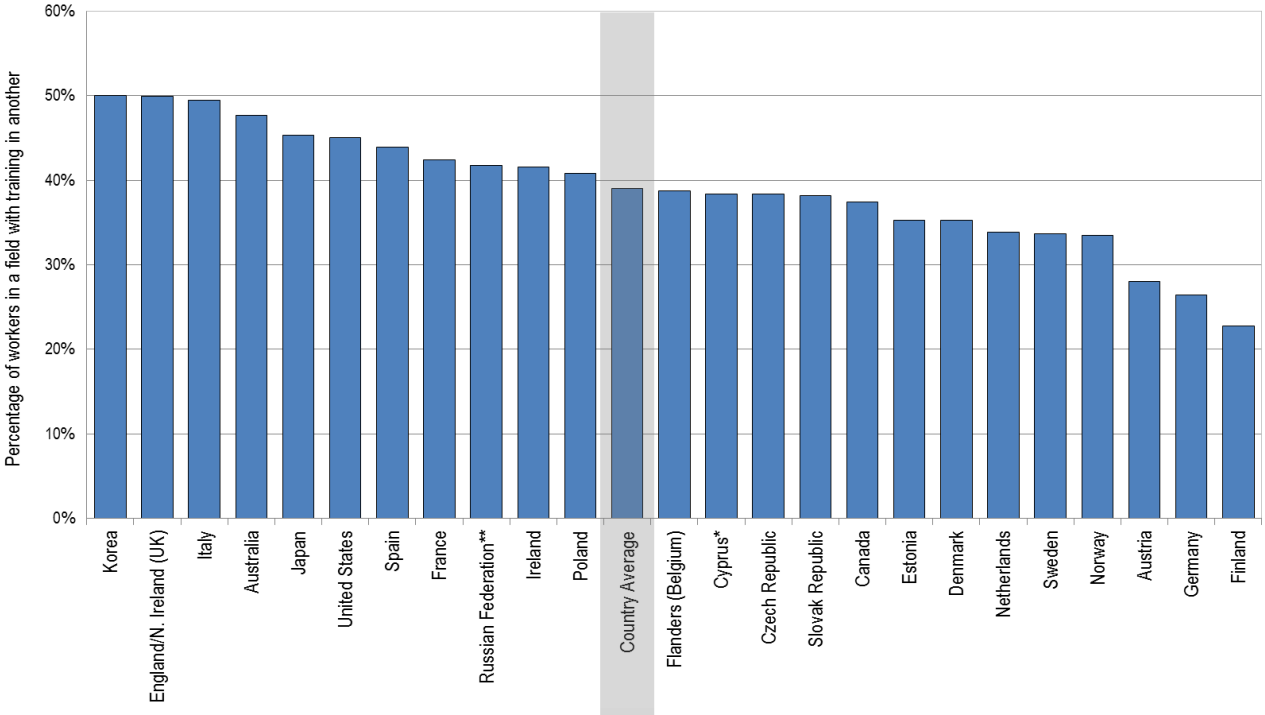
1. PIAAC refers to the Programme of International Assessment of Adult Competencies' Survey of Adult Skills. Annex 1 provides details on the characteristics of the sample and the data used for this paper's analyses.

2. PIAAC asks about the highest qualification. For individuals with more than one qualification it is not possible to assess which is the latest one or the one that is most closely related to their job. Certain individuals may have obtained a qualification and went back to education to earn a second, lowest one which more closely matches their career interests. Although impossible to quantify in PIAAC, these cases would be marked as mismatched by field of study when, in practice they may not experience such mismatch.

3. Services includes fields related to the provision of personal services, transport services, environmental protection and security services.

fact that individuals' decisions to invest in training were made in the context of an economy that has changed; or from changes in an economy's or occupation's skill demand as a result of technological change, the global division of labour, economic cycles and changes in the way firms are organised. The seeming inevitability of mismatch does not preclude countries from developing policies and programmes to reduce it or to limit their negative effects on individuals' and an economy's outcomes.

Figure 1. **Prevalence of field-of-study mismatch across countries**



Countries are sorted in descending order on the percentage of workers mismatched by field-of-study.

* 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.

** The data from the Russian Federation are preliminary and may be subject to change. Readers should note that the sample for the Russian Federation does not include the population of the Moscow municipal area. The data published, therefore, do not represent the entire resident population aged 16-65 in Russia but rather the population of Russia excluding the population residing in the Moscow municipal area. More detailed information regarding the data from the Russian Federation as well as that of other countries can be found in the Technical Report of the Survey of Adult Skills (OECD, 2013a).

Source: Annex 3, Table 1.

Box 3. **Measuring field-of-study mismatch**

In general, studies analysing skills, qualification, or field-of-study mismatch define mismatch through either self-reports, the use of normative definitions or statistical definitions (Quintini, 2011a). Self-reported field-of-study mismatch asks respondents the degree to which they feel their initial training is required in their job. While self-reported mismatch measures are common in the field-of-study mismatch literature (see, for example, Robst, 2007a; Robst, 2007b; Robst, 2008; Hensen, De Vries et al., 2009; Kim, Ahn et al., 2012; Klein, 2010; McGuinness and Sloane 2011; Kelly, O'Connell et al., 2010) they suffer from certain complications that limit their validity or cross-national comparability. A self-reported mismatch may be related to wages or other job characteristics, as it may be a way for workers to rationalise their disappointment with their work. Self-reported mismatch may limit cross-national comparisons as certain situations of mismatch may be considered as such by some workers in certain cultural frame of reference but not in others. Comparisons across studies are further limited by the fact that the questions used to measure self-reported mismatch differ in their wording or their response options.

Normative definitions of field-of-study mismatch, by contrast, compare the education and training received by the worker and the type of job he/she performs. It requires precise categorisations of the jobs held by workers and the education received as well as an assessment of the match between the two. The fact that this definition is more precise and based on cross-nationally comparable definitions of occupations (e.g. ISCO codes) and education levels (e.g. fields of study) allows for better comparisons across countries. Depending on the precision with which education and training and job/occupation data is collected and sample size, studies can evaluate match to a more precise degree or even evaluate gradations of the quality of the match (see, for example, Wolbers, 2003; Béduwé and Giret, 2011: Nordin, Persson et al., 2010).

Sources: Béduwé, C. and J. Giret (2011), "Mismatch of Vocational Graduates: What Penalty on French Labour Market?", *Journal of Vocational Behavior,* 78(1), pp. 68-79; Hensen, M.M., M.R, De Vries and F. Cörvers (2009), "The Role of Geographic Mobility in Reducing Education-Job Mismatches in the Netherlands", *Papers in Regional Science,* 88(3), pp. 667-682; Kelly, E., P.J. O'Connell and E. Smyth (2010), "The Economic Returns to Field of Study and Competencies among Higher Education Graduates in Ireland", *Economics of Education Review,* 29(4), pp. 650-657; Kim, H., S.C. Ahn and J. Kim (2012), "Vertical and Horizontal Education-Job Mismatches in the Korean Youth Labor Market: A Quantile Regression Approach", *Working Papers 1201, Research Institute for Market Economy, Sogang*; Klein, M. (2010), "Mechanisms for the Effect of Field of Study on the Transition from Higher Education to Work", *Working Papers, Mannheimer Zentrum für Europäische Sozialforschung*, 130; McGuinness, S. and P.J. Sloane (2011), "Labour Market Mismatch among UK Graduates: An Analysis using REFLEX Data", *Economics of Education Review,* 30(1), pp. 130-145; Nordin, M., I. Persson and D. Rooth (2010, "Education–Occupation Mismatch: Is there an Income Penalty?", *Economics of Education Review,* 29(6), pp. 1047-1059; Robst, J. (2008), "Overeducation and College Major: Expanding the Definition of Mismatch between Schooling and Jobs", *The Manchester School,* 76(4), pp. 349-368; Robst, J. (2007a), "Education and Job Match: The Relatedness of College Major and Work", *Economics of Education Review,* 26(4), pp. 397-407; Robst, J. (2007b), "Education, College Major, and Job Match: Gender Differences in Reasons for Mismatch", *Education Economics,* 15(2), pp. 159-175; Wolbers, M.H.J. (2003), "Job Mismatches and their Labour-Market Effects among School-Leavers in Europe", *European Sociological Review,* 19(3), pp. 249-266.

Box 4. **Evidence of field-of-study mismatch from other surveys**

Unfortunately, PIAAC estimates shown in Figure 1 are not comparable to those of studies of participating countries relying on self-reports or (e.g. Kim, Ahn et al. (2012) for Korea, Klein (2010) for Germany, or Robst (2007a) for the United States; see Box 3) or those using non-comparable normative definitions because they are based on another set of field categories (e.g. Nordin, Persson et al. (2010) for Sweden).

These estimates are consistent with field-of-study mismatch estimates from the 2004 European Social Survey (ESS) in Quintini (2011a) for 8 of the 12 countries that are in both studies (Denmark, Finland, Ireland, Germany, the Netherlands, Norway, Spain and Sweden). There are differences, however, and they are most notable in Austria (ESS finds 36% of field of study mismatch while PIAAC finds 28%), the Czech Republic (ESS: 23%, PIAAC: 36%), Estonia (ESS: 28%, PIAAC: 33%), and Poland (ESS: 32%, PIAAC: 38%).

The differences in estimates of observed field-of-study mismatch in ESS and PIAAC in these four countries could be due to real changes that have shifted the prevalence of mismatch over the 8 years between the surveys (e.g. effect of the financial crisis in these countries or changes in the job-matching mechanisms) or to subtle methodological differences that are particularly relevant in certain countries but not in others.

To test the robustness of field-of-study mismatch in PIAAC, Annex 4 compares the measures of field-of-study mismatch estimated with PIAAC for the year 2012 with those of the 2012 European Labour Force Survey. Results diverge, and this divergence could result from 1) the EULFS filters the measurement of field-of-study to individuals who graduated in the past two years while PIAAC does not have a large enough sample to compare recently graduated individuals and/or 2) that PIAAC relies on subjective assessments of field-of-study while EULFS relies on a normative approach. Estimates from PIAAC and EULFS will thus differ if there are age, period or cohort differences in field characteristics (from (1)) or if certain or all individuals differ in the way they characterise their field-of-study with respect to the normative criteria used by the EULFS (from (2)).

Sources: Kim, H., S.C. Ahn and J. Kim (2012), "Vertical and Horizontal Education-Job Mismatches in the Korean Youth Labor Market: A Quantile Regression Approach", Working Papers 1201, Research Institute for Market Economy, Sogang; Klein, M. (2010), "Mechanisms for the Effect of Field-of-study on the Transition from Higher Education to Work", Working Papers, Mannheimer Zentrum für Europäische Sozialforschung, 130; Robst, J. (2007a), "Education and Job Match: The Relatedness of College Major and Work", Economics of Education Review, 26(4), pp. 397-407; Nordin, M., I. Persson and D. Rooth, (2010), "Education–Occupation Mismatch: Is there an Income Penalty?", Economics of Education Review, 29(6), pp. 1047-1059; Quintini, G. (2011a), "Over-Qualified or Under-Skilled: A Review of Existing Literature", OECD Social, Employment an Migration Working Papers, 121.

10. By field, the 2012 field-of-study mismatch estimates from PIAAC presented on Table 1 show that, on average across countries, around two-thirds of workers who studied "Science, mathematics or computing" work in another field, as do more than 70% of workers who studied "Humanities, languages and arts" or "Agriculture and veterinary". These high rates of mismatch may be indicative of lower labour market demand in these fields, forcing graduates from these fields to look elsewhere for jobs or that they face better job prospects given their skills in other fields; they could also signal greater transferability of skills from these fields, offering graduates from these fields greater ability to work in different occupational groups. Mismatch is greater than 85% among graduates from the "Humanities, languages and arts" field in Australia, England/N. Ireland (UK) and Japan, as well as among graduates from the "Agriculture and veterinary" field in Flanders (Belgium), Korea and Norway.

11. Conversely, less than 30% of working graduates from "Health and Welfare" and less than 25% of "Social science, business and law" working graduates are mismatched by field of study. Fewer than 20% of workers from the "Social science, business and law" field in Canada, Denmark, Finland, Germany, Italy, the Netherlands, Norway and Poland work in occupations unrelated to their field of study, as do less than 15% of graduates from the "Health and welfare" fields in Austria and Finland.

12. The previous section focused on mismatch according to workers' field of study. But mismatch can also be measured from the perspective of the worker's occupation. In which jobs is it most common to

find mismatched workers? The analysis by job[4] shows that more than four out of ten individuals working in the "Social science, business and law" and "Service" occupational groups were trained in other fields, possibly pointing out the fact that these occupational groups do not require a large amount of field-specific skills, that there is more demand for workers than supply or that employers value skills gained in other fields. The argument of high skill demand may particularly be the case in the "Social science, business and law" occupational group, as workers trained in this field are comparatively less likely to be mismatched. By contrast, around 1 in 5 workers in the "Science, mathematics and computing" and "Humanities, languages and arts" occupational groups were trained in other fields, suggesting, possibly, higher skill barriers to entry in these occupational groups or lower demand for workers in these occupations, with matched workers having a higher likelihood of obtaining a job in the field. It could also be the case that, for graduates from the "Science, mathematics and computing" and the "Humanities, languages and arts fields" it may be more attractive to work in other occupational groups in terms of pay if their qualifications are recognised. It is possible, then, to find graduates from the "Science, mathematics and computing field" working in the business or finance occupations (as is sometimes the case in the United Kingdom, for example) or workers attracted to other fields to benefit from the advantageous working conditions in unionised jobs (as is sometimes the case in Germany, for example).

13. Interestingly, as shown in Figure 2, some fields have high levels of mismatch among both graduates and among workers. Such is the case of "Agriculture and veterinary": almost three-quarters of graduates end up working in other occupational groups, but also around 30% of workers in that occupational group come from other fields. This occupational group may be highly saturated, forcing graduates to find jobs elsewhere (or training in this field could be transferable to other, more attractive occupations), but entrance to work in this occupational group also seems relatively open to graduates from other fields (Annex 2 provides details on the occupations that correspond to each field or occupational group). This could be due to differences by occupation level within the field: the field may be saturated at the professional level, forcing many graduates with university degrees in the field to work in other occupational groups, but the occupational group may face shortages or have low barriers to entry at the lower occupational levels, attracting graduates from other fields with upper secondary school qualifications specific to other occupational groups.

14. By contrast, many workers trained in "Science, mathematics and computing" find work in other occupational groups (65%), yet comparatively fewer workers trained in other fields work in "Science, mathematics and computing" (18%). This may signal high saturation in the field or high transferability of skills to the business or engineering fields (hence the graduates working in another field and very few from other fields) and also possibly high barriers to entry to the occupational group, as few workers from other occupational groups currently work in it.

15. Figure 3 decomposes field-of-study mismatch into its relationship to skills and qualification mismatch. On average across countries, half of field-of-study-mismatched workers are well matched in terms of qualifications and numeracy skills (i.e. mismatched by field-of-study only). These are workers that studied in a field unrelated to their current job (field-of-study mismatch) but they are in a job for which their educational level (qualifications match) and the literacy requirements are matched to the workers'

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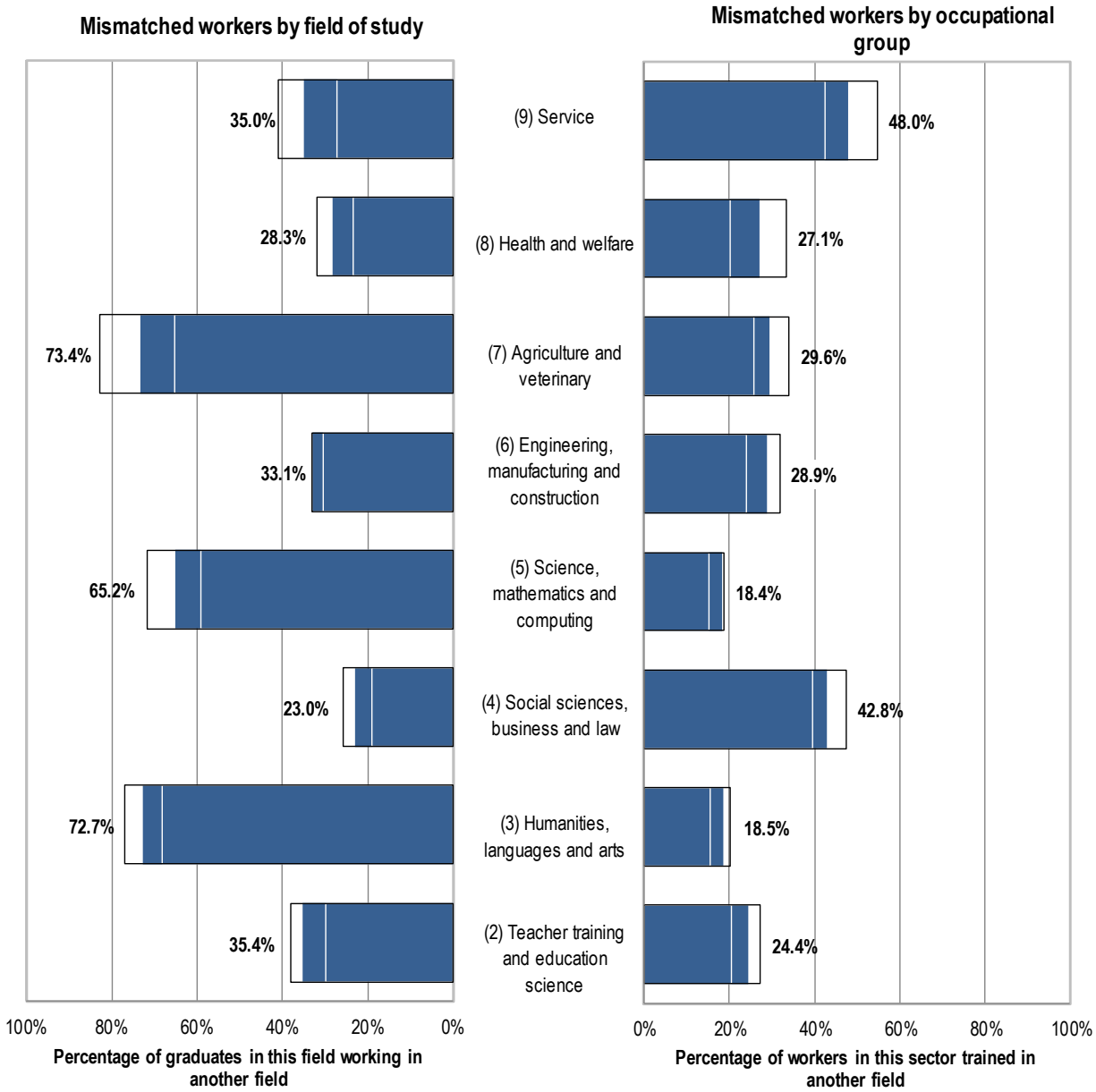
4. Jobs are grouped in sectors according to field of work, to match the categorisation for field of study. As described in more detail in the discussion of the construction of the field saturation index in section 3.1.1, given that several fields of study can lead to a matched occupation, a particular occupation can be matched to several fields of work. Because certain ISCO 3-digit codes cannot provide a one-to-one match between occupations and fields of study, this paper assumes the uncertainty by allowing certain occupations to correspond to more than one sector.

literacy levels (skills match). This signals that field-of-study mismatch is not only conceptually but also empirically distinct from qualifications or skills mismatch. For this group of workers, and on aggregate for the economy, the cost of mismatch relates to the sunk costs of providing field-specific training, the cost of providing supplementary training in their occupational group if they received any and any temporary or permanent wage penalty (and loss in productivity) as a result of the lack of occupational group-specific skills.

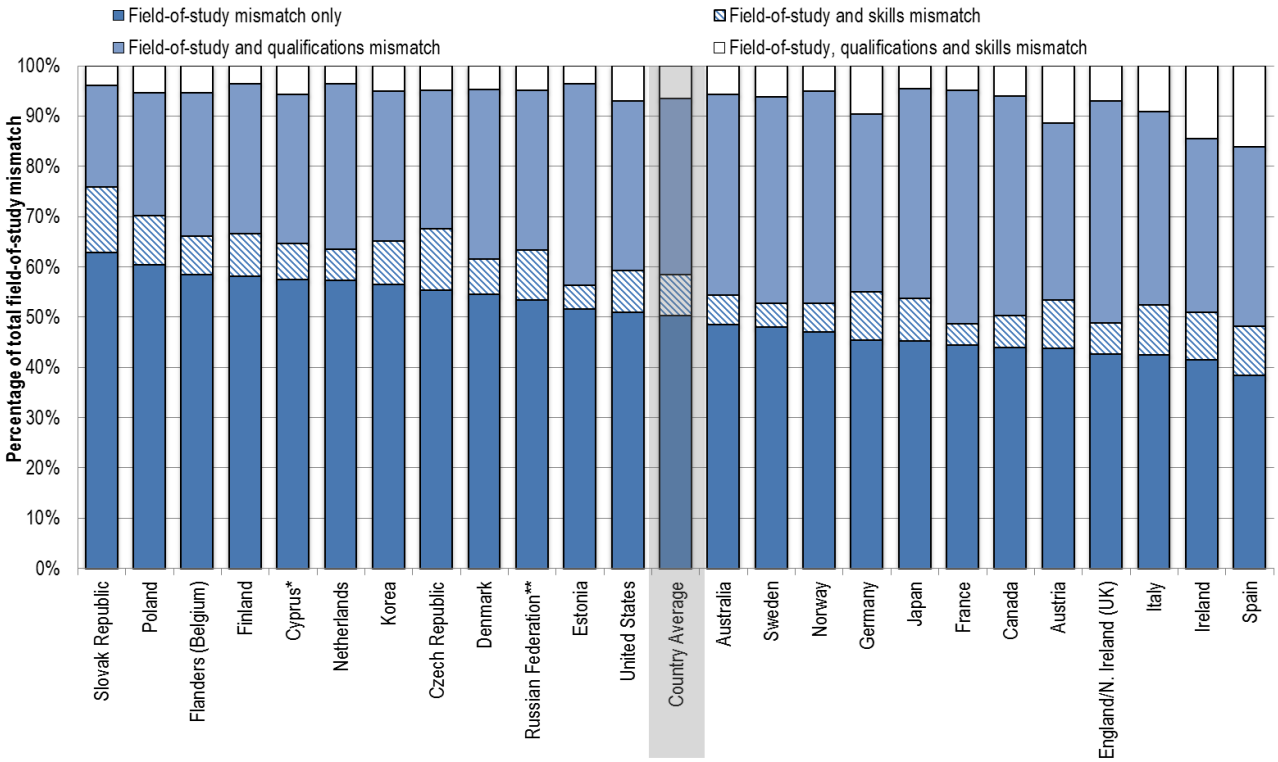
Figure 2. **Field-of-study mismatch by field-of-study and occupational group, country average**



Notes: Bars and numbers represent the average percentage across participating countries. Outer border (black) represents the 75th percentile, inner border (white) and the 25th percentile of the percentages across countries.

Source: Annex 3, Table 1.

Figure 3. **The relationship of field-of-study with qualification and skills mismatch**



Countries are sorted in descending order of field-of-study mismatch that is unrelated to qualifications or skills mismatch (field-of-study mismatch only).
*, ** See notes to Figure 1

Source: Annex 3, Table 2.

16. Also, about a third of workers who are mismatched by field-of-study are also well matched in terms of skills, but not so in terms of qualifications (Figure 3).[5] For this group of workers, working outside the field-of-study implied downgrading their occupational status, to the extent that they took a job that does not need these qualifications. For these workers, the educational investment in higher educational level did not pay off as the qualification demand of the job they perform is below their own attainment. For a minority of workers, around eight percent, it seems that employers value educational credentials independent of the specific field; these are workers who are mismatched in terms of field and skills, but not qualifications. As these workers are mismatched by both field-of-study and numeracy skills, they may require training to increase their match along dimensions that go beyond the fact that they are working in a field that is unrelated to their training. Around seven percent of field-of-study mismatched workers are also mismatched by both skills and qualifications.

17. As mentioned earlier, workers from the "Humanities, languages and arts" or the "Agriculture and veterinary" fields are more likely to be mismatched (left panel of Figure 2). Among workers that are

5. Among workers who are field-of-study mismatched, qualifications mismatch usually takes the form of over-qualification. Of all of workers who are mismatched by field of study and qualifications, 79% percent are over-qualified and 21% percent are under-qualified (33.0% and 8.6% of total field-of-study mismatched workers, respectively, Table 2).

mismatched by field of study, as shown in Figure 3, some are more likely than others to be over-qualified or over-skilled. Table 3 shows the likelihood of field-of-study mismatched workers to be overqualified or overskilled (or both) across fields. On average across countries, the distribution of overqualification and overskilling in numeracy skills does not vary strongly by field: irrespective of their field, those workers who are mismatched by field are most likely to be field-mismatched alone, and a smaller proportion to be overqualified as well.

3 Do broad labour demand and supply factors relate to field-of-study mismatch?

18. The literature on field-of-study mismatch assumes that mismatched workers do not voluntarily choose mismatch, but are driven to it because they cannot find work in their field, or because their skills are better rewarded in other occupational groups. Although these hypotheses have not been tested directly, they imply a relationship between skill demand and the characteristics of skill supply as related to field-of-study mismatch. Two attributes of skill demand and supply are field saturation and skill transferability. Field saturation speaks to the degree to which there are jobs available in a particular field. Skill transferability speaks to the degree to which the skills associated to a specific field are rewarded and valued in other occupational groups of the labour market.

3.1 Measuring field saturation and skill transferability

3.1.1 Field saturation

19. Several studies suggest that field-of-study mismatch occurs because workers are unable to find work in their field at their desired level of pay and must seek work in another in order to be employed. Yet, as mentioned in Box 2, this suggestion has not been empirically tested. This paper proposes a measure of field saturation by comparing the number of graduates from a particular field to the number of jobs currently held in the economy in that field (irrespective of whether these jobs are occupied by people trained in that field). A saturated field is thus one where there are more graduates from that field than workers in that field. Formally, the saturation S of field f in country c can be expressed as

$$S_{f,c} = \frac{G_{f,c}}{W_{f,c}}$$

where $G_{f,c}$ is the number of graduates from field f in country c and $W_{f,c}$ is the number of workers currently employed in occupations in occupational group f in country c. $G_{f,c}$ is estimated directly from respondents' report to the field-of-study that corresponds to their highest degree and includes individuals both employed and not employed. $W_{f,c}$ is derived from the number of workers in the corresponding occupational group.

20. Annex 2 provides the link between ISCO-08 occupations and field as used in determining field-of-study mismatch. In this link, some occupations may be matched to more than one field-of-study (e.g. an author, journalist or linguist (ISCO-08 code 264) is considered to be matched to his/her field-of-study if they graduated from the "Humanities, languages and arts" or "Social sciences, business and law" fields). Thus, for some occupations, there is a many (fields) to one (occupation) match and it is not possible to identify the specific field the worker actually works in. Instead of forcing occupations to match exclusively to one occupational group, uncertainty is assumed and workers in these occupations are identified to work in as many fields as described in Annex 2. As a result, while the $G_{f,c}$ is based on one-response per respondent, $W_{f,c}$ is based on the attribution that allows for one occupation to belong to more than one field.

21. Given this specification, the indicator has no interpretable scale. It is thus centred at 0 for countries and fields, so that positive (negative) values indicate that, for the specific field, there is higher (lower) saturation than the average field across participating countries. It is standardised to have a standard

deviation of 1 across fields and countries, so that a value of 1 (-1) indicates that the saturation is one standard deviation above (below) the average observed across all fields and countries.[6]

22. Note that $W_{f,c}$ considers both workers who are well-matched and mismatched, because the interest in this measure is to gauge the relative number of graduates to jobs available in a way that is independent of field-of-study mismatch. The underlying premise is that for a job available in a particular occupational group, those graduates from the corresponding field are better aligned for the job and have a higher standing in the hiring queue than graduates from other fields.

23. This indicator provides insight on the saturation of a particular field, but is not perfect, particularly because it does not clearly identify the source of the saturation. Ideally, field saturation and shortage would be measured using trends in vacancies or using wage pressure analyses. This information is, however, unavailable in the Survey of Adult Skills or unavailable, using other data sources for all the countries and fields used in this paper. The measure of field saturation also assumes that saturation is constant for all workers within the field. There may be segmentation within the field, however, with saturation present in the occupations that require certain educational attainment, but not for occupations in the occupational group requiring another educational attainment. This possibility is discussed in the context of Figure 2, in the case of "Agriculture and veterinary": the field may be saturated at the professional level, forcing many graduates with university degrees in the field to work in other occupational groups, but the occupational group may face shortages or have low barriers to entry at the lower occupational levels, attracting graduates from other fields with upper secondary school qualifications specific to other occupational groups.

3.1.2 Skill transferability

24. Several studies also suggest that field-of-study mismatch is more common in certain occupations than others because training in some fields has a more general orientation, as opposed to field/occupation/job-specific orientation, giving workers trained in more general fields the flexibility to transfer more of their skills to other fields. This paper proposes a measure of skill transferability of a particular field-of-study by estimating the proportion of graduates working outside their field that are not under- or over-skilled, or under- or overqualified. Those fields that allow more of their graduates to work in other fields all the while having them use all their skills and feel that their level of education is adequate are those that have a higher level of transferability of skills. Formally, the transferability T of field f in country c can be expressed as

$$T_{f,c} = \frac{T_{f,c}}{M_{f,c}}$$

where $T_{f,c}$ is the number of graduates from field f in country c that are working in another field but are well matched by skills and qualifications, and $M_{f,c}$ is the number of graduates from field f in country c that are working in another field. Skills match is defined by considering information about workers' own skill proficiency, self-reported mismatch and the skill proficiency of other workers in similar occupations. Skill-matched workers are those that have a proficiency level in literacy that is between the 5th and 95th percentiles of workers in that occupation that consider themselves well-matched (Pellizzari and Fichen, 2013; OECD, 2013b). This measure of skills match refers specifically to one of the many types of skills

6. Models that assume a one-to-one match between occupations and fields in the estimation of saturation yield similar results to those presented in this report (available upon demand). Assuming one-to-one match between occupations adds many unverifiable assumptions to the models, reason for which the one-to-many approach was preferred.

required by employers. Specifically, it refers to foundation skills or information-processing skills needed in all occupations; it is therefore not a field- or job-specific but a measure of match/mismatch in general literacy skills. Qualification-matched workers are those that report that their education level is adequate for the type of job they carry out (OECD, 2013b; Quintini, 2011a, 2011b). This skill transferability indicator ranges from 0 to 1, with values closer to 1 indicating a higher degree of transferability. This measure of skill transferability is not independent from employers' behaviour. The ability of a worker to be mismatched by field but accurately matched by qualification and literacy skills depends on the transferability of the skills themselves and employers' capacity to identify and/or value transferable skills.[7]

3.2 The relationship of field saturation and skill transferability with field-of-study mismatch

25. Table 4 in the annex presents, for all countries and fields of study, the estimates for skill transferability and saturation. Within each country there is variability across fields, signalling that both the skill transferability and saturation measures identify specific attributes of that field within each country. Moreover, for each field, there is little cross-country correlation between the two measures (generally below 0.2 across fields), and for each country the relationship is not consistent across fields (with strong and positive correlations in some countries, strong, weak correlations in others and strong and negative correlations in others). The lack of consistency in the relationship between these two measures signals that they are measuring different attributes of a field.[8]

26. On average across countries, for example, saturation is especially visible in the "Humanities, language and arts", inasmuch as saturation is almost a standard deviation above the average field across countries.[9] Similarly, saturation is also present in "Teaching, training and education science" and "Engineering, construction and manufacturing". Conversely, there appears to less-than-average saturation in "Services", "Social science, humanities and law" and "Agriculture and veterinary". There is also cross-national variability in these measures, signalling that country-specific factors determine whether a

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7. It may be the case that for some field-of-study mismatched workers transferability is high because they have taken further training not captured by their highest educational qualification. Since skills transferability is a measure to characterise fields of study, this situation will bias the skills transferability measure if workers from a particular field are more likely to undergo unobserved training than workers that graduated from another field.

8. The European Labour Force Survey (EU-LFS) also asks respondents about their occupation and their field of study. Estimates for saturation and field-of-study mismatch are generally consistent with PIAAC. Differences between the two studies can be traced to the way each measures respondents' field of study. While PIAAC asks respondents to report their field of study with respect to one of the nine fields (e.g. general, humanities/languages/arts, engineering/manufacturing/construction, health and welfare, etc.), the EU-LFS asks respondents to point out their degree from a country-specific list of degrees, which is then coded into different fields (see Annex 4).

9. Values for England/N. Ireland (UK) (5.1) and Italy (3.0) are particularly large. Ignoring these two cases leaves the cross-country average of saturation in "Humanities, languages and arts at 0.6. These high values could be due to a low number of individuals sampled that are working in the "Humanities, language or arts" field, yet this is not the case. Annex 4 discusses this possibility and presents the number of observations used to compute the field saturation and skill transferability indices. It evaluates the robustness of the field saturation index to sampling characteristics by comparing PIAAC estimates of field saturation to those estimated with the European Labour Force Survey which draws larger samples at the country level. This validation exercise finds that the saturation estimates are generally consistent across PIAAC and the EU-LFS. There are differences, however, and these are due mostly to the estimated number of graduates from each field which could relate to differences in the methodology used to identify respondents' field of study (see Annex 4).

particular field is saturated or not. For example, although "Teacher training and education science" seems to have more-than-average saturation in every country (it has a positive value in most countries), it is lower than average in Italy (-0.3), France (-0.2), Germany (-0.1) and Korea (-0.1). Similarly, although "Engineering, construction and manufacturing" seems slightly more saturated than average across countries, it is less so the case in the United States (-0.3), Canada (-0.3) and Italy (-0.2) than in Norway (1.2), Austria (1.1) or the Czech Republic (1.1).

27. Skill transferability measures also vary both within and between countries, although, on average, the index of skill transferability is similar across fields. On average across countries and for each field, between 40% and 60% of field-mismatched workers are working in other fields but at a qualifications and skills level that is adequate. In Denmark, for example, skill transferability is higher in the "Health and welfare" field (0.7) than in the "Social science, business and law" field (0.4), but there is no difference in skill transferability levels between these two fields in Canada or the Czech Republic. Across countries, but within field, the skill transferability of graduates also varies: the transferability of the "Teacher, training and education science" field is low, for example, in Ireland and Spain (0.3), but high in Denmark (0.7). Taking the average for each country across fields as a measure of overall field transferability, skill transferability is highest in the Netherlands, Poland and the Slovak Republic and lowest in Ireland, Italy and Spain.

28. To what extent does field saturation and skill transferability relate to the likelihood of field-of-study mismatch? Table 5 presents logistic regression models that predict the likelihood that a worker works in a field different than the one from which he/she graduated. All models use a pooled sample to take advantage of the observed variability across fields and countries. Model 1 includes only the field-specific attributes that relate to the labour demand (field saturation) and labour supply (skill transferability). Model 2 then adds worker socio-demographic and skill attributes, to control for worker-type selection into different fields and for skill heterogeneity. In Model 2, both educational attainment and skill numeracy are labour supply factors. Model 3 adds job characteristics (e.g. labour demand) that have previously been linked to field-of-study mismatch, to control for different jobs characteristics across different fields. Model 4 then adds measures of qualification and skill mismatch to control for other forms of mismatch and evaluate the extent to which field-of-study mismatch and its relationship with labour market dynamics is just representing dynamics that govern other forms of mismatch. Finally, Model 5 adds system-level economic contextual variables relative to the year each worker began their current job, as it is that economic context that determined mismatched employment[10] and Model 6 adds country-level fixed effects to ensure that the observed factors are not driven by one particular country or certain country-level attributes not already accounted for. Annex 1 provides more details on the data, methods and variables included in the models.

29. Results show that in all models, as expected, field saturation is predictive of a higher likelihood of being mismatched by field of study. The estimate from Model 1 – which is consistent across the different model specifications – signals that were the field saturation to increase by one standard deviation (e.g. from the saturation of "Agriculture and veterinary" (-0.5) to that of "Teaching and education training" (0.5) in Flanders (Belgium)), the odds that a graduate is mismatched by field-of-study would increase by 64% ($e^{0.49}$ - 1). After controlling for worker attributes and skill heterogeneity, the estimate for the relationship between field saturation and field mismatch remains significant and with the same magnitude.

10. The current economic context may also impact field-of-study mismatch through, for example, motivating on-the-job searches. While carrying out the search, the worker remains mismatched in his/her current job and the placement to that current job depended on the economic conditions that lead to it.

30. The estimate for skill transferability is negative (suggesting, contrary to expectations, that higher transferability reduces mismatch) or not statistically significant in the pooled models. This negative relationship changes to the expected direction when country-level variables, and country-level fixed effects in particular, are included in the model (Model 6). This suggests that, on average across the participating countries, there is no clear relationship between a fields' skill transferability and the likelihood of graduates from that field being mismatched. This relationship holds, however, within countries. This variability may point to the articulation of specific education systems; the way credentials from certain fields are considered transferable in certain countries but not in others and the way employers in different countries are more or less open to recognising the skills of workers from other fields. These points are relevant inasmuch as the balance of general and specific skills may differ across countries, in broad terms or within specific fields or the degree to which employers in an occupational group value skills gained in other fields may vary from country to country. These factors speak to the relationship of the education system and the labour market and how employers interpret educational credentials. Further study analysing the variability of the skill transferability estimate across countries is needed to understand how and why transferability leads to field-of-study mismatch in some contexts but not in others. These analyses could include interacting this covariate with country-level characteristics of the education system such as the level of standardisation and differentiation which have been shown to influence the fluidity of the transition from school to work (e.g. Shavit and Müller, 1998; Kerckhoff, 2000; Rosenbaum, 2001).

31. Field-of-study mismatch is equally likely among workers with an upper-secondary degree attainment or workers with a higher educational attainment (the estimate for ISCED 3, with ISCED 3+ as the reference category is not statistically significant in Model 6). Mismatch by field-of-study is more common among workers with, at most, a lower secondary education. Although few workers with a lower secondary education have degrees that are field-specific and not general in nature, the higher likelihood of mismatch among lower educated workers may relate to the fact that at lower levels of education the re-training costs may be comparatively low for employers and a field-of-study may be a less relevant signal when hiring less educated workers.

32. Consistent with other studies, older workers are more likely to be mismatched by field. This is expected: as workers age, their career moves depend more on their past experience than their formal education training. Such an interpretation is consistent with "employer learning" where, employers learn about their workers true skill levels as they gain experience. Thus, as workers spend more time in the firm, employers are better able to reward their true skill levels (and not proxies such as education credentials) and, in bigger firms, promote internal mobility so that job requirements are better aligned to workers' actual skill levels. In this regard, as observed in other studies, while the likelihood of field of study mismatch increases with age, skills mismatch actually tends to decline. In fact, wage penalties associated to field-of-study mismatch weaken as workers age, reflecting the different skills valued at different points in workers careers (OECD, 2014a).

33. The other estimates in the models are consistent with previous research. Most notably, field-of-study mismatch is less likely among workers with more experience, in larger firms, in the public/NGO sector or with a full-time contract (Wolbers, 2003; Robst, 2007a). Interestingly, countries with higher levels of employment protection tend to have lower levels of field-of-study mismatch. In those specific cases (e.g. women or youth, particular industries) where unemployment is related to greater protection (OECD, 2013c), it may be that workers prefer to be unemployed instead of being mismatched or that employers value the field specific credentials to a greater extent to perceive lower risks associated to inadequate hires. Also, mismatch is more likely among workers who took up the job when the economy was experiencing higher unemployment levels, as found in previous research (Wolbers, 2003).

4 The individual costs of field-of-study mismatch

34. Previous studies have explored the individual-level correlates of mismatch by field-of-study. These findings show that mismatched workers are more likely to receive lower wages (Kelly, O'Connell et al., 2010; Robst, 2007a; Wolbers, 2003; Nordin, Persson et al., 2010; Quintini, 2011b; OECD, 2014a), experience lower levels of job satisfaction and are more likely to be actively looking for a job while in the job (Wolbers, 2003; Béduwé and Giret, 2011). Box 4 highlights findings from previous studies on the relationship of field-of-study mismatch with wages and job satisfaction.

35. Few of the studies that explore the individual-level correlates of field of study mismatch allow for comparable estimates across countries (for three approaches to a comparative analysis of field-of-study mismatch, see OECD, 2014a; Quintini, 2011b; and Wolbers, 2003). The majority of studies focus on one particular country and each adopts particular methodological choices, are bound to the specific characteristics of the survey or use self-reports to measure field-of-study mismatch, all of which limit the comparability of mismatch (see Box 3 for a discussion on measuring field-of-study mismatch).

36. Even fewer studies explore the correlates of field-of-study mismatch in conjunction with qualification mismatch (see, for example, Kim, Ahn et al., 2012; Béduwé and Giret, 2011; and Kelly, O'Connell et al., 2010 for noteworthy exceptions). The importance of accounting for qualification mismatch in analyses of the relationship between field-of-study mismatch and pay (or any other individual correlate thereof) is both statistical and conceptual.

37. Most graduates will hope to gain employment at the level of their qualifications and in the field of specialisation (i.e. well-matched) and avoid employment that is both in another field and at a lower qualification level. However, the decision process that leads an individual to be matched by field but overqualified, or well-matched by qualification level but mismatched by field-of-study is unclear. For some recent graduates, particularly in fields that experience high levels of saturation and/or low levels of transferability, the priority might be to find work in the field, even if that means accepting a job with lower qualifications; for others, from fields with high transferability, the priority might be to find work at the appropriate qualifications level, even if that means accepting a job in a different field. Moreover, studies that fail to account for qualification mismatch while estimating the field-of-study mismatch wage penalty risk producing biased estimates as part of the marginal penalty associated to field-of-study mismatch has to do with workers having to downgrade in order to find work in other fields rather than to them working in other fields per se (Kim, Ahn et al., 2012).

38. This section provides comparable and up-to-date estimates of the effect of field-of study mismatch (in conjunction with qualifications mismatch) on three important individual outcomes, namely wages, unemployment and job satisfaction.

4.1 Wages

39. The individual-level consequences of field-of-study mismatch are consistent with alignment theories as they respond, at least in part, to the fact that mismatched individuals are not using the full array of skills gained in training. Because wages are a function of the match of a worker's skills and the job's skill demand, mismatched workers are expected to earn less than well-matched workers by field-of-study (Sattinger, 1993). Mismatched individuals are able to use their general skills, which are more readily transferrable, in the workplace, but not the job-specific skills gained in training. For employers, mismatched individuals need training to acquire the job-specific skills and are thus more costly and/or less productive, resulting in lower pay.

40. As a result of this alignment process, the wage penalty is stronger for individuals who report that their field-of-study is at a greater distance from the occupational group (Robst, 2008; Nordin, Persson et al., 2010). Also, the wage penalty decreases with tenure in the job, in line with the assumption that mismatched workers earn job-specific skills in the workplace (Nordin, Persson et al., 2010).[11]

41. Precise and comparable figures for the wage penalty associated with field-of-study are obscured by the fact that many country-specific studies use self-reported measures of field-of-study mismatch (e.g. Robst, 2007a, 2007b, 2008; Nordin, Persson et al., 2010; and Kelly, O'Connell et al., 2010, Verhaest, Sellami and van der Velden, 2013); for noteworthy exceptions, see, for example, Kim, Ahn et al., 2012), or even if they allow for cross-country comparisons, they are based on relatively old data or do not isolate the relative effects of qualification and field-of-study mismatch (e.g. Wolbers, 2003; Quintini, 2011b).

42. The path diagram in Figure 4 outlines how field-of-study mismatch relates to wages. It takes into account the fact that the relationship between wages and field-of-study mismatch cannot be understood in isolation of qualifications mismatch or the labour market supply and demand dynamics discussed in section 3.2. Section 2 showed how a part of field-of-study mismatch is related to overqualification, and studies have shown that a large penalty is associated to qualifications mismatch and that part of the overall field-of-study mismatch penalty is due to workers having to downgrade when they find work in other fields (become overqualified) (Kim, Ahn et al., 2012; OECD, 2014a; Quintini, 2011a, 2011b). Furthermore, section 3.2 showed how field saturation relates to the likelihood of being mismatched. As a measure of labour market demand, it is also expected to influence wages. A path analysis (also known as simultaneous regression analysis) like that shown in Figure 4 can estimate these relationships simultaneously and is thus preferable to OLS regressions. Analyses at the country level, however, rely on more traditional OLS wage regressions because this path analysis cannot be replicated at the country level. Annex 1 provides more details about the data, methods and variables used in this analysis.

Box 5. **Wages and other individual correlates of field-of-study mismatch**

The available evidence of the field-of-study mismatch wage penalty suggests that after accounting for qualification mismatch, mismatched workers usually face a penalty, but there is variability in this estimate. The penalty can be higher or lower depending on the reasons for which the worker accepted the mismatched job and the educational demands of the job. The field-of-study mismatch wage penalty in the United States – with data from 1993 and among the overqualified – is around 20% when workers report working in a job that is unrelated to their field-of-study compared to field-of-study matched peers (the penalty is around 5% for those working in a field that is somewhat related to the field of study) (Robst, 2008). Robst (2008) finds, however, no wage loss among those reporting to be underqualified and does not identify a wage penalty for well-qualified mismatched workers by field-of-study. In Ireland, for the graduating class of 2001 and one year after graduation, Kelly et al. (2010) find a 6% penalty for field-of-study mismatched workers who are matched by qualification level compared to well-matched individuals. In France, and only for workers who graduated from vocational education institutions, Béduwé and Giret (2011) find no field-of-study mismatch wage penalty for these workers, neither when they are overqualified or well-matched by qualification level. In Korea in 2005, two years after graduation and after accounting for qualification mismatch, the wage penalty associated with self-reports of a complete mismatch between field-of-study and occupational group amounted to 2% for women and 3% for men, with the penalty being larger the lower the hourly wage (the penalty is steeper in the first and third deciles, and not significant in the seventh or ninth deciles[12]) (Kim, Ahn et al., 2012).

11. Alternatively, the interaction between tenure and the wage penalty could reflect a selection process, as mismatched individuals who are able to keep their job for longer are more productive (Nordin, Persson et al., 2010).

12. The variability of the field-of-study mismatch wage penalty by income level may reflect a selection process referred to skill heterogeneity as the lower skilled workers from each field are more likely to be mismatched and settle for lower paid work. See, for example, Quintini (2011a).

Box 5. **Wages and other individual correlates of field-of-study mismatch** (cont.)

Nordin, Persson et al. (2010) report a 30% wage penalty for Sweden but do not consider qualification mismatch in the estimation strategy.

The variability in estimates of the field-of-study mismatch wage penalty has several sources, other than the already mentioned methodological differences relating to the measurement of field-of-study mismatch. Studies that fail to account for qualification mismatch while estimating the field-of-study mismatch wage penalty risk producing biased estimates (Kim, Ahn et al., 2012). This failure to jointly take qualification and field-of-study mismatch into account explains part of the variation in estimates across studies that do and do not account for other forms of mismatch. Other than the estimation strategy and the restriction (or not) of the analyses to recent graduates, to certain fields or to particular countries may explain the difference in estimates across studies. At least one study allows for a cross-national comparison of the field-of-study mismatch wage penalty while clearly distinguishing it from qualification and skills mismatch. Using data from the PIAAC Adult Skills survey and focusing on the change in the penalty across age groups, OECD (2014a), finds a relationship between field-of-study mismatch and wages at all age groups, although a penalty is observed only among prime-age and older workers (among young workers there is a wage premium associated with field-of-study mismatch).

The analyses in this paper extend the findings from OECD (2014a) as they relate the relationship between the penalty to field-of-study mismatch and qualification mismatch simultaneously and to the labour market precursors to field-of-study mismatch. They also estimate the field-of-study wage penalty for more than 20 countries. Estimates differ slightly inasmuch as these analyses are not segmented by age groups and the firm- and individual-level characteristics used as controls are also different. Path analyses estimate the specific weights for each relationship in a pooled regression analyses.

Although less studied than the relationship between qualifications mismatch and job satisfaction (see, for example, Quintini, 2011b), field-of-study mismatch is related to lower levels of job satisfaction (Wolbers 2003). Under the assumption that students enter a field with the expectation to work in it, as they invest more knowledge in gaining information on the wages and characteristics of that occupational group compared to others (Betts, 1996), lower levels of job satisfaction may reflect that failed expectation. Moreover, field-of-study mismatch is related to correlates of job satisfaction including on-the-job search (Wolbers, 2003; Béduwé and Giret, 2011).

Sources: Béduwé, C. and J. Giret (2011), "Mismatch of Vocational Graduates: What Penalty on French Labour Market?", *Journal of Vocational Behavior,* 78(1), pp. 68-79;Betts, J.R. (1996), "What Do Students Know about Wages? Evidence from a Survey of Undergraduates", *Journal of Human Resources,* Vol. 31, No. 1, pp. 27-56; Kelly, E., P.J. O'Connell and E. Smyth (2010), "The Economic Returns to Field-of-study and Competencies among Higher Education Graduates in Ireland", *Economics of Education Review,* 29(4), pp. 650-657; Kim, H., S.C. Ahn and J. Kim (2012), "Vertical and Horizontal Education-Job Mismatches in the Korean Youth Labor Market: A Quantile Regression Approach", *Working Papers 1201, Research Institute for Market Economy, Sogang*; Nordin, M., I. Persson and D. Rooth (2010), "Education–Occupation Mismatch: Is there an Income Penalty?", *Economics of Education Review,* 29(6), pp. 1047-1059; Quintini, G. (2011a), "Over-Qualified or Under-Skilled: A Review of Existing Literature", *OECD Social, Employment and Migration Working Papers,* 121; Robst, J. (2008), "Overeducation and College Major: Expanding the Definition of Mismatch between Schooling and Jobs", *The Manchester School,* 76(4), pp. 349-368; Wolbers, M.H.J. (2003), "Job Mismatches and their Labour-Market Effects among School-Leavers in Europe", *European Sociological Review,* 19(3), pp. 249-266.

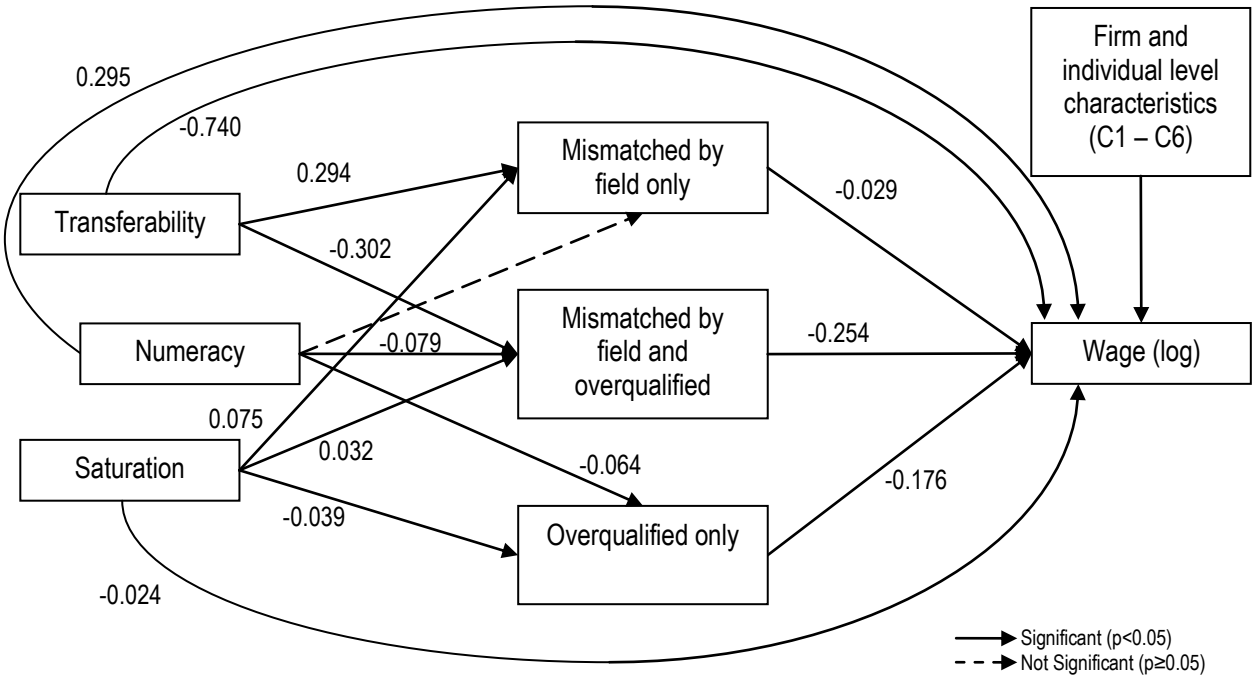
43. As Figure 4 shows, on average across countries that participated in the PIAAC survey and compared to well-matched individuals[13] by both qualifications and field of study, mismatched individuals experience a wage penalty. This penalty is highest (25%) for individuals who are mismatched by field-of-study and overqualified. Individuals who are overqualified, but work in their field, experience a penalty of 18% and those that work in a job that is adequate for their qualifications level but in a different field experience a penalty of 3%. Field-of-study mismatch implies, therefore, a penalty for workers and it is larger if workers downgrade; with the bulk of the penalty resulting from the downgrading. While the field-of-study mismatch penalty is 3% for workers at the adequate qualifications level, it is more costly, at 7% (25% – 18%), for overqualified workers. The penalty associated to field-of-study mismatch and

13. The reference category "matched by field of study and qualifications" also includes the few individuals who are underqualified and matched by field of study.

overqualification is more than the simple addition of the penalties for field-of-study mismatch and overqualification.

44. As expected from the analyses of Section 3 and the fact that saturation and skill transferability speak to attributes of labour market supply and demand, they are related to workers' earnings. Fields that experience more saturation (higher skill supply or lower skill demand) tend to offer lower wages. Fields with more transferrable skills also offer lower wages, but as discussed later, in the context of country-specific models of the wage penalty in Figure 5, much of the wage penalty associated with a majors' skill transferability disappears after including country fixed effects. There are also interactions between the field-of-study mismatch wage penalty and skill transferability, signalling that the relationship between skill transferability and wages varies by country and that the field of study mismatch penalty also varies by field according to its balance of general/specific skills.

Figure 4. **The relationship between labour market dynamics, mismatch and wages**



Notes: Estimates from path analysis (i.e. simultaneous equations). Coefficients shown are unstandardised estimates and can be interpreted as the effect of a one-unit change in the independent variable on the dependent variable, as signalled by the direction of the arrow. Only statistically significant (at the p<0.05 level) are shown. Firm and individual-level controls (variables C1-C6) include age, age-squared, experience, experience-squared, tenure, and dummy variables for temporary contract, public sector or NGO, firm size and field-of-study (major). Numeracy scores are rescaled so that one unit equals 100 points.

Source: Annex 3, Table 6.

45. These estimates of the wage penalty related to field-of-study mismatch account for numeracy skills, so it is unlikely that skill heterogeneity explains the source of the penalty. As expected, workers with higher numeracy skills earn higher wages. Workers with higher numeracy skills are also less likely to be overqualified and also less likely to be simultaneously mismatched by field and overqualified, a finding that is consistent with the fact that part of over-qualification is due to skill heterogeneity (Quintini, 2011a). Workers with higher numeracy skills are no less likely to be mismatched by field-of-study alone.[14]

46. The estimates in Figure 4 depict the average worker in the average participating country. There is cross-national variability in the size of the field-of-study mismatch wage penalty, as depicted in Figure 5. In fact, the field-of-study mismatch wage penalty among matched workers by qualifications is statistically significant only in Estonia, Ireland and Italy; in the majority of countries there is no wage penalty for mismatched worker by field who are well qualified in their jobs (the estimate is non-significant in 19 countries). In Estonia, Ireland and Italy, the field-of-study mismatch wage penalty without overqualification is greater than 5%. In Ireland, Italy and there is a penalty for field-of-study mismatch that does not bring about overqualification, but there is no additional field-of-study penalty when workers are already overqualified. One way to interpret this is that overqualification overrides field-of-study mismatch and field of study has little value once workers are overqualified. In Finland and Sweden, mismatched workers by field-of-study who are well matched in terms of occupations tend to earn more than their well-matched field-of-study peers, probably because the most productive mismatched workers by field are attracted by the better salaries in other fields instead of staying in the field they studied or because employers value graduates from different fields equally, so mismatched workers are not penalised by their lack of job-specific skills.

47. On average, the field-of-study mismatch penalty is stronger amongst the overqualified. This is the additional penalty that overqualified workers receive because of field-of-study mismatch; it is not the addition of a field-of-study penalty and the overqualification penalty. It is statistically significant in Austria, Canada, Estonia, Flanders (Belgium), Germany and the Netherlands. In Estonia, mismatched workers are sure to face a penalty, whether they are overqualified for the job or not; it amounts to 8% and 19% for workers who are matched by qualifications and overqualified, respectively. In Italy and Ireland, field-mismatched workers will face a wage penalty if their job is at the level of their qualifications, but may not face a stronger penalty if they are overqualified for their jobs (although not statistically significant, the point estimates signal penalties of around 5%); in Italy and Ireland there is no additional penalty to field-of-study mismatch once workers downgrade. In Germany, although field-mismatched workers do not face a penalty when they are matched by qualifications, they face a 15% penalty if they are overqualified, which comes in addition to the penalty that they expect by virtue of being overqualified in their field (of 16%, Table 7).

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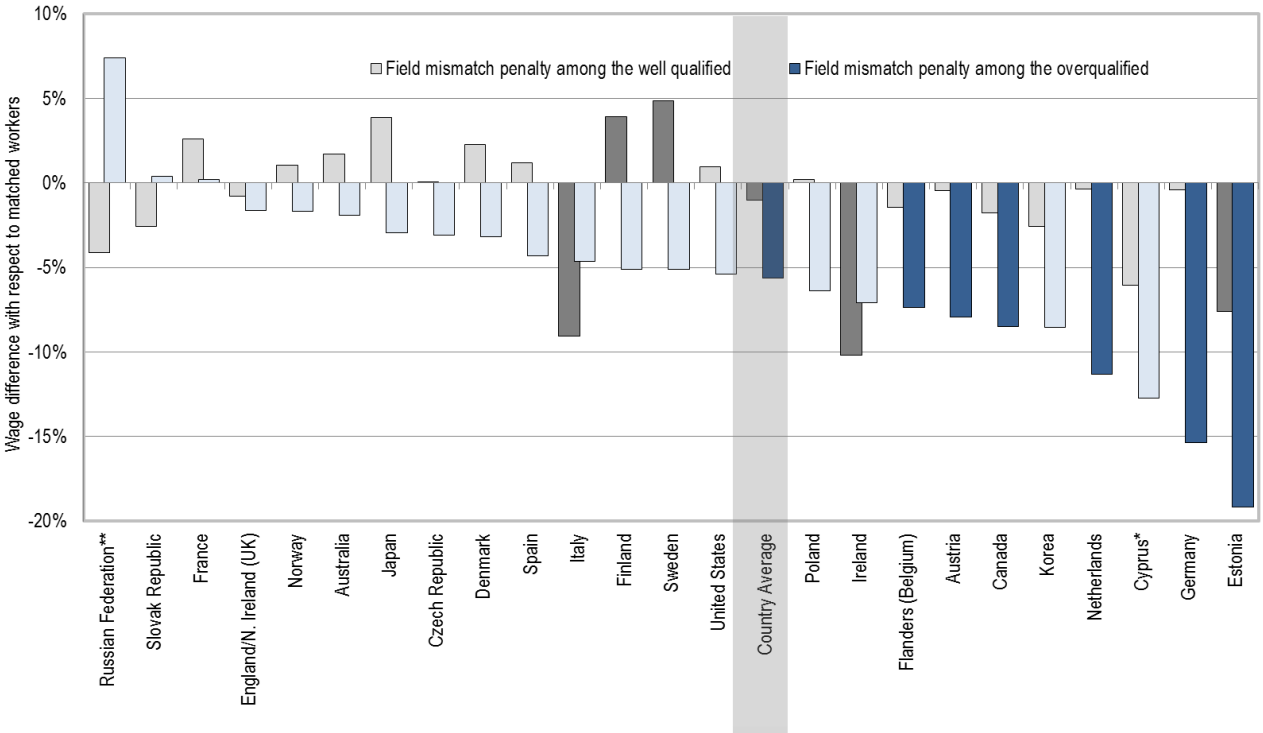
14. Models that include numeracy skills mismatch in addition to field-of-study and qualifications mismatch report similar findings. This is expected as there is not much overlap between field-of-study mismatch and numeracy skills mismatch as reported in Figure 3.

Figure 5. **Wage penalty associated with field-of-study mismatch for overqualified workers and workers well matched by qualification**



Notes: Reference category is matched workers by field-of-study and qualification. It includes the few workers who report being underqualified. Estimates for the fi field-of-study mismatch penalty among overqualified workers calculated as the difference of the penalty associated with overqualified-only and overqualified and field mismatched workers, reported in Table 7.
Light-coloured bars indicate that the wage penalty is not statistically significant at the $p < 0.05$ level.
Countries are sorted by the field-of-study mismatch wage penalty for overqualified workers.
*, ** See notes to Figure 1

Source: Annex 3, Table 7.

48. The field-of-study mismatch wage penalty also varies according to a field's skill transferability: the higher the skill transferability of the field, the lower the associated wage penalty if a worker from that field is working in another field. Individuals from fields with higher levels of skill transferability are more likely to have a larger proportion of general skills (as opposed to field/job/occupation-specific skills) that can be useful across fields (alternatively, they could be more likely to work in field-specific labour markets with employers who are recognise the value of skills gained out-of-field).

49. Model 2 in Table 8 shows how fields with greater levels of skill transferability experience a lower field-of-study mismatch wage penalty. The estimate for skill transferability means that fields with greater transferability reduce the penalty both for field-mismatched workers who are well qualified and who are overqualified. The magnitude of this estimate means that if the field-of-study mismatch penalty for well-qualified workers from a field with no skill transferability is 10%, there is no such wage penalty for workers who graduated from fields with a transferability index of 0.59. Such transferability is commonly observed across countries in fields like "Engineering, manufacturing and construction", "Services" or "Teacher training and education" (see Table 4). The wage penalty for workers who are both overqualified and mismatched by field and come from a field with no transferability is 35% but resembles the penalty for overqualification only (18%) for graduates from a field with a skill transferability index of around 0.5. Table 4 shows that, average skill transferability across fields and countries is, in fact, 0.5 with a minimum of 0.2 for workers from the "Health and Welfare" field in Italy to graduates from the "Services" field in Poland and England/N. Ireland (UK) with indices of 0.8 and 0.9, respectively. Note, however, that

these estimates vary greatly from Model 1 to Model 2. Model 2 includes country fixed effects, so the fact that including these controls changes the estimates signals that although, on average, the relationship between the balance of general/specific skills and the wage penalty holds, there is important variability across countries. Future studies should account and attempt to explain this variation.

50. Model 4 in Table 8 includes interactions for each field-of-study and country fixed effects. It shows how, on average across countries, the wage penalty associated with workers who are field-of-study mismatched but well-matched by qualification is strongest for workers from the "Social sciences, business and law" field and even positive (no penalty) for the "Health and welfare" or "Agriculture and veterinary" fields when compared to workers graduating from the "Service" field. Similarly, workers from the "Service" occupational group (reference group) who are both overqualified and mismatched by field face no penalty, but this penalty exists – and is larger than the penalty associated with being overqualified only – among workers from the "Teaching, education and training" or the "Humanities, social sciences and law" fields. Comparing the results of the wage penalty associated with each field from Model 3 and Model 4 in Table 8 signals that there are important levels of variability in the mismatch penalties associated with each field across countries (Model 4 includes country fixed effects while Model 3 does not).

4.2 Job satisfaction

51. Field-of-study mismatch can affect other outcomes than just wages. Mismatched workers are not only more likely to earn lower wages, but are also more likely to experience lower levels of job satisfaction, even in those circumstances where they do not suffer a wage penalty (Béduwé and Giret, 2011). Field-of-study mismatch can lead to different levels of dissatisfaction, depending on the extent of mismatch (if the current job is further away from the tasks more commonly associated with the field), on the career prospects of the current job, workers' age and the socio-economic context of the labour market. Older workers may be more sensitive to job satisfaction in relation to field-of-study mismatch because they may have lower chances of getting a matched job in the future than young workers. Workers may feel less dissatisfied if mismatched in labour markets with a higher unemployment rate because the increased possibility of being unemployed leads them to be satisfied with the fact of having a job, not with the type of job itself.

52. Across the 22 countries that participated in PIAAC that allow for the analysis of field-of-study mismatch, job satisfaction is generally high even among mismatched workers. In all countries except Japan, Korea and the Russian Federation**, three quarters or more of respondents report being satisfied with their jobs. In 22 of the 23 countries, field-mismatched workers report lower levels of job satisfaction, though this relationship is statistically significant only in Canada, Estonia, Finland, Italy, Korea, the Netherlands, Spain and the United States. In the United States, for example, the share of mismatched workers by field-of-study who report being dissatisfied with their job is more than ten percentage points lower than that of matched workers (Table 9).

53. However, in many cases, mismatched workers by field-of-study do not, as a result of field mismatch itself, experience lower job satisfaction; it may be a result of the accompanying overqualification. In Estonia, Italy, Korea, the Netherlands and Spain, in fact, after accounting for workers' qualification mismatch, the lower levels of job satisfaction reported by field-of-study mismatched workers disappears. Only in Canada, Finland, Korea and the United States does field-of-study mismatch remain a relevant source of job dissatisfaction even among workers who are well qualified for the job (Table 10) and this relationship holds after accounting for wages, a key determinant of job satisfaction (results not shown). These are all countries with comparatively low unemployment rates (the interaction between the year's unemployment rate and field of study mismatch is statistically significant at the $p<0.05$ level, not shown). Thus, albeit the exceptions of Canada, Korea, and the United States, the already weak relationship between

job satisfaction and field-of-study mismatch observed stems mainly from the downgrading that mismatched workers experience in terms of qualifications (Ortiz and Kucel 2008; Klein 2010) or occupational status (Wolbers, 2003).

4.3 Employment stability

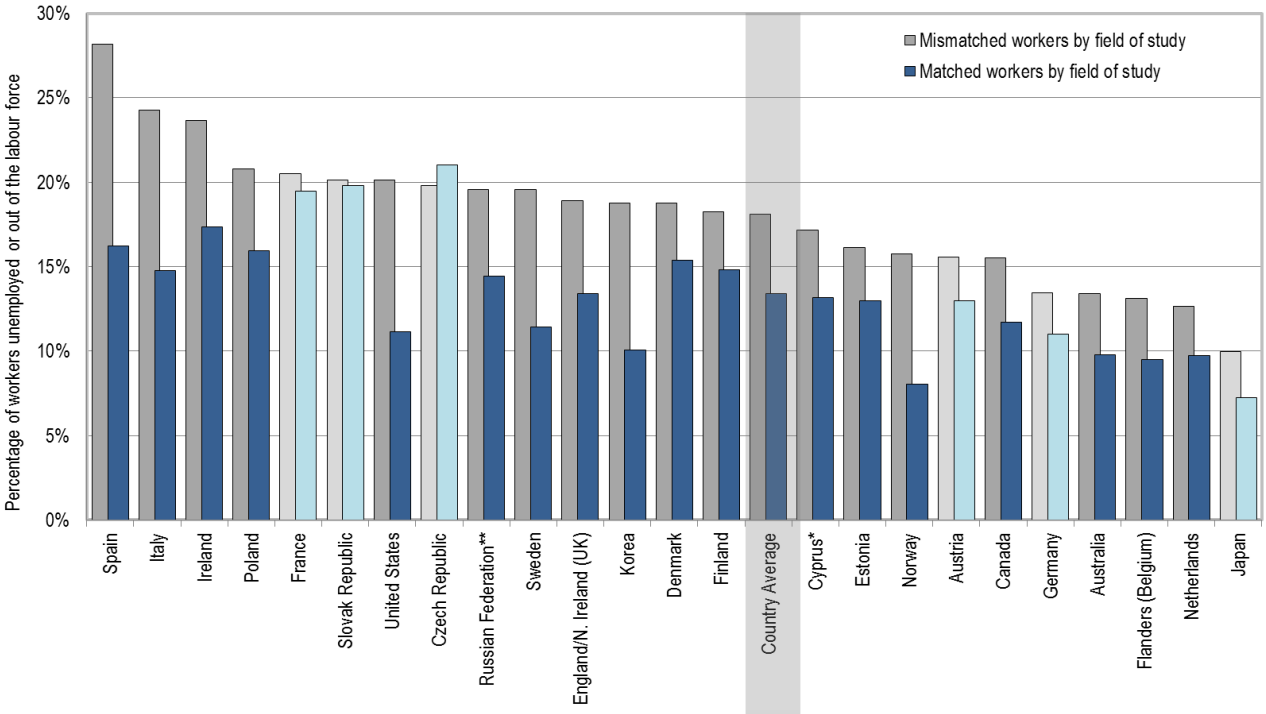
54. Previous cross-national evidence has shown that unemployment is related to the incidence of mismatch. Wolbers (2003) finds that in periods of higher unemployment in the whole economy, workers are more likely to accept a job in which they are mismatched by field of study. When faced with the prospect of being jobless, workers are more likely to take a job outside their field. Quintini (2011b) finds similar results for qualification mismatch, and Marsden et al. (2002) for skills mismatch.

55. The reverse, that mismatched workers may be more likely to become be out of work, however, has not been fully explored. If mismatched workers are less productive – as indicated by their lack of job-specific skills in the first years in the job and their lower levels of pay – or less satisfied in the workplace, they may be the first ones employers decide to lay off in periods of economic difficulty. If they are less satisfied, they may be more likely to resign. Wolbers (2003) observes – but does not test – that a period of economic recession is an opportunity for employers to select their most productive employees, which are most likely to be the matched ones or, at least, most likely to be thought as the matched ones. Workers who were mismatched by field-of-study in their previous job are indeed more likely to be out of work, as shown from PIAAC results in Figure 6. On average across participating countries, 15.4% of surveyed respondents that are employed or held a job in the past 5 years were unemployed or out of the labour force. Among those that were matched in their last job, this figure is 13.4%, and among those that were mismatched, 18.1%. The relationship between mismatch and being unemployed or out of the labour force is observed in 17 of the 23 participating countries and is particularly strong in Italy, Korea, Spain, Sweden and the United States, where there is at least an 8 percentage point difference in the likelihood of being unemployed or out of the labour force when comparing mismatched to matched workers by field of study. It is not significant in Austria, the Czech Republic, France, Germany, Japan and the Slovak Republic (Figure 6 and Table 11). Previously mismatched workers are no more likely to have resigned; only in Flanders (Belgium) are they more likely to have resigned, but in Japan the reverse is true (Table 11).[15]

56. The increased likelihood of being unemployed or out of the labour force if an individual was mismatched in the last job could reflect a selection process or skill heterogeneity. Individuals who were mismatched by field-of-study in the last job may have lower skills levels or may have underlying characteristics that make them less likely to hold a job in the first place; they may have been concentrated in fields that are especially likely to being laid off if mismatched. Yet these results remain statistically significant after controlling for individuals' numeracy skills and the length of tenure in the last job (Table 12). It may be that field-of-study mismatch remains a signal of productivity in the eyes of employers, even though these workers may not necessarily have lower skill or productivity levels. These findings also suggest that workers from fields that experience higher levels of saturation are more likely to be unemployed or out of the labour force, and those who graduated from fields with a higher level of skills transferability are less likely to be unemployed or out of the labour force (Models 3 and 4 in Table 12).

15. The result that previously mismatched workers are generally not more likely to have stopped work for voluntary reasons holds after accounting for numeracy skills and other background characteristics.

Figure 6. **Field-of-study mismatch and the likelihood of unemployment or being out of the labour force**



Notes: Field-of-study mismatch is calculated for individuals based on their last reported job. Percentage calculated over individuals currently employed or, among those unemployed or out of the labour force, those who were employed in the past five years.
Countries are sorted by the percentage of previously mismatched workers unemployed or out of the labour force.
Light-coloured bars indicate that the difference between matched and mismatched individuals is not statistically significant at the p <0.05 level.
*, ** See notes Figure 1.

Source: Annex 3, Table 10.

57. Moreover, individuals who were mismatched by field-of-study in their last job have remained, on average, out of work for a similar amount of time compared to non-working individuals who were matched in their previous job (Table 13). This suggests that once field-of-study mismatched individuals lose their jobs, they are no different than non-working previously-matched individuals: they are all similarly unemployed or out of the labour force and equally likely to find a new job. Thus, when out of work, previously field-of-study mismatched workers' experience does not count for or against them in the prospect of looking for a new job; future employers do not seem to discount the previously mismatched experience and consider it as valuable as the experience for previously matched workers.

5 The national level costs of field-of-study mismatch

58. As shown in the previous sections, workers who are mismatched by field-of-study experience a small wage penalty, but is particularly large when field-of-study mismatch entails overqualification as well, and are more likely to lose their job. These are costs to the individual worker that, on aggregate, have implications for the entire economy.[16] Wage penalties may reflect the lower productivity of mismatched workers compared to matched workers, as mismatched workers lack the field-specific skills of their matched counterparts, at least before mismatched workers gain these field-specific skills through on-the-job training or work experience. In the context of overskilling and using wages as an indicator of productivity, Mavromaras, McGuinness and Fok (2009) estimate the cost of overskilling in Australia in 2005 to be around 2.6% of GDP. Furthermore, field-of-study mismatch implies sunk education costs if mismatched remain so for their entire careers, as these workers are not putting the field-specific skills earned in training to use.[17]

59. This section draws on the estimates from Sections 2 and 4 to estimate the costs of field-of-study mismatch experienced in 2012. It uses the statistically significant point estimates from the models that estimate the relationship between field-of-study and qualifications mismatch on one part, and wages and risk of being out of work, on the other. It draws on data from OECD's work on education expenditure and countries' educational organisation (OECD, 2013d) to put a value on the costs of education. In aggregating the costs of field-of-study mismatch, many assumptions are made; results and conclusions from this exercise should be taken as an illustration of the potential magnitude of the issue. Several assumptions are made in this calculation – generally conservative ones when compared to Mavromaras et al. (2009) –; the estimates presented here should be interpreted with caution. Implementation of policies and programmes to overcome field-of-study mismatch might not necessarily overcome these costs as changes in one field or in supply or demand may induce mismatch in other fields. Nonetheless and considering the unforeseen consequences of overcoming field-of-study mismatch, the estimation of the national-level costs of field-of-study mismatch quantifies the problem and enables comparisons with other labour market phenomena.[18]

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16. For an individual firm, having mismatched or overqualified workers may increase their productivity (Mahy, Ryck and Vermeylen, 2015). This is because overqualified workers experience wage premiums compared to his/her colleagues that are well matched by education; but this wage premium is lower than the penalty that overqualified workers experienced when compared to peers that have reached a similar educational attainment.

17. Given the findings in section 4 that field-of-study mismatched individuals spend an equal amount of time unemployed than previously well matched individuals, aggregate unemployment costs are not included in the calculations carried out in this section. In fact, while the costs of unemployment also potentially aggregate up at the national level because of higher expenditure on unemployment benefits and lost revenues in the form of income taxes and social security contributions, this is only the case if field-of-study mismatched workers spend more time in unemployment than well-matched individuals. The fact that field-of-study mismatched workers are more likely to be unemployed does not, by itself, result in an aggregate cost: if laid-off mismatched workers are replaced by well-matched individuals, the cost may even become a gain as well-matched workers earn more and thus pay higher taxes. Furthermore, it is unclear whether field-of-study mismatch, on aggregate, increases the overall unemployment rate though higher turnover can increase the transaction costs for an employer.

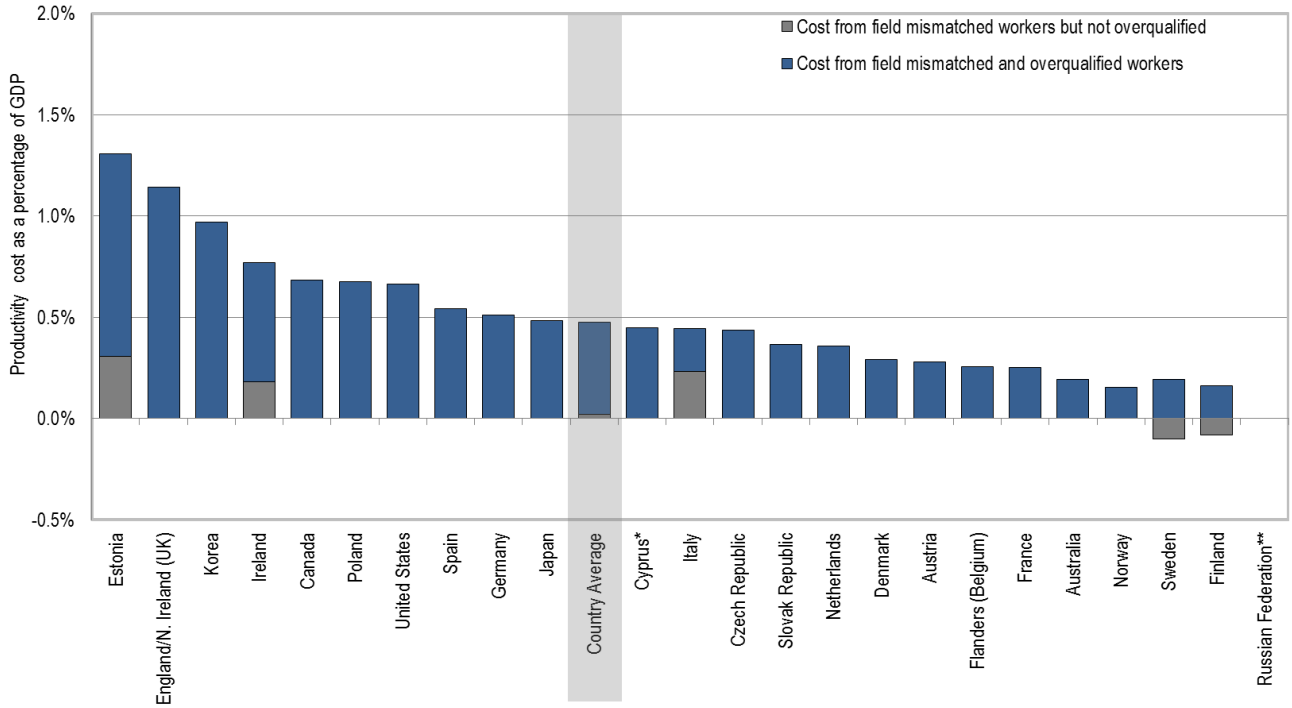
18. Not all countries are included in the analysis of system-level costs of field-of-study mismatch because of data availability. Education expenditure data is unavailable for Belgium, Canada and Germany; graduation numbers are unavailable for the Russian Federation**; and data on benefits and taxes is unavailable for the Russian Federation** as well.

60. A first source of national-level costs of field-of-study mismatch stems from the fact that mismatched workers may be less productive than their matched peers (as argued by assignment theories (Sattinger, 1993)). By working in a field different than the one in which they graduated, mismatched workers bring a narrower set of skills to the workplace and have to learn the field-specific skills through experience or further training. Figure 7 shows the productivity cost of field-of-study mismatch, relative to GDP. It assumes that the wage penalty associated with field-of-study mismatch is a measure of lost output or lost productivity and aggregates this wage penalty to all mismatched workers. It is possible that currently mismatched workers would be less productive if they were matched when compared to their matched peers (e.g. skills heterogeneity as discussed in Quintini (2011a)). Mismatched workers may also be slightly more productive when compared to matched workers; replacing an overqualified worker with a well-qualified worker may imply lower productivity (Kampelmann and Ryck, 2012; Mahy, Ryck and Vermeylen, 2015). As a result of these phenomena, for the purposes of these estimates, the productivity costs of field-of-study mismatch are assumed to be half the wage penalty.[19] Two types of penalties are analysed: the one stemming from field-of-study mismatched workers who are also overqualified – which tends to be large - and the one associated with field-of-study mismatched workers who are well matched by qualifications –which tends to be not statistically significant except in Estonia, Ireland and Italy. The estimates for these penalties control for workers' age, gender, experience, tenure, temporary or part-time work arrangements, firm size, the firms' private or public sector and size. They also partly control for skills heterogeneity as a source of mismatch penalties by including controls for educational attainment and numeracy skills. Estimates also assume that workers mismatched at the time of the Survey of Adult Skills in 2012 reflect the year's population of mismatch. Aggregates of the lost productivity in 2012 assume the average number of reported hours worked per week by matched workers in PIAAC multiplied by 48 weeks to estimate the earnings and productivity costs for the year.

61. Any national-level cost is driven not only by the number of individuals who are mismatched by field-of-study (overqualified or not), as observed in Section 2, but also by the size of the wage penalty associated with mismatch, as described in Section 4. In most cases the productivity costs are driven by field-of-study mismatched workers who downgrade to find work in another field (i.e. they are driven more by the resulting overqualification than by field-of-study mismatch itself). Figure 7 shows that the total productivity costs associated with field-of-study mismatch may amount to more than 1% of GDP in England/N. Ireland (UK) and Estonia, to more than 0.5% in Korea and Ireland, Canada, Germany, Poland, Spain and the United States. The total productivity costs associated with field-of-study mismatch are relatively small in Australia, and Norway. In Finland and Sweden, any costs associated to the resulting overqualification are practically offset by the wage premia enjoyed by field-of-study mismatched workers who are not overqualified. In the Russian Federation** field-of-study mismatch does not entail a statistically significant penalty (or premium) neither when associated with overqualification nor when not associated with overqualification. Given the assumptions, these are likely to be lower-bound estimates.

19. In their study of the relationship between training, wages and productivity in the United Kingdom, Dearden et al. (2006) found that wage effects are around half of productivity effects. As a result, the assumptions taken in this paper to assess the aggregate costs of field-of-study mismatch to aggregate productivity are conservative.

Figure 7. **Productivity costs of field-of-study mismatch, 2012**



Note: Productivity costs measured as the half of the average wage differential between mismatched and matched workers, multiplied by the average wage of matched workers and the number of mismatched workers, expressed as a share of 2012 GDP (2011 GDP in the case of England/N. Ireland [UK] and Flanders [Belgium]). Countries are sorted by the total productivity cost of field-of-study mismatch as a share of GDP. In parentheses, next to the country name, the total productivity cost of field-of-study mismatch (addition of the grey and blue bars).
*, ** See notes to Figure 1.

Source: Annex 3, Table 15.

62. By comparing the size of the grey and blue bars, results show that productivity costs related to field-of-study study mismatch arise mostly from the penalty associated with workers working in a field unrelated to their studies and at a level that is below their qualifications. Such is the case of all countries (with the exception of Estonia, Ireland and Italy) where the productivity costs associated with field-of-study mismatch but no qualification mismatch are null, as a result of the statistically non-significant penalty to field-of-study mismatch with qualifications match. In England/N. Ireland (UK) all the productivity cost is related to the penalty associated with overqualification that mismatched workers face when downgrading. In Korea, Ireland and Italy, by contrast, the productivity cost of field-of-study mismatch without overqualification amounted to around 0.2% of GDP in 2012.

63. Given that workers who graduated and entered the workforce in 2012 on a mismatched by field-of-study may not make full use of the field-specific skills acquired in training, this field-specific training can become a sunk cost if workers remain mismatched throughout their careers. Remaining mismatched for the entire career is not unlikely given the path dependency in career trajectories. For those workers who are mismatched by field-of-study and overqualified, a larger part of the training that led up to their highest qualification can be considered a sunk cost. Figure 8 shows, for countries with available

information,[20] the sunk formal education costs associated with field-of-study mismatch. As described below, this estimation draws on several assumptions, so estimates should be taken with caution. The calculation draws on information on the 2012 expenditure at ISCED 3 and ISCED 5 levels to measure the training costs. These estimates are drawn from Education at a Glance 2013 (OECD, 2013d). These costs are multiplied by the number of mismatched workers (separately for overqualified and not overqualified) that graduated from ISCED 3 and ISCED 5, respectively. The number of mismatched graduates is estimated, in turn, as the product of the proportion of mismatched workers with ISCED 3 or ISCED 5 degrees as their final qualification and the number of graduates (as terminal degrees) from ISCED 3 and ISCED 5 levels. While the total number of graduates from ISCED 5 per year is available in Education at a Glance, the total number of graduates from ISCED 3 not continuing on to further education is not; it is estimated as the number of graduates from ISCED 3 minus the total number of entrants into ISCED 5 in any given year. These estimates do not consider any costs associated to the few mismatched workers who have ISCED 2 as their highest educational attainment. These costs may be lower (higher) under the assumption that the field-specific training component of a programme is smaller (larger). This assumption is currently fixed for all countries; total estimates for each country could be larger (smaller) if the proportion of field-specific training that is not relevant outside the specific field is larger (smaller). Given that there is no data to determine this variability, the analyses take a conservative approach and assume that the majority of the training received in a particular field confers general or transferable skills and a minority of skills that are only relevant to that specific field.

64. Of the total duration of studies, the estimated sunk costs only relate to the field-specific time spent in training (it does not consider foregone earnings, for example). Recognising that not all of the training received becomes a sunk cost, the sunk time is assumed to be 0.25 years (out of 2 years of training) for ISCED 3 and 0.5 years (out of 4) for ISCED 5 graduates.[21] For workers who are mismatched by field-of-study and are overqualified, the sunk cost is associated with the total duration of their final level of attainment. Also recognising that the time spent in the training that led to overqualification is not completely sunk because training confers general and soft skills, the sunk time is assumed to be 0.5 years for ISCED 3 and 0.75 years for ISCED 5 graduates who are mismatched by field-of-study and also overqualified. For the purposes of this estimation, 40% of the cohort entering the workforce in a mismatched status is assumed to remain mismatched throughout their career. Total education costs do not include training or re-training costs that may be incurred once workers enter the workforce, as retraining costs are already considered in the productivity loss. Other discounts may be applied considering a greater or lower share of sunk time in training and the total education costs will increase or decrease accordingly.

65. Similar to the total productivity costs, the estimated total education costs of field-of-study mismatch stem both from the cost of educational provision at each educational level and the number of mismatched workers from that corresponding level. As a result, and as shown in Figure 8, education costs associated with field-of-study mismatch are estimated to be highest in Poland, at more than 0.1% of GDP per year. These costs are comparatively low, equivalent to 0.025% or less of GDP in Austria, Sweden and Norway. These costs associated to the provision of training are not absorbed by the productivity costs mentioned above, as the education cost takes into account only the cost of the provision of skills that are not used later in students' working lives.

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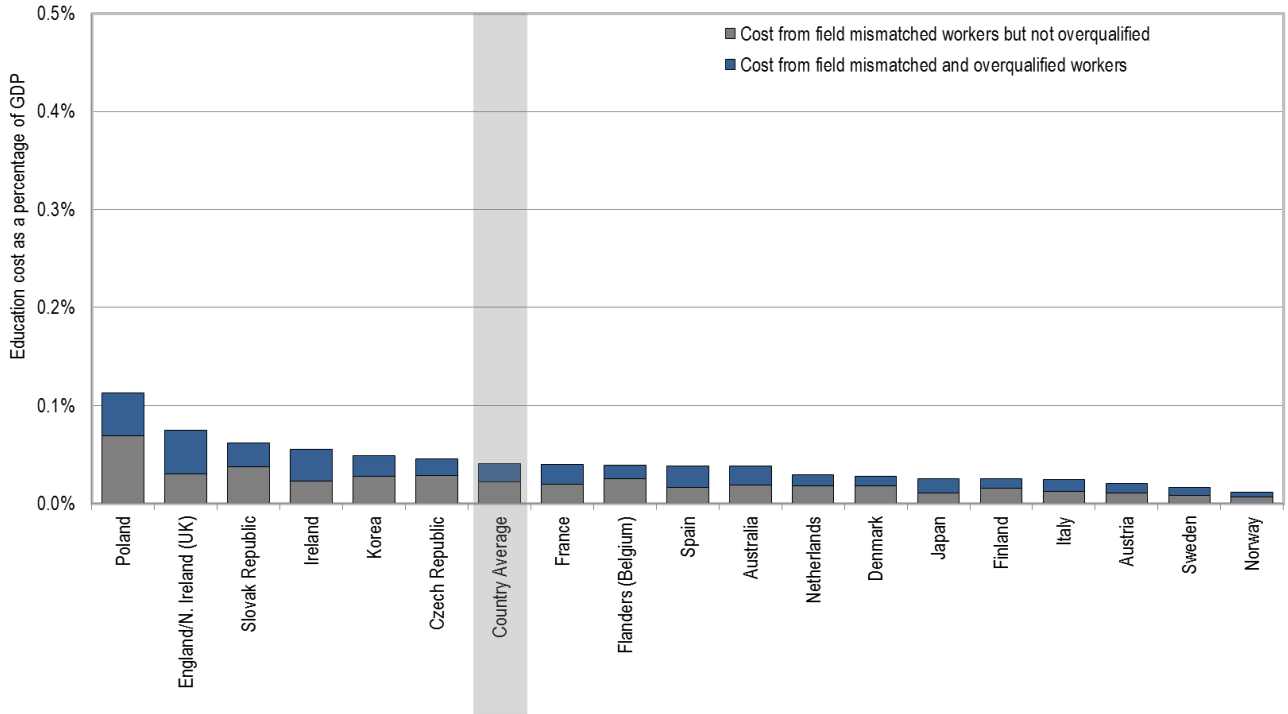
20. Education at a Glance (OECD, 2013c) does not provide the cost of provision of ISCED 3 or 5 level education in Canada and Germany nor does it provide information to estimate the number of graduates at ISCED 3 or 5 level per year in Canada, Estonia, Russian Federation and the United States. Countries are sorted by the total education cost of field-of-study mismatch as a share of GDP.

21. Further, this exercise assumes that the ratio of general/specific training provided at each level is constant between fields of study and countries.

Figure 8. **Sunk educations cost of field-of-study mismatch in 2012**



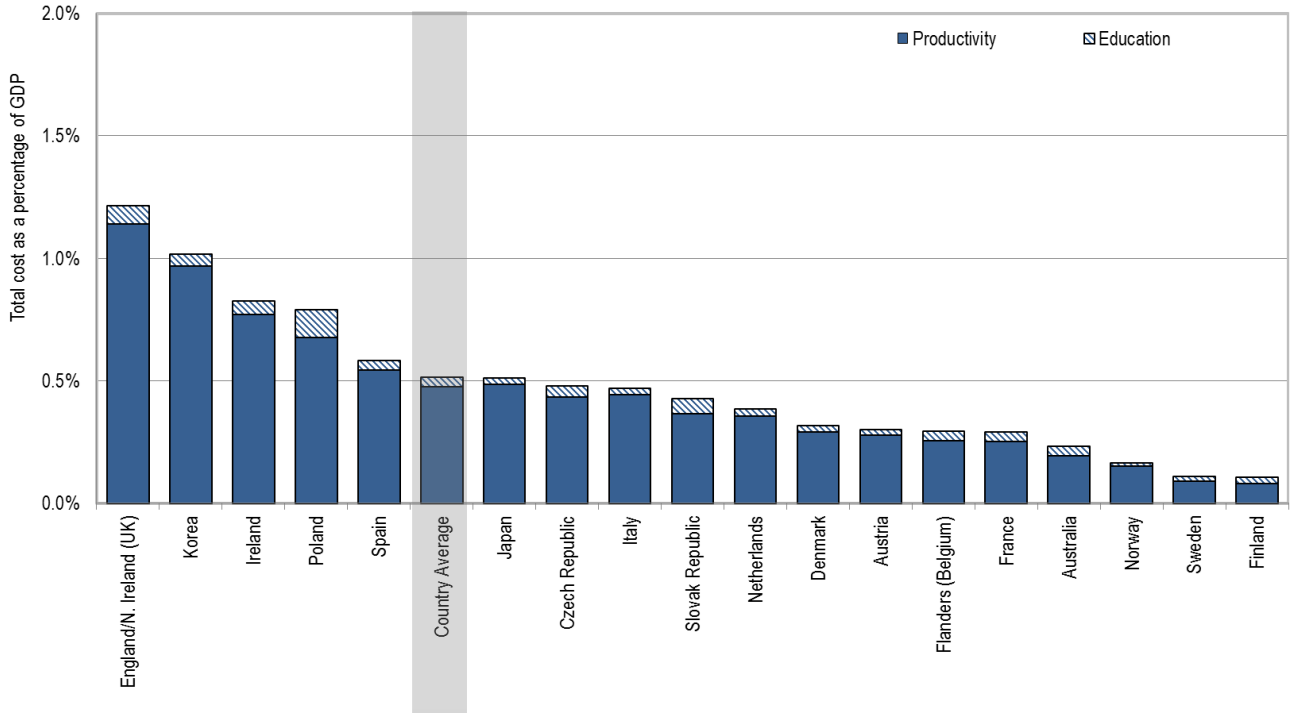
Note: Education costs measured as the cost of provision of formal education, discounted by an estimate of the proportion of training that is field-specific. Costs multiplied by the number of graduates from each level assumed to remain mismatched for their entire career, expressed as a share of 2012 GDP (2011 GDP in the case of England/N. Ireland (UK) and Flanders (Belgium)). Education at a Glance (OECD, 2013d) does not provide the cost of provision of ISCED 3 or 5 level education in Canada and Germany nor does it provide information to estimate the number of graduates at ISCED 3 or 5 level per year in Canada, Estonia, Russian Federation** and the United States. For England/N. Ireland (UK) and Flanders (Belgium), the cost of educational provision at each year for the UK and Belgium, respectively, is used.
Countries are sorted by the total education cost of field-of-study mismatch as a share of GDP.

Source: Annex 3, Table 15.

66. The addition of the productivity and education costs provides an estimate of the total costs of field-of-study mismatch in 2012. As shown in Figure 9, field-of-study mismatch costs more than 1% of GDP in England/N. Ireland (UK) and Korea. Practically all of this cost is driven by productivity costs which can be traced to the fact that around 50% of workers are mismatched by field-of-study and the large penalty associated to any resulting overqualification (field-of-study mismatched workers who are not overqualified do not contribute to lost productivity in England/N. Ireland (UK) or Korea (Figures 1, 7). In Korea, these productivity costs are largely driven by the costs associated with field-of-study mismatched who are also overqualified workers (almost 1 percentage point, Figure 7).

67. In fact, across countries, much of the overall cost of field-of-study mismatch is driven by the share of mismatched workers (the correlation between the cost of field-of-study mismatch relative to GDP and the percentage of mismatched workers is 0.65). In Australia and Italy, by contrast, there is around 50% of field-of-study mismatch (Figure 1), yet the relative costs, at 0.2 and 0.5% of GDP, respectively, amount to less than half of those of Korea and England/N. Ireland (UK). The lower relative costs in Australia and Italy can be explained by both the lower wage penalty experienced by field-mismatched and overqualified individuals and the smaller proportion of workers who are simultaneously overqualified and mismatched by field of study.

Figure 9. **Total costs of field-of-study mismatch in 2012**



Note: Total costs are the sum of productivity and education costs associated with field-of-study mismatch, expressed as a share of 2012 GDP (2011 GDP in the case of England/N. Ireland [UK] and Flanders [Belgium]). Data on benefits and taxes for the Russian Federation** is unavailable; data for educational provision costs or number of graduates is unavailable for Canada, Estonia, Germany, the Russian Federation** and the United States. For England/N. Ireland (UK) and Flanders (Belgium), the benefits and taxes for the UK and Belgium, respectively, are used. Countries are sorted by the total cost of field-of-study mismatch as a share of GDP.

Source: Annex 3, Table 15.

68. Results from Section 3 highlighted how field saturation and the transferability of skills were related to higher levels of field-of-study mismatch. Field saturation and skill transferability are subject to public policy through the coordination of vacancies by field-of-study during upper secondary, tertiary or adult education programmes and the curriculum and general/specific orientation of each programme of study. Insofar saturation and skill transferability promote field-of-study mismatch by forcing graduates from a saturated field to find work in other areas or by providing them with sufficient general skills to be adequately matched in other areas (and be as productive as matched workers as possible), public policy can reduce the extent and costs of field-of-study mismatch.

69. A viable policy option to reduce mismatch and/or reduce the consequences of mismatch at both the individual and system level is to anticipate future skill needs. Systems that anticipate skill needs through forecast and foresight exercises, for example, can inform the provision of incentives for skills in expected to be in shortage to be provided.

6 Conclusions and policy implications

70. Field-of-study mismatch occurs when a worker trained in a particular field works in another. It is conceptually and empirically distinct from qualifications mismatch or skills mismatch, but workers who cannot find work in their field-of-study may have to accept jobs that are below their qualifications or skill level. Under the assumption that students choose a particular field because of their expectation to develop

professionally in that field, field-of-study mismatch entails unaccomplished expectations for students and possibly a source of frustration because of the unmet expectations and because of the inability to put all their skills to use in the workplace. It also entails lower wages, increased likelihood of unemployment and lower levels of job satisfaction when it is associated to overqualification. For employers, mismatched workers may be less productive as they are more likely to be actively looking for a job and they require field-specific training. For the economy as a whole, field-of-study mismatch entails the sunk costs of developing human capital that will not be used, as well as the any social costs and the loss in output from the lower productivity associated with workers not being well-matched to their skills, as well as the frustration of graduates failing to find work and professional development in the field of their choice.

71. All countries experience some level of field-of-study mismatch, with the highest levels observed in Korea, England/N. Ireland (UK) and Italy – at around 50% of workers – and the lowest in Austria, Germany and Finland – at less than 30%. Some level of mismatch is expected as individuals look for a job that fits their skills and interests, and as economies shift in the types and levels of skill in demand in the labour market. Mismatch is also expected as workers age and career decisions depend more on their past experience than on their formal education. Using data from PIAAC it is difficult to estimate what proportion of this mismatch is temporary or to what extent mismatch is a transitory stage in workers' careers. Future studies should explore the magnitude and transience of field-of-study mismatch, as well as the long-term consequences for individual workers who enter their careers in a mismatched job, especially if that mismatched job entailed overqualification.

72. Field-of-study mismatch is responsive to the broader labour market context; it is not an individual outcome or one that results uniquely from workers' choice. Field saturation is predictive of a higher likelihood of individual field-of-study mismatch. The demand for skills in the labour market is one of the drivers of mismatch: when there are more graduates from a particular field than jobs available in that field, some necessarily need to look elsewhere for a job. In this situation, mismatch is indeed preferable to unemployment; both at the individual and macroeconomic level, but the costs of mismatch can be reduced if graduates from saturated fields need not downgrade to jobs with lower qualifications requirements or if skills anticipation systems are in place to reduce the likelihood that any given field is highly saturated in the future. Similarly, workers from fields that show higher saturation levels are also more likely to be unemployed or out of the labour force.

73. Similarly, the supply of skills, through the characteristics of the training received, can also drive field-of-study mismatch. Fields of study that provide more transferrable skills offer their graduates more opportunities to find work in other fields and increase the likelihood that in the event of field-of-study mismatch, workers can find jobs at the adequate qualifications level, thus reducing both the individual and system-level costs associated with field-of-study mismatch. However, the transferability of skills is not equally predictive of field-of-study mismatch across all countries, pointing to the articulation of education systems and curricula and the extent to which a particular field provides the same set of general skills across all countries and how credentials are used as signals of worker skills. Such variability is also consistent with the relationship between each field's skill transferability levels and the field-of-study mismatch penalty. Much of the wage penalty associated with a field's skill transferability disappears after including country fixed effects and there are interactions between the field-of-study mismatch wage penalty and skill transferability. This signals that the relationship between skill transferability and wages varies greatly by country, possibly because of the degree to which employers rely on field-of-study as a measure of worker skills or because of the degree of transferability of skills of each field across countries (training for a particular field may be more field-specific in one country than another).

74. The fact that in most countries there is no significant wage penalty associated with field-of-study mismatch when workers are not overqualified (Figure 5) and that overqualification accounts for only a part of the total mismatch (OECD, 2014a, Figure 5.4) suggests that training is already producing sufficient

skills to allow at least some, but not all, workers to move across fields at the same qualification level. Investing in retraining or providing alternative career paths so that mismatched workers can earn a credential in a new field at their same qualification level may help the labour market prospects of mismatched workers who are forced to downgrade, and also reduce the system-level costs of downgrading. Encouraging the development of more general skills in training so that workers who are not able to find work in their field-of-study do not have to downgrade to find work may be advisable as is the determination of vacancies in educational programmes in accordance to the current or expected labour market demand. Moreover, encouraging the development of a qualifications framework that takes into account workers' flexibility may help employers recognise workers' skills and thus recognise that, for many occupations, a perfect match between field-of-study and occupation is not a requirement for sufficient performance in the job which in turn will allow for graduates from saturated fields to find jobs at their qualification levels in other fields.

75. Consistent with previous studies, in PIAAC, mismatched individuals experience a wage penalty. Field-of-study mismatch implies a small penalty for workers but it is large if workers are forced to take a job that is below their qualification level. It points to lost productivity related to a lack of job-specific skills (models control for skill heterogeneity), and can aggregate to important national level costs when associated to overqualification.

76. Field-of-study mismatch when associated to overqualification should be addressed at the policy level because of the consequences it brings to individuals (particularly when they downgrade and become overqualified) and for the costs involved in skilling individuals for jobs that will not necessarily use those skills. Considering that the bulk of the wage penalty – and the aggregate cost – that results from field-of-study mismatch comes from workers' downgrading, facilitating the transferability of workers and skills across fields without having to downgrade (by recognising their skills through comprehensive qualifications frameworks) or by offering workers and graduates the opportunity to re-skill in a different field while recognising their highest qualification may help reduce the individual and system-level costs of field-of-study mismatch.

77. Other interesting findings in these analyses include the fact that countries with higher levels of employment protection and union density tend to have lower levels of field-of-study mismatch (for those groups and countries where employment protection is related to unemployment (see OECD, 2013c) it may be that field-of-study mismatch is replaced by higher unemployment). It may be that in the context of high levels of employment protection, employers may have fewer incentives to hire workers from other fields as it is less clear in the recruitment process if incumbents have the necessary skills to perform the job tasks. This interpretation – although purely speculative – is consistent with the fact that field-of-study mismatched workers are more likely to be in temporary and part-time work arrangements. Also, mismatch is more likely among workers who took up the job when the economy was experiencing higher unemployment levels, which is consistent with previous studies and the analyses of job saturation in this paper: if there are no jobs available, workers are more likely to take up any job even if it means stepping into another field or a lower qualification level.

78. Several implications stem from these findings, especially when considering the high likelihood of workers experiencing field-of-study mismatch and its consequences for both individuals and the economy. At the system level, a policy lever to reduce the incidence of field-of-study mismatch - and any resulting overqualification – is to better anticipate future skill needs. Skill needs assessment and forecast exercises exist in many countries (see CEDEFOP, 2008 for a review of European initiatives), but, in many instances, the richness of information from these exercises does not translate into effective policies (Bartlett, 2013; McGuinness and Bennett, 2008). Information from skills assessment and forecast exercises that identify current and potential skill shortages and surpluses can be linked to educational systems to inform the number of vacancies by level or field of study. Denmark, Finland and Ireland, for example, use forecast

exercises to determine the number of vacancies in VET or university-level programmes (Commission of the European Communities, 2009). Australia, Turkey and Northern Ireland also consider the list of occupations facing shortages to allocate funding for apprenticeships (OECD, 2014c).

79. Another policy option to reduce field-of-study mismatch is to better inform students' field-of-study choices. Individualised career guidance that can portray students' likely career path can enhance students' ability to make informed choices and create realistic expectations for students (Rosenbaum, 2001; Quintini, 2011a). Evidence from Spain suggests that students take labour market information into account when making educational decisions like dropping out (Aparicio, 2010), so providing accurate and individualised information may prevent students from creating false expectations about their choices and labour market outcomes. The channelling of this information to the education system to co-ordinate vacancies in upper secondary and tertiary education may help reduce the likelihood of mismatch. Denmark, Finland and Ireland, for example, use forecast and foresight exercises to inform the number of vacancies by level and field-of-study and to adjust course contents in light of future skill needs (Commission of the European Communities, 2009). Career guidance should not focus solely on the projected labour market demand to inform student choices, as workers who chose their field of study by extrinsic motivation (e.g. future wages) have worse labour market outcomes than those who chose their fields by intrinsic motivation (e.g. perceived vocation) (Sellami et al, 2014). Similarly, enhanced links between employers and schools, work experience programmes for students in lower- or upper-secondary programmes or apprenticeship programmes can provide students exposure to a job (or to a set of jobs) before they commit several years of their educational career to it.

80. Such career guidance and work experience programmes imply an information system that can measure current labour market outcomes and anticipate future skill needs with the ability to cater this information to the individual characteristics of students. Not all students are average students and not all educational institutions signal the same prestige or skill level about their graduates. Thus, information provided to students choosing a field should be precise enough for them to imagine their individual trajectories by providing, for example, employability and employability in the field, time to find a job and career advancement for graduates from different institutions as well as the distribution of these outcomes beyond the mean or median (e.g. top-10 and bottom-10 earnings percentiles) with clear guidance for students to create realistic expectations about their trajectories.

81. To reduce the consequences of mismatch, it may be preferable to offer flexibility for workers by enhancing the provision of general skills and worker adaptability in the education system and shifting the field- and job-specific training to workplace learning schemes. For workers already mismatched, re-skilling programmes may be advisable in countries where the field-of-study mismatch with overqualification penalty is high and where field-of-study mismatch brings about overqualification. Re-skilling currently mismatched workers or those currently unemployed so that they don't have to downgrade if looking for work in another field may reduce the penalties associated with working out of field. It may also help in reducing the likelihood that workers have to downgrade to find a job in another field. Similarly, establishing avenues for validating experience in another field with an educational credential may allow employers to better recognise the skills acquired by workers working out of their field and thus increasing the chances for these workers to find jobs in other fields at their appropriate qualification level. A comprehensive qualifications framework that considers the transferability of skills from a field-of-study across occupations may also help employers value skills from workers with credentials from other fields, particularly in labour markets where employers rely mostly on educational credentials to make hiring decisions. In the context of rapid economic change, frequent transitions across jobs and occupations, these anticipation and flexible schemes may be a more appropriate policy response.

82. Alternatively, to reduce the costs of field-of-study mismatch is to weaken the link between mismatch and wages/productivity. One way to do this is to create a comprehensive qualifications framework that recognises the transferability of skills across fields and occupations, so that employers can readily recognise – and value accordingly – that mismatched workers may not need to downgrade their qualifications to find work out of their field. Qualification frameworks can adopt a task-specific human capital approach to link fields to occupations and occupations to occupations, facilitating transferability where it is most suited (Gathmann and Schönberg, 2010; Poletaev, Robinson, 2008). Such a development is especially relevant in countries where qualifications are the main hiring signal and there is little capacity by the part of employers to get at workers' underlying skill or productivity levels (OECD, 2014a). Another avenue to reach this goal is to enhance the provision of general skills in the education and training system so that workers can more readily adapt to different working environments and allow them to learn field- or job-specific skills in the job. This will allow workers to have flexibility to move across occupations and jobs if economic conditions suddenly change in particular occupational group. Yet for job- and field-specific training to be provided in the job, a comprehensive workplace training programme needs to be in place with appropriate incentives for employers to hire and train workers with a general skill set as employers are more likely to prefer workers with job-specific training and fund training in job-specific tasks. This could be done, for example, by increasing trial periods for recent hires, by subsidising the first wages as part of a training period using funds from field-specific training in the education system that may be liberated.

83. The results from this paper could also suggest the policy objective of promoting matches as a viable policy option (e.g. by encouraging employers to prefer recruits in the adequate field-of-study), but this is not recommended. Three issues reduce the attractiveness of this option. First, the analyses assume that there are workers' field-of-study is fixed and that jobs can be created to accommodate such stock of human capital. Although grounded in human capital theory, economic circumstances do not necessarily allow for the creation and substitution of jobs to accommodate the stock of human capital by field-of-study and nothing ensures that the rates of return and productivity observed among matched individuals will be improved or even maintained if the economic sector structure shifts to accommodate the stock of human capital. Second and signalling a related issue, encouraging matches by field-of-study in fields that are saturated may lead to unemployment, which may not be preferable to a mismatched job, both at the individual level and the system level. Third, focusing the attention on hiring matched individuals may reduce the incentive for employers to look at other skill signals that may be more indicative of the broad array of skills required to perform well on the job. Fourth, encouraging the rigidity of the link between field of study and occupations may harm workers if economic shocks make their skills redundant. In effect, the low levels of mismatch observed in Germany and Austria may be a positive outcome, but if job-specific training entails rigidities to move across occupations it may hurt their long term labour outcomes even though it facilitates youth's school-to-work transition (Hanushek et al. 2014).

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ANNEX 1: DETAILS ON DATA AND METHODS

Data

84. Data for this study comes from the Programme for International Assessment of Adult Competencies' Survey of Adult Skills (PIAAC). PIAAC is a cross-national survey – 24 countries took part in 2012[22] – that measures adults' numeracy, literacy and problem solving in a technology rich environment. In addition to the assessment, PIAAC asks respondents about their job characteristics, their education and training, their use of different skills at work and home, and their socio-demographic characteristics. Given the diversity of participating countries, both the assessment and the background questionnaire were developed and piloted to ensure linguistic and cultural comparability. The PIAAC target population were all noninstitutionalised adults aged 16 to 65 (inclusive) who reside in the country at the time of the assessment, regardless of their nationality, citizenship or language. On average across participating countries, a probability-based sample of more than 5 000 adults was drawn, following population registries or household registries where population registries were unavailable. Depending on the characteristics of each country and its sampling frame, different multistage sampling designs were used; yet the samples for all countries are representative of the target population (OECD, 2013a).

85. Cross-national data like PIAAC is ideally suited for the study the prevalence and costs of worker mismatch in relation to the broader economic context it takes place because the richness of the background data allow for comprehensive and comparable measures of mismatch, and the cross-national variability allows for the analysis of mismatch in different fields across different economic contexts.

86. These analyses in this paper take advantage of the richness of the PIAAC background questionnaire data to include in the analysis factors that have been related to skills, qualification or field-of-study mismatch. These include respondent's socio-demographic characteristics (age, gender, marital status and family composition, educational attainment, proficiency in numeracy) and the characteristics of the job they hold (temporary or indefinite contract, full- or part-time status, firm size, public or private sector firm, hourly wages in 2010 USD PPP, qualification and foundation skills match). System-level attributes (ratio of unemployment at the time of hiring with respect to the five previous years, employment protection, union density, and labour productivity) were gathered from OECD's Employment and Labour Market Statistics dataset (OECD, 2014b). OECD's country level data are unavailable for all years, particularly for workers who began their last employment prior to 1985. For the Flemish Community of Belgium, for England or Northern Ireland, so the data for Belgium and Great Britain is used, respectively. Country-level data are not available for the Russian Federation** so these countries are excluded from the pooled models that consider these system-level variables.

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22. Participating countries include Australia, Austria, Canada, Czech Republic, Denmark, Estonia, Finland, Flanders (Belgium), France, Germany, Ireland, Italy, Japan, Korea, Netherlands, Norway, Poland, Russian Federation**, Slovak Republic, Spain, Sweden, the United Kingdom (England and Northern Ireland only), and the United States. See Annex 5 for complementary notes regarding Cyprus (*) and the Russian Federation (**). For simplicity, throughout this paper all national entities that took part in PIAAC are referred to as "countries" even though some may not be considered as such under certain definitions (e.g. the Flemish Community of Belgium). A future PIAAC round in 2015 will include Chile, Greece, Indonesia, Israel, Lithuania, New Zealand, Singapore, Slovenia and Turkey with results published and data made available in 2016.

Methods

87. A first set of analyses describe the extent of field-of-study mismatch and its relationship to other forms of mismatch across PIAAC participating countries with available data and across the different fields using simple frequencies and percentages on the data segmented by countries. This analysis provides an update and an extension to Quintini's (2011b) comparative analysis and provides comparable results from which to analyse different countries' mismatch levels, overcoming the limitation of comparing results from studies relying on self-reports.

88. All models and descriptive statistics take into account PIAAC's sampling design through jack knife replicate weights and, where appropriate given the use of numeracy or literacy skills measures, plausible values. Where possible, the SAS PIAAC Tool Macro was used and where certain procedures were not included in the macro – namely path analyses – these were adapted to consider PIAAC's specific survey and assessment design.[23]

The relationship between field-of-study mismatch and field saturation and transferability

89. The likelihood of a worker being mismatched by field-of-study has been associated with the particular field-of-study (Robst, 2007a), under the assumption that certain fields have a higher level of general or transferable skills and/or that workers from certain fields have trouble finding work in that particular field. These two explanations refer to two distinct mechanisms, one relative to labour supply processes and the other to labour demand processes. To estimate the relative contribution of these two mechanisms, logit models estimate the likelihood of being mismatched by field-of-study using the proposed measures of field saturation and skills transferability. Formally, these models estimate

$$ln\left[\frac{P(mismatch_i)}{1-\ P(mismatch_i)}\right] = \beta_0 + \beta_1 S_i + \beta_2 T_i + \boldsymbol{X'\gamma} + \boldsymbol{Z'\mu} + \varepsilon_i$$

where *mismatch* is a binary variable indicating whether individual *i* is matched (0) or mismatched (1) by field of study, S_i and T_i the saturation and transferability measures described above, **X** a vector of individual-level covariates used for control and associated with the likelihood of mismatch in previous studies and **Z** a vector of country-level covariates used for controls or associated with mismatch in previous studies.

90. The coefficients of interest are β_1 and β_2 as they reflect the importance of a fields' saturation and skill transferability in predicting whether a worker from that field will be mismatched. Model 1 includes only these two measures, Model 2 adds the socio-demographic controls and Model 3 adds skills and qualification mismatch, to isolate the effect of other forms of mismatch. Finally Model 4 adds system level attributes to control for the general economic context at the time of hiring to capture the field-specific variation in predicting mismatch.

91. To take advantage of the country-level variation in fields' levels of saturation and skill transferability, these analyses pool the entire PIAAC data.

23. The SAS PIAAC Tool macro takes the design and assessment features of the PIAAC dataset to calculate unbiased estimates. It is available for download at www.oecd.org/site/piaac/publicdataandanalysis.htm .

6.1.1 Individual costs of field-of-study mismatch

92. The relationship between field-of-study mismatch and wages is estimated through a path analysis and regression models. Path analyses estimate several relationships between field saturation, skill transferability, field-of-study mismatch, overqualification, numeracy skills and wages, visualised in Figure 4. The path analysis model also adds direct controls for age, age-squared, experience, experience-squared, tenure, and dummy variables for temporary contract, public sector or NGO, firm size and field-of-study (major). Estimates presented are unstandardised and should be interpreted considering the scale of the variables, just like any regression-based analyses. To use the complete variability of the PIAAC dataset when accounting for field characteristics, path analyses are run on pooled data. Formally, these models estimate, jointly, the following relationships:

$$\ln(wage)_i = \beta_0 + \beta_1 S_i + \beta_2 T_i + \beta_3 F_i + \beta_4 Q_i + \beta_5 FQ_i + \beta_5 N_i + \boldsymbol{X'\gamma} + \boldsymbol{Z'\mu} + \varepsilon_{1i}$$
$$F_i = \alpha_0 + \alpha_1 S_i + \alpha_2 T_i + \alpha_3 N_i + \varepsilon_{2i}$$
$$Q_i = \delta_0 + \delta_1 S_i + \delta_3 N_i + \varepsilon_{3i}$$
$$FQ_i = \omega_0 + \omega_1 S_i + \omega_2 T_i + \omega_3 F_i + \omega_3 N_i + \varepsilon_{4i}$$

where $wage_i$ is the respondents hourly wages in USD, including bonuses corrected for purchasing power parity, S_i and T_i the saturation and transferability measures described above; F_i, Q_i, and FQ_i are dummy variables indicating whether the respondent is mismatched by field-of-study only, is overqualified only or is mismatched by both field-of-study and overqualified, respectively; N_i is the respondent's numeracy skill score and **X'** is a vector of individual and firm-level controls including age, age-squared, experience, experience-squared, tenure, firm size and dummy variables indicating whether the worker is under a temporary work arrangement, working full time, working in a public organisation or NGO as well as fixed effects for each field of study. Due to a lack of variability on the saturation and transferability measures at the within-country level, these path analyses can only be estimated with a pooled sample.

93. Wage-regressions follow the same structure as the first equation estimated in the path analysis with the specificity of adding interactions between field attributes (or field-specific dummies) and the skills transferability measure as well as adding country fixed effects or running the models independently by country to gauge variability cross national contexts and variability across fields and field attributes.

94. Models that estimate job satisfaction and unemployment follow a similar structure as wage-regressions but in the context of logit models to account for the binary nature of the dependent variable. Models for unemployment use a slightly different array of independent variables because the PIAAC data asked employed and unemployed workers a different array of questions; only those that are comparable across the two groups are used in the analyses.

Analytical sample and weights

95. The full PIAAC sample consists of 165 599 observations. Because of the imprecise meaning of "general programmes", individuals reporting this type of educational programme are not used in the analysis (n = 25 303). Similarly, and also in consistency with Quintini (2011b), ISCO-08 occupations under the major groups 0 (armed forces) are not included in the analysis (n = 960), nor are some unclassifiable occupations (e.g. chief executives, senior officials and legislators; social and religious professionals; street and market salespersons; and manufacturing labourers) or those requiring very minimal training that is not field-specific (e.g. subsistence farmers/hunters/fishermen; food preparation assistants; street and related sales and service workers; refuse workers and other elementary workers) (n = 13 987). Also, it is impossible to determine field-of-study mismatch for workers with missing data on their occupation (n = 58 289) or field-of-study (n = 40 505).

96. The analyses focusing on the likelihood of field-of-study mismatch, job satisfaction and wages excludes individuals who are self-employed or not employed. Wage regressions exclude observations that have wages above the 99th and below the 1st percentile in each country. Analyses that focus on the likelihood of unemployment consider individuals who report being unemployed or out of the labour force. Pooled regressions using system-level data drawn from sources outside PIAAC exclude the sample of the Russian Federation** as they have no country-level data on macro-economic factors, and certain older workers who started their jobs before OECD data on labour market indicators became available in their respective countries.

97. To avoid losing further observations due to missing values on analytical variables, they have been imputed to the country-specific mean using the dummy-variable imputation method (Allison, 2002).

98. Given that PIAAC is a probability-sample with different sampling strategies by country, weights are used to make results representative to the population of workers aged 15 to 64 who are employed in fields other than "general programmes".[24] For country-specific analyses, the estimates are weighted by the full final weight. For pooled analyses, weights are adjusted considering the entire sample so that each country contributes a weighted sum of observations of 6623.96, equivalent to the average sample size observed across countries, to prevent countries with larger weighted samples leveraging the results (the United States has an overall weighted sum of observations equal to the target population of 203 million, while Estonia has less than one million).

99. PIAAC's uses a complex sampling strategy. As a result, standard errors estimated under the assumption of simple random sampling (as is the case in most standard statistical packages) will be biased. PIAAC provides jack knife-based replicate weights to correctly account for the complex sampling design (OECD, 2013a). The estimates presented in this paper take these weights into account through the use of the publicly available "PIAAC Tool" macro.[25]

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24. For the representativity of the analytical sample to this target population several assumptions must hold among which a) missing data on any of the analytical variables must be completely at random and b) the distribution of weights in the sample is invariant to this change in the target population (i.e. the sampling strata are not affected by this change in the definition of the population).

25. The macro and user documentation is available for SAS and Stata at www.oecd.org/site/piaac/publicdataandanalysis.htm.

ANNEX 2: CODING OF ISCO-08 3-DIGIT OCCUPATION TO FIELDS

100. The following correspondence defines well matched individuals based on their field-of-study (in italics) and ISCO-08 occupation. The same correspondence table categorises occupations into occupational groups.

- *(2) Teacher training and education science*: university, higher education, vocational, secondary, primary, early childhood and other teaching professionals (ISCO 231-235); sports and fitness workers (ISCO 342); and child care workers and teaches' aides (ISCO 531).

- *(3) Humanities, languages and arts:* university, higher education, vocational and secondary education teaching professionals (ISCO 231-233); architects, planners, surveyors and designers (ISCO 216); librarians, archivists and curators (ISCO 262); social and religious professionals (ISCO 263); authors, journalists and linguists (ISCO 264); creative and performance artists (ISCO 265); legal, social and religious associate professionals (ISCO 341); and artistic, cultural and culinary associate professionals (ISCO 343).

- *(4) Social sciences, business and law:* directors and chief executives (ISCO 112), managers (ISCO 121-122, 131-134, 141-143); university, vocational and secondary education teaching professionals (ISCO 231-233); business and administration professionals (ISCO 241-243); other health professionals (ISCO 226); legal professionals (ISCO 261); librarians, archivists and curators (ISCO 262); social and religious professionals (ISCO 263); authors, journalists and linguists (ISCO 264); business and administration associate professionals (ISCO 331-335); other health associate professionals (ISCO 325); legal, social and religious associate professionals (ISCO 341); clerical support workers (ISCO 411-413, 421-422, 431-432, 441); sales workers (ISCO 521-524); and street vendors (excluding food) (ISCO 952).

- *(5) Science, mathematics and computing:* physical and earth science professionals (ISCO 211); mathematicians, actuaries and statisticians (ISCO 212); life science professionals (ISCO 213); other health professionals (ISCO 226); university, vocational and secondary education teaching professionals (ISCO 231-233); Information and communications technology professionals (ISCO 251-252); physical and engineering science technicians (ISCO 311); process control technicians (ISCO 313); life science technicians and related associate professionals (ISCO 314); medical and pharmaceutical technicians (ISCO 321); financial and mathematical associate professionals (ISCO 331); information and communications technicians (ISCO 351-352).

- *(6) Engineering, manufacturing and construction:* engineering professionals (ISCO 214); electrotechnology engineers (ISCO 215); architects, planners, surveyors and designers (ISCO 216); university, higher education and vocational education teaching professionals (ISCO 231-232); information and communications technology professionals (ISCO 251-252); physical and engineering science technicians (ISCO 311); mining, manufacturing and construction supervisors (ISCO 312); process control technicians (ISCO 313); ship and aircraft controllers and technicians (ISCO 315); regulatory government associate professionals (ISCO 335); information and communications technicians (ISCO 351-352); building and housekeeping supervisors (ISCO 515); crafts and related trades workers (ISCO 711-713, 721-723, 731-732, 741-742, 751-754); plant and machine operators and assemblers (ISCO 811-818, 821, 831-835); and labourers in mining, construction, manufacturing and transport (ISCO 931-933).

- *(7) Agriculture and veterinary:* life science professionals (ISCO 213); veterinarians (ISCO 225); university, higher education and vocational education teaching professionals (ISCO 231-232); life science technicians and related associate professionals (ISCO 314); medical and

pharmaceutical technicians (ISCO 321); veterinary technicians and assistants (ISCO 324); other health associate professionals (ISCO 325); skilled agricultural, forestry and fishery workers (ISCO 611-613, 621-622, 631-634); food processing and related trades workers (ISCO 751); other craft and related workers (ISCO 754); mobile plant operators (ISCO 834); and agricultural, forestry and fishery labourers (ISCO 921);

- *(8) Health and welfare:* life science professionals (ISCO 213), health professionals (ISCO 221-227); university and higher education teaching professionals (ISCO 231); primary school and early childhood teachers (ISCO 234); social and religious professionals (ISCO 263); health associate professionals (ISCO 321-325); legal, social and religious associate professionals (ISCO 341); other personal service workers (ISCO 516); personal care workers (ISCO 531-532); and protective services workers (ISCO 541).

- *(9) Service:* professional services managers (ISCO 134); sales, marketing and public relations professionals (ISCO 243); other health associate professionals (ISCO 325); administrative and specialised secretaries (ISCO 334); regulatory government associate professionals (ISCO 335); legal, social and religious associate professionals (ISCO 341); artistic, cultural and culinary associate professionals (ISCO 343); clerical support workers (ISCO 411-413, 421-422, 431-432, 441); service and sales workers (ISCO 511-516, 521-524, 531-532, 541); drivers and mobile plant operators (ISCO 831-835); cleaners and helpers (ISCO 911-912); food preparation assistants (ISCO 941); street and related service workers (ISCO 951); and street vendors (excluding food) (ISCO 952).

- *Coded as missing*: all self-employed workers and those who majored in "general programmes"; armed forces occupations (ISCO major group 0); legislators and senior officials (ISCO 111); and refuse workers and other elementary workers (ISCO 961-962).

101. The following is the SAS code used to create the field-of-study mismatch measure (FIELDMISMATCH) from PIAAC data. It has a value of 1 if the respondent is working in a field different from their training. The MAJOR variable contains the type of field the respondent received (coded 1 to 9, equal to the B_Q02C variable in the PIAAC dataset). The ISCO3C variable contains the 3-digit ISCO-08 codes (the ISCO_08C variable in the PIAAC dataset converted to numerical values).

```
**START CODE FOR Field-of-study mismatch**;

if b_q01b in (1 2 3 4 5 6 7 8 9) then major=b_q01b;

*three-digit code, current occupation;
isco3dint=substr (isco08_c,1,3);
if isco3dint=999 then isco3dint=.;
isco3c=input (isco3dint,4.);
if isco3c<111 then isco3c=.;
if isco3c=999 then isco3c=.;
```

```
*field-of-study mismatch (current job);
Field mismatch = . ;

if major = 2 and
    ( isco3c= 231  | isco3c= 232 | isco3c= 233 | isco3c= 234 | isco3c= 235  |
isco3c= 342        | isco3c= 531)
    then fieldmismatch = 0;
if major = 3 and
    ( isco3c= 216  | isco3c= 231 | isco3c= 232 | isco3c= 233 | isco3c= 262  |
isco3c= 263        | isco3c= 264 | isco3c= 265 | isco3c= 341 | isco3c= 343  )
    then fieldmismatch = 0;
if major = 4 and
    ( isco3c= 112  | isco3c= 121 | isco3c= 122 | isco3c= 131 | isco3c= 132  |
isco3c= 133        | isco3c= 134 | isco3c= 141 | isco3c= 142 | isco3c= 143  |
isco3c= 226        | isco3c= 231 | isco3c= 232 | isco3c= 233 | isco3c= 241  |
isco3c= 242        | isco3c= 243 | isco3c= 261 | isco3c= 262 | isco3c= 263  |
isco3c= 264        | isco3c= 325 | isco3c= 331 | isco3c= 332 | isco3c= 333  |
isco3c= 334        | isco3c= 335 | isco3c= 341 | isco3c= 411 | isco3c= 412  |
isco3c= 413        | isco3c= 421 | isco3c= 422 | isco3c= 431 | isco3c= 432  |
isco3c= 441        | isco3c= 521 | isco3c= 522 | isco3c= 523 | isco3c= 524  |
isco3c= 952        )
    then fieldmismatch = 0;
if major = 5 and
(   isco3c= 211    | isco3c= 212 | isco3c= 213 | isco3c= 226 | isco3c= 231  |
isco3c= 232        | isco3c= 233 | isco3c= 251 | isco3c= 252 | isco3c= 311  |
isco3c= 313        | isco3c= 314 | isco3c= 321 | isco3c= 331 | isco3c= 351  |
isco3c= 352        )
    then fieldmismatch = 0;
if major = 6 and
    ( isco3c= 214  | isco3c= 215 | isco3c= 216 | isco3c= 231 | isco3c= 232  |
isco3c= 251        | isco3c= 252 | isco3c= 311 | isco3c= 312 | isco3c= 313  |
isco3c= 315        | isco3c= 335 | isco3c= 351 | isco3c= 352 | isco3c= 515  |
isco3c= 711        | isco3c= 712 | isco3c= 713 | isco3c= 721 | isco3c= 722  |
isco3c= 723        | isco3c= 731 | isco3c= 732 | isco3c= 741 | isco3c= 742  |
isco3c= 751        | isco3c= 752 | isco3c= 753 | isco3c= 754 | isco3c= 811  |
isco3c= 812        | isco3c= 813 | isco3c= 814 | isco3c= 815 | isco3c= 816  |
    isco3c= 817    | isco3c= 818 | isco3c= 821 | isco3c= 831 | isco3c= 832  |
isco3c= 833        | isco3c= 834 | isco3c= 835 | isco3c= 931 | isco3c= 932  |
isco3c= 933        )
    then fieldmismatch = 0;
if major = 7 and
    ( isco3c= 213  | isco3c= 225 | isco3c= 231 | isco3c= 232 | isco3c= 314  |
isco3c= 321        | isco3c= 324 | isco3c= 325 | isco3c= 611 | isco3c= 612  |
isco3c= 613        | isco3c= 621 | isco3c= 622 | isco3c= 631 | isco3c= 632  |
isco3c= 633        | isco3c= 634 | isco3c= 751 | isco3c= 754 | isco3c= 834  |
isco3c= 921        )
      then fieldmismatch = 0;
if major = 8 and
    ( isco3c= 213  | isco3c= 221 | isco3c= 222 | isco3c= 223 | isco3c= 224  |
isco3c= 226        | isco3c= 227 | isco3c= 231 | isco3c= 234 | isco3c= 263  |
isco3c= 314        | isco3c= 321 | isco3c= 322 | isco3c= 323 | isco3c= 324  |
isco3c= 325        | isco3c= 341 | isco3c= 516 | isco3c= 531 | isco3c= 532  |
isco3c= 541        )
```

```
    then fieldmismatch = 0;
if major = 9 and
    ( isco3c= 134  | isco3c= 243 | isco3c= 325 | isco3c= 334 | isco3c= 335  |
isco3c= 341        | isco3c= 343 | isco3c= 411 | isco3c= 412 | isco3c= 413  |
isco3c= 421        | isco3c= 422 | isco3c= 431 | isco3c= 432 | isco3c= 441  |
isco3c= 511        | isco3c= 512 | isco3c= 513 | isco3c= 514 | isco3c= 515  |
isco3c= 516        | isco3c= 521 | isco3c= 522 | isco3c= 523 | isco3c= 524  |
isco3c= 531        | isco3c= 532 | isco3c= 541 | isco3c= 831 | isco3c= 832  |
isco3c= 833        | isco3c= 834 | isco3c= 835 | isco3c= 911 | isco3c= 912  |
    isco3c= 941    | isco3c= 951 | isco3c= 952 )
    then fieldmismatch = 0;
if fieldmismatch = . and 2<=major<=9 and isco3c ne .
    then fieldmismatch = 1;
if isco3c= 111     | isco3c= 961 | isco3c= 962
    then fieldmismatch = .;
**END CODE FOR Field-of-study mismatch**;
```

ANNEX 3: TABLES

Table 1. Prevalence of field-of-study mismatch by field (part I/IV)

Country	Overall rate of field-of-study mismatch		Field-of-study mismatch by field of study							
			(2)		(3)		(4)		(5)	
	Percent	S.E.	Percent	S.E.	Percent	S.E.	Percent	S.E.	Percent	S.E.
Australia	47.7	(1.27)	32.9	(3.55)	89.7	(2.96)	44.4	(2.43)	63.4	(4.20)
Austria	28.0	(1.00)	25.9	(4.14)	60.8	(5.66)	21.8	(1.52)	49.3	(6.77)
Canada	37.4	(0.75)	29.9	(2.51)	77.1	(2.01)	19.1	(1.50)	62.5	(1.73)
Cyprus*	38.4	(1.34)	36.6	(3.91)	67.4	(3.64)	14.0	(2.39)	71.7	(3.94)
Czech Republic	38.3	(1.41)	35.9	(4.43)	77.8	(6.48)	22.6	(2.84)	69.7	(5.95)
Denmark	35.2	(0.95)	40.0	(2.43)	71.7	(2.72)	20.0	(1.60)	51.0	(2.93)
England/N. Ireland (UK)	49.9	(1.15)	40.6	(3.94)	87.3	(1.41)	26.9	(2.20)	76.5	(2.30)
Estonia	35.3	(0.76)	30.9	(3.16)	61.5	(4.02)	23.6	(1.66)	47.5	(4.43)
Finland	22.8	(0.76)	31.2	(3.71)	53.3	(4.19)	16.7	(1.71)	41.5	(5.72)
Flanders (Belgium)	38.8	(1.17)	28.5	(3.05)	76.3	(3.35)	20.8	(1.64)	68.1	(2.97)
France	42.4	(0.93)	37.1	(3.64)	68.1	(3.20)	25.5	(1.94)	73.1	(1.98)
Germany	26.4	(0.94)	31.9	(4.87)	55.6	(5.28)	17.4	(1.57)	51.6	(5.07)
Ireland	41.5	(1.28)	29.1	(4.00)	76.5	(3.59)	23.2	(1.98)	79.5	(2.62)
Italy	49.5	(1.34)	47.3	(6.25)	75.6	(3.30)	18.7	(2.39)	76.9	(2.36)
Japan	45.3	(1.21)	71.8	(3.02)	85.8	(3.03)	27.1	(2.32)	59.5	(5.30)
Korea	50.0	(1.15)	33.7	(4.60)	72.7	(3.04)	25.9	(2.59)	84.0	(2.26)
Netherlands	33.9	(1.06)	30.0	(3.08)	72.7	(4.42)	17.4	(1.66)	59.1	(3.61)
Norway	33.4	(0.94)	21.6	(2.13)	71.0	(4.12)	19.4	(1.39)	66.1	(3.28)
Poland	40.8	(0.97)	38.2	(4.20)	65.5	(4.13)	19.0	(2.34)	79.4	(3.17)
Russian Federation**	41.8	(1.55)	32.7	(5.13)	73.3	(3.13)	26.2	(5.32)	70.2	(5.39)
Slovak Republic	38.2	(1.06)	25.6	(3.45)	80.1	(3.94)	21.2	(2.37)	66.0	(3.46)
Spain	43.9	(1.31)	40.4	(4.85)	80.5	(2.47)	26.8	(2.49)	70.7	(2.84)
Sweden	33.7	(0.93)	27.7	(3.22)	71.1	(3.74)	30.8	(1.87)	54.7	(3.68)
United States	45.0	(1.16)	49.7	(3.78)	73.6	(3.36)	24.5	(2.22)	71.7	(2.77)
Country Average	**39.1**	**(0.23)**	**35.4**	**(0.80)**	**72.7**	**(0.77)**	**23.0**	**(0.47)**	**65.2**	**(0.80)**

(2) Teacher training and education science

(3) Humanities, languages and arts

(4) Social sciences, business and law

(5) Science, mathematics and computing

(6) Engineering, manufacturing and construction

(7) Agriculture and veterinary

(8) Health and welfare

(9) Service

Notes: (c) the estimate is not reported because there are less than 30 observations in that particular field of study.

Source: OECD, PIAAC (2012).

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Table 1. Prevalence of field-of-study mismatch by field (part II/IV)

Country	Field-of-study mismatch by field of study							
	(6)		(7)		(8)		(9)	
	Percent	S.E.	Percent	S.E.	Percent	S.E.	Percent	S.E.
Australia	36.6	(2.96)	62.2	(11.64)	54.6	(3.92)	38.2	(4.11)
Austria	28.6	(1.69)	77.7	(5.04)	14.7	(2.76)	25.6	(2.50)
Canada	25.8	(1.64)	57.3	(5.88)	32.0	(2.18)	41.3	(2.60)
Cyprus*	34.2	(3.55)	c	c	31.5	(4.94)	33.8	(4.64)
Czech Republic	32.2	(1.83)	77.7	(4.75)	39.4	(6.69)	52.3	(3.66)
Denmark	29.0	(1.76)	63.7	(5.88)	19.8	(2.33)	41.8	(2.55)
England/N. Ireland (UK)	37.6	(2.54)	83.7	(14.03)	24.7	(3.07)	c	c
Estonia	32.4	(1.33)	75.7	(3.13)	23.5	(2.55)	40.7	(2.44)
Finland	21.1	(1.14)	55.0	(6.32)	14.7	(1.82)	18.1	(2.50)
Flanders (Belgium)	32.1	(2.09)	90.2	(4.39)	30.9	(2.81)	25.1	(4.93)
France	35.9	(1.52)	65.9	(4.46)	35.2	(2.50)	40.7	(2.08)
Germany	29.2	(1.59)	54.5	(6.86)	23.2	(2.65)	18.0	(3.25)
Ireland	31.2	(3.26)	83.1	(6.22)	28.6	(2.94)	34.7	(3.71)
Italy	34.1	(3.30)	82.2	(6.20)	25.3	(5.32)	47.6	(4.78)
Japan	38.3	(2.12)	79.4	(4.66)	24.1	(2.92)	32.1	(4.20)
Korea	44.1	(2.15)	85.9	(4.53)	39.4	(4.68)	22.9	(4.22)
Netherlands	39.2	(2.45)	69.4	(5.00)	32.6	(2.11)	37.1	(4.86)
Norway	35.2	(1.89)	91.9	(3.63)	21.7	(2.04)	27.4	(3.64)
Poland	34.4	(1.71)	66.9	(5.81)	24.8	(3.90)	47.0	(3.19)
Russian Federation**	32.1	(2.83)	70.3	(5.37)	26.2	(5.75)	37.0	(5.11)
Slovak Republic	28.3	(1.60)	84.1	(3.19)	22.8	(3.64)	35.9	(2.59)
Spain	37.8	(2.99)	c	c	29.9	(3.66)	35.1	(5.80)
Sweden	30.6	(1.81)	64.9	(6.93)	23.8	(1.75)	27.2	(4.45)
United States	33.2	(3.99)	c	c	35.2	(2.68)	46.2	(4.31)
Country Average	**33.1**	**(0.48)**	**73.4**	**(1.40)**	**28.3**	**(0.73)**	**35.0**	**(0.81)**

(2) Teacher training and education science

(3) Humanities, languages and arts

(4) Social sciences, business and law

(5) Science, mathematics and computing

(6) Engineering, manufacturing and construction

(7) Agriculture and veterinary

(8) Health and welfare

(9) Service

Notes: (c) the estimate is not reported because there are less than 30 observations in that particular field of study.

Source: OECD, PIAAC (2012).

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Table 1. Prevalence of field-of-study mismatch by field (part III/IV)

Country	Field-of-study mismatch by occupational group									
	(2)		(3)		(4)		(5)		(6)	
	Percent	S.E.	Percent	S.E.	Percent	S.E.	Percent	S.E.	Percent	S.E.
Australia	11.2	(2.57)	32.4	(2.82)	31.7	(1.86)	26.8	(3.42)	25.2	(2.81)
Austria	22.5	(3.83)	18.8	(3.23)	26.8	(1.34)	19.6	(2.15)	20.8	(1.61)
Canada	21.9	(1.84)	15.4	(1.63)	41.7	(1.02)	15.5	(1.58)	29.2	(1.30)
Cyprus*	20.6	(3.19)	12.5	(3.17)	42.7	(1.72)	13.7	(2.54)	28.2	(2.75)
Czech Republic	32.0	(5.39)	28.3	(5.98)	47.2	(2.02)	25.4	(3.26)	25.6	(1.51)
Denmark	23.8	(2.14)	20.3	(2.49)	38.5	(1.32)	32.0	(2.14)	27.6	(1.68)
England/N. Ireland (UK)	42.3	(3.44)	18.2	(3.36)	51.0	(1.53)	29.3	(3.13)	38.7	(2.50)
Estonia	28.9	(2.75)	19.7	(2.47)	41.2	(1.40)	16.3	(2.23)	23.2	(1.03)
Finland	16.4	(2.42)	10.6	(2.09)	30.7	(1.15)	15.4	(2.12)	16.2	(1.24)
Flanders (Belgium)	22.1	(2.13)	20.3	(2.91)	49.6	(1.48)	15.4	(2.10)	22.8	(1.60)
France	23.3	(2.55)	20.2	(1.80)	46.9	(1.19)	18.7	(1.85)	37.8	(1.66)
Germany	19.5	(3.60)	14.9	(2.31)	28.1	(1.35)	12.4	(1.82)	18.7	(1.32)
Ireland	19.7	(3.44)	16.1	(3.02)	42.9	(1.71)	13.4	(2.57)	39.8	(2.85)
Italy	32.1	(4.28)	17.6	(3.84)	47.5	(2.00)	14.9	(2.52)	46.7	(3.02)
Japan	23.5	(3.04)	23.1	(3.59)	53.3	(1.78)	16.0	(2.46)	31.9	(2.43)
Korea	33.8	(3.34)	15.7	(3.12)	57.5	(1.53)	15.2	(2.54)	33.2	(1.72)
Netherlands	27.4	(2.57)	16.5	(2.12)	33.5	(1.15)	17.0	(2.16)	29.0	(2.21)
Norway	23.7	(2.19)	13.3	(2.12)	40.5	(1.47)	16.5	(1.92)	19.5	(1.49)
Poland	22.4	(2.69)	16.8	(3.59)	47.6	(1.45)	17.7	(2.29)	28.0	(1.49)
Russian Federation**	12.0	(3.04)	21.0	(3.12)	52.1	(2.18)	18.3	(2.79)	27.5	(3.36)
Slovak Republic	25.8	(3.29)	19.0	(4.09)	48.6	(1.82)	21.3	(2.52)	30.2	(1.53)
Spain	35.6	(3.24)	17.9	(3.12)	43.0	(2.05)	17.6	(2.34)	29.2	(2.61)
Sweden	19.6	(2.16)	14.4	(2.99)	39.6	(1.52)	14.0	(1.79)	24.1	(1.65)
United States	26.0	(3.44)	22.1	(3.43)	46.2	(1.29)	18.9	(2.72)	40.3	(2.93)
Country Average	**24.4**	**(0.64)**	**18.5**	**(0.64)**	**42.8**	**(0.32)**	**18.4**	**(0.49)**	**28.9**	**(0.43)**

(2) Teacher training and education science

(3) Humanities, languages and arts

(4) Social sciences, business and law

(5) Science, mathematics and computing

(6) Engineering, manufacturing and construction

(7) Agriculture and veterinary

(8) Health and welfare

(9) Service

Notes: (c) the estimate is not reported because there are less than 30 observations in that particular field of study.

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Table 1. Prevalence of field-of-study mismatch by field (part IV/IV)

Country	Field-of-study mismatch by occupational group					
	(7)		(8)		(9)	
	Percent	S.E.	Percent	S.E.	Percent	S.E.
Australia	35.5	(3.75)	27.4	(2.99)	53.5	(2.48)
Austria	31.6	(3.99)	33.4	(2.30)	27.8	(1.53)
Canada	17.8	(2.10)	19.3	(1.41)	48.3	(1.35)
Cyprus*	25.7	(8.00)	22.7	(3.24)	50.2	(2.22)
Czech Republic	31.9	(5.74)	45.4	(4.38)	43.5	(2.23)
Denmark	27.0	(3.31)	19.8	(1.52)	40.4	(1.64)
England/N. Ireland (UK)	37.2	(7.18)	36.4	(2.22)	62.6	(1.77)
Estonia	22.6	(2.71)	26.0	(1.84)	44.0	(1.51)
Finland	14.9	(3.14)	9.8	(1.16)	25.0	(1.35)
Flanders (Belgium)	27.6	(4.49)	19.6	(1.81)	54.6	(1.71)
France	33.9	(3.34)	25.3	(1.75)	41.8	(1.31)
Germany	16.3	(3.07)	19.5	(1.61)	30.3	(1.44)
Ireland	34.0	(5.27)	27.0	(2.16)	52.4	(2.01)
Italy	50.7	(5.40)	34.8	(3.17)	61.4	(2.24)
Japan	33.6	(4.35)	26.9	(2.43)	57.2	(1.71)
Korea	32.7	(5.69)	36.3	(2.85)	65.8	(1.61)
Netherlands	24.3	(3.74)	13.9	(1.25)	39.5	(1.62)
Norway	28.0	(3.42)	20.3	(1.32)	45.4	(1.67)
Poland	33.8	(3.40)	36.8	(2.91)	49.4	(1.88)
Russian Federation**	35.3	(4.22)	39.8	(2.21)	54.9	(2.66)
Slovak Republic	22.5	(3.03)	28.0	(2.59)	42.4	(1.74)
Spain	36.4	(4.15)	32.6	(2.35)	59.5	(2.04)
Sweden	28.5	(3.72)	23.9	(1.62)	45.6	(1.74)
United States	27.6	(4.55)	26.0	(2.13)	56.5	(1.82)
Country Average	**29.6**	**(0.91)**	**27.1**	**(0.48)**	**48.0**	**(0.37)**

(2) Teacher training and education science

(3) Humanities, languages and arts

(4) Social sciences, business and law

(5) Science, mathematics and computing

(6) Engineering, manufacturing and construction

(7) Agriculture and veterinary

(8) Health and welfare

(9) Service

Notes: (c) the estimate is not reported because there are less than 30 observations in that particular field of study.

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Table 2. Field-of-study mismatch by skill and qualification mismatch (part I/II)

	Overall rate of field-of-study mismatch		Decomposition of field-of-study mismatch by qualification mismatch					
			Field-of-study mismatch and qualifications match		Field-of-study mismatch and over-qualification		Field-of-study mismatch and under-qualification	
	Percent	S.E.	Percent	S.E.	Percent	S.E.	Percent	S.E.
Australia	47.7	(1.27)	54.4	(2.03)	39.7	(1.98)	5.9	(0.83)
Austria	28.0	(1.00)	53.3	(2.18)	34.6	(2.28)	12.1	(1.46)
Canada	37.4	(0.75)	50.4	(1.21)	41.9	(1.35)	7.8	(0.78)
Cyprus*	38.4	(1.34)	64.6	(2.11)	24.9	(1.86)	10.4	(1.50)
Czech Republic	38.3	(1.41)	67.6	(1.97)	26.9	(2.14)	5.5	(1.10)
Denmark	35.2	(0.95)	61.6	(1.68)	29.8	(1.52)	8.6	(0.90)
England/N. Ireland (UK)	49.9	(1.15)	48.9	(1.80)	38.1	(1.66)	13.0	(1.41)
Estonia	35.3	(0.76)	56.3	(1.47)	37.0	(1.52)	6.7	(0.98)
Finland	22.8	(0.76)	66.7	(2.21)	27.8	(2.32)	5.5	(0.93)
Flanders (Belgium)	38.8	(1.17)	66.0	(1.67)	24.1	(1.46)	9.8	(1.02)
France	42.4	(0.93)	48.7	(1.24)	39.2	(1.15)	12.1	(0.91)
Germany	26.4	(0.94)	55.1	(1.98)	35.7	(1.76)	9.2	(1.48)
Ireland	41.5	(1.28)	51.0	(2.29)	45.7	(2.28)	3.3	(0.74)
Italy	49.5	(1.34)	52.4	(2.21)	30.3	(1.91)	17.3	(1.75)
Japan	45.3	(1.21)	53.7	(1.79)	40.7	(1.78)	5.6	(1.13)
Korea	50.0	(1.15)	65.1	(1.76)	29.8	(1.64)	5.1	(0.86)
Netherlands	33.9	(1.06)	63.5	(1.67)	26.0	(1.61)	10.5	(1.18)
Norway	33.4	(0.94)	52.7	(2.02)	33.3	(1.77)	14.0	(1.26)
Poland	40.8	(0.97)	70.1	(2.17)	23.8	(1.84)	6.1	(0.96)
Russian Federation**	41.8	(1.55)	63.4	(3.69)	33.8	(3.70)	2.8	(0.72)
Slovak Republic	38.2	(1.06)	75.9	(1.60)	21.4	(1.51)	2.6	(0.56)
Spain	43.9	(1.31)	48.2	(2.13)	44.5	(2.09)	7.3	(1.14)
Sweden	33.7	(0.93)	52.7	(1.96)	31.0	(1.94)	16.3	(1.49)
United States	45.0	(1.16)	59.2	(2.38)	32.5	(2.06)	8.2	(1.05)
Country Average	**39.1**	**(0.23)**	**58.4**	**(0.41)**	**33.0**	**(0.40)**	**8.6**	**(0.23)**

Source: OECD, PIAAC (2012).

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Table 2. Field-of-study mismatch by skill and qualification mismatch (part II/II)

	Decomposition of field-of-study mismatch by skills and qualification mismatch							
	Field-of-study mismatch but qualifications and skill match		Field-of-study and skills mismatch but qualifications match		Field-of-study and qualifications mismatch but skills match		Field-of-study, qualifications and skill mismatch	
	Percent	S.E.	Percent	S.E.	Percent	S.E.	Percent	S.E.
Australia	48.5	(2.12)	5.9	(0.87)	40.0	(1.91)	5.6	(0.95)
Austria	43.8	(2.25)	9.5	(1.18)	35.3	(2.09)	11.4	(1.36)
Canada	43.9	(1.26)	6.4	(0.56)	43.6	(1.28)	6.0	(0.60)
Cyprus*	57.5	(2.42)	7.1	(1.13)	29.7	(1.94)	5.6	(1.19)
Czech Republic	55.4	(2.04)	12.2	(1.34)	27.5	(2.00)	4.9	(0.82)
Denmark	54.5	(1.68)	7.1	(0.78)	33.7	(1.58)	4.8	(0.84)
England/N. Ireland (UK)	42.7	(1.73)	6.2	(0.74)	44.1	(1.65)	7.1	(0.97)
Estonia	51.6	(1.60)	4.7	(0.64)	40.0	(1.46)	3.7	(0.56)
Finland	58.1	(2.28)	8.6	(1.29)	29.8	(2.01)	3.5	(0.88)
Flanders (Belgium)	58.4	(1.68)	7.6	(0.83)	28.7	(1.64)	5.3	(0.74)
France	44.5	(1.33)	4.2	(0.58)	46.5	(1.34)	4.8	(0.68)
Germany	45.4	(2.04)	9.7	(1.25)	35.4	(1.88)	9.6	(1.26)
Ireland	41.4	(2.27)	9.6	(1.20)	34.5	(1.98)	14.5	(1.71)
Italy	42.5	(2.07)	9.8	(1.28)	38.5	(2.13)	9.2	(1.41)
Japan	45.2	(1.96)	8.5	(1.08)	41.7	(1.82)	4.6	(0.71)
Korea	56.5	(1.68)	8.6	(0.91)	29.9	(1.63)	5.1	(0.71)
Netherlands	57.2	(1.62)	6.3	(1.03)	32.9	(1.60)	3.6	(0.72)
Norway	47.0	(1.97)	5.7	(0.82)	42.3	(1.90)	5.0	(0.74)
Poland	60.4	(2.18)	9.8	(1.00)	24.5	(1.76)	5.4	(0.94)
Russian Federation**	53.4	(3.23)	9.9	(1.06)	31.7	(2.82)	4.9	(0.92)
Slovak Republic	62.9	(1.82)	13.1	(1.47)	20.1	(1.48)	4.0	(0.67)
Spain	38.4	(1.98)	9.9	(1.34)	35.6	(2.02)	16.2	(1.78)
Sweden	48.0	(1.89)	4.7	(0.83)	41.1	(1.97)	6.2	(0.85)
United States	51.0	(2.66)	8.2	(1.18)	33.7	(2.08)	7.0	(1.10)
Country Average	**50.3**	**(0.41)**	**8.1**	**(0.21)**	**35.0**	**(0.38)**	**6.6**	**(0.21)**

Source: OECD, PIAAC (2012).

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Table 3. Skill and qualification mismatch for workers mismatched by field-of-study, by field

	Overall rate of field-of-study mismatch		Decomposition of field-of-study mismatch by skills and qualification mismatch							
			Field-of-study mismatch but qualifications		Field-of-study and skills mismatch but		Field-of-study and qualifications mismatch but skills		Field-of-study, qualifications and skill mismatch	
	Percent	S.E.	Percent	S.E.	Percent	S.E.	Percent	S.E.	Percent	S.E.
(2) Teacher training and education science	35.4	(3.90)	52.6	(7.10)	6.6	(3.76)	33.8	(6.82)	8.0	(4.15)
(3) Humanities, languages and arts	72.7	(3.79)	49.7	(5.54)	7.4	(3.20)	36.0	(5.09)	6.8	(2.69)
(4) Social sciences, business and law	23.0	(2.30)	41.4	(5.82)	7.7	(3.30)	42.1	(5.71)	8.8	(3.06)
(5) Science, mathematics and computing	65.2	(3.94)	52.7	(5.29)	11.0	(3.42)	28.5	(4.55)	7.7	(2.77)
(6) Engineering, manufacturing and construc	33.1	(2.36)	53.6	(4.57)	9.6	(2.60)	31.2	(4.18)	5.7	(2.36)
(7) Agriculture and veterinary	73.4	(6.41)	52.6	(7.06)	6.8	(3.41)	34.2	(6.79)	6.4	(3.87)
(8) Health and welfare	28.3	(3.56)	48.3	(7.24)	6.8	(3.89)	40.1	(7.19)	4.8	(3.09)
(9) Service	35.0	(3.88)	50.7	(7.34)	5.9	(3.49)	39.1	(7.07)	4.5	(2.97)
Field average	**45.8**	**(1.40)**	**50.2**	**(2.24)**	**7.7**	**(1.20)**	**35.6**	**(2.13)**	**6.6**	**(1.12)**

Note: Observations are weighted such that each country contributes equally to the estimates.
Source: OECD, PIAAC (2012).

Table 4. Field saturation and skills transferability

	Field saturation								Skill transferability							
	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Index	Index	Index	Index	Index	Index	Index	Index	Index	Index	Index	Index	Index	Index	Index	Index
Australia	1.2	-0.3	-0.1	-0.2	0.5	-1.2	0.5	-1.2	0.5	0.4	0.5	0.5	0.5	0.3	0.6	0.4
Austria	0.3	-0.5	0.0	-1.2	1.1	-0.4	-0.5	-0.9	0.5	0.5	0.4	0.5	0.5	0.5	0.4	0.4
Canada	0.2	0.9	-0.7	0.7	-0.3	-1.2	-0.1	-1.2	0.5	0.5	0.4	0.5	0.6	0.4	0.4	0.4
Cyprus*	0.3	1.1	-0.8	0.9	0.2	-1.2	-0.7	-1.2	0.6	0.5	0.4	0.6	0.7	0.2	0.5	0.6
Czech Republic	0.9	0.6	-0.3	-1.0	1.1	0.8	-0.9	-0.8	0.5	0.4	0.4	0.6	0.6	0.5	0.4	0.5
Denmark	0.7	0.4	-0.5	-0.1	0.2	-0.4	-0.3	-0.8	0.7	0.5	0.4	0.5	0.5	0.4	0.7	0.5
England/N. Ireland (UK)	-0.1	5.1	-0.4	1.3	0.0	-1.0	-0.6	-1.6	0.5	0.4	0.4	0.4	0.5	0.6	0.4	0.9
Estonia	0.1	0.1	-0.5	-0.5	0.4	0.1	-0.5	-0.9	0.6	0.6	0.4	0.5	0.5	0.5	0.6	0.6
Finland	0.1	-0.2	-0.3	-1.1	0.7	-0.3	0.3	-1.1	0.6	0.4	0.5	0.7	0.7	0.6	0.6	0.4
Flanders (Belgium)	0.5	0.6	-0.7	0.8	0.7	-0.5	0.2	-1.4	0.6	0.6	0.6	0.6	0.5	0.6	0.6	0.5
France	-0.2	0.0	-0.6	0.5	0.1	-0.2	0.1	-0.6	0.6	0.3	0.3	0.5	0.6	0.4	0.4	0.3
Germany	-0.1	-0.3	0.0	-0.5	1.0	-0.8	0.3	-1.2	0.6	0.6	0.3	0.6	0.5	0.4	0.4	0.5
Ireland	0.4	1.1	-0.3	1.9	0.2	-0.4	-0.1	-1.1	0.3	0.3	0.4	0.5	0.4	0.5	0.4	0.6
Italy	-0.3	3.1	-0.6	1.4	-0.2	-0.2	-0.5	-1.1	0.5	0.4	0.4	0.5	0.5	0.3	0.2	0.4
Japan	2.0	1.6	-0.9	-0.9	0.2	-0.4	-0.5	-1.4	0.5	0.4	0.3	0.5	0.5	0.5	0.4	0.4
Korea	-0.1	1.6	-0.9	2.8	0.2	-0.1	-0.5	-1.5	0.5	0.6	0.5	0.6	0.7	0.5	0.6	0.3
Netherlands	0.3	-0.5	-0.2	-0.1	0.5	-0.1	0.5	-1.4	0.4	0.4	0.5	0.6	0.7	0.8	0.6	0.7
Norway	0.0	0.1	-0.3	0.1	1.2	-0.7	-0.2	-1.4	0.6	0.4	0.4	0.4	0.5	0.3	0.5	0.4
Poland	0.5	1.0	-0.7	0.2	0.9	-0.3	-0.8	-0.7	0.6	0.5	0.4	0.6	0.7	0.7	0.4	0.8
Russian Federation**	1.1	1.1	-1.0	0.4	0.4	0.3	-0.8	-1.0	0.5	0.5	0.3	0.7	0.5	0.5	0.5	0.5
Slovak Republic	0.7	0.9	-0.7	0.3	0.8	1.1	-0.5	-0.5	0.5	0.6	0.6	0.7	0.7	0.7	0.5	0.6
Spain	0.1	1.9	-0.4	1.0	0.6	-1.0	-0.1	-1.4	0.3	0.4	0.2	0.4	0.4	0.6	0.4	0.6
Sweden	0.4	0.4	-0.2	-0.8	0.7	-0.4	0.0	-1.3	0.5	0.4	0.3	0.4	0.5	0.5	0.6	0.6
United States	0.8	1.0	-0.4	1.3	-0.3	-1.3	0.2	-1.2	0.6	0.5	0.5	0.6	0.5	0.4	0.4	0.4
Country Average	0.4	0.9	-0.5	0.3	0.5	-0.4	-0.2	-1.1	0.5	0.5	0.4	0.5	0.6	0.5	0.5	0.5

(2) Teacher training and education science
(3) Humanities, languages and arts
(4) Social sciences, business and law
(5) Science, mathematics and computing
(6) Engineering, manufacturing and construction
(7) Agriculture and veterinary
(8) Health and welfare
(9) Service
Source: OECD, PIAAC (2012).

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Table 5. Field-of-study mismatch by individual, job, country and field characteristics

	Model 1			Model 2			Model 3			Model 4			Model 5			Model 6		
	Beta		S.E.	Beta		S.E.	Beta		S.E.	Beta		S.E.	Beta		S.E.	Beta		S.E.
Intercept	-0.35	***	(0.05)	-0.33	*	(0.13)	-0.48	**	(0.15)	-1.35	***	(0.16)	-1.38	***	(0.18)	-1.75	***	(0.18)
Field saturation (log)	0.49	***	(0.02)	0.50	***	(0.02)	0.50	***	(0.02)	0.52	***	(0.02)	0.52	***	(0.02)	0.51	***	(0.02)
Skill transferability	-0.35	**	(0.10)	-0.31	**	(0.11)	-0.31	**	(0.11)	0.06		(0.12)	0.23		(0.12)	0.37	*	(0.15)
Age				0.00	***	(0.00)	0.03	***	(0.00)	0.03	***	(0.00)	0.03	***	(0.00)	0.03	***	(0.00)
Female				0.09	***	(0.02)	0.06	*	(0.03)	0.10	***	(0.03)	0.11	***	(0.03)	0.14	***	(0.03)
Number of children				0.01		(0.01)	0.00		(0.01)	0.00		(0.01)	0.00		(0.01)	0.00		(0.01)
Single				0.11	***	(0.02)	0.08	**	(0.03)	0.05		(0.03)	0.04		(0.03)	0.01		(0.03)
Education: < ISCED 2				0.24	**	(0.08)	0.20	*	(0.09)	0.38	***	(0.08)	0.48	***	(0.09)	0.34	**	(0.10)
Education: ISCED 2				0.10	**	(0.03)	0.05		(0.03)	0.06		(0.04)	0.14	***	(0.04)	0.18	***	(0.04)
Education: ISCED 3				0.14	**	(0.04)	0.10	*	(0.05)	-0.11	*	(0.05)	-0.10		(0.05)	-0.01		(0.05)
Numeracy				-0.17	***	(0.03)	-0.13	***	(0.03)	-0.05		(0.04)	0.01		(0.04)	0.07		(0.04)
Experience							-0.02	***	(0.00)	-0.02	***	(0.00)	-0.02	***	(0.00)	-0.02	***	(0.00)
Firm size							-0.04	***	(0.01)	-0.02	*	(0.01)	-0.03	**	(0.01)	-0.02	*	(0.01)
Temporary contract							0.07		(0.03)	0.05		(0.04)	0.04		(0.04)	0.03		(0.04)
Full time contract							-0.22	***	(0.03)	-0.12	***	(0.03)	-0.12	***	(0.03)	-0.13	***	(0.03)
Tenure							-0.01	***	(0.00)	-0.01	***	(0.00)	0.00		(0.00)	-0.01	***	(0.00)
Public or NGO							-0.37	***	(0.03)	-0.29	***	(0.03)	-0.27	***	(0.03)	-0.28	***	(0.03)
Underqualified										0.29	***	(0.05)	0.28	***	(0.05)	0.23	***	(0.06)
Overqualified										0.86	***	(0.03)	0.85	***	(0.03)	0.85	***	(0.03)
Underskilled										-0.09		(0.09)	-0.04		(0.10)	0.00		(0.11)
Overskilled										0.13	**	(0.04)	0.10	*	(0.04)	0.08		(0.05)
Relative unemployment rate													0.13	*	(0.06)			
Employment protection													-0.15	***	(0.02)			
Union density													0.00	***	(0.00)			
Country fixed effects	NO			NO			NO			NO			NO			YES		
N	*52327*			*52327*			*52327*			*52327*			*52327*			*52327*		

Notes: Estimates from logistic regressions (log-odds) with field-of-study mismatch as the dependent variable (mismatched by field vs. matched). In regression models, > ISCED 3 the reference category for educational attainment.
Source: OECD, PIAAC (2012).

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Table 6. The relationship between field-of-study, qualifications mismatch and wages

	Variable 1	->	Variable 2	Unstandadized path coefficient Coeff.		S.E.
F1	Field saturation	->	Wage (log)	-0.024	***	(0.01)
F2	Field saturation	->	Field-of-study mismatch only	0.075	***	(0.00)
F3	Field saturation	->	Overqualification and field mismatch	0.032	***	(0.00)
F4	Field saturation	->	Overqualification only	-0.039	***	(0.00)
M1	Field-of-study mismatch only	->	Wage (log)	-0.029	*	(0.01)
B1	Field-of-study mismatch and overqualification	->	Wage (log)	-0.254	***	(0.02)
O1	Overqualification only	->	Wage (log)	-0.176	***	(0.02)
G1	Skill transferability	->	Field-of-study mismatch only	0.294	***	(0.03)
G2	Skill transferability	->	Overqualification and field mismatch	-0.302	***	(0.02)
G3	Skill transferability	->	Wage (log)	-0.740	***	(0.05)
N1	Numeracy	->	Wage (log)	0.295	***	(0.04)
N2	Numeracy	->	Field-of-study mismatch only	0.037		(0.02)
N3	Numeracy	->	Overqualification and field mismatch	-0.079	***	(0.02)
N4	Numeracy	->	Overqualification only	-0.064	***	(0.02)
C1	Age	->	Wage (log)	0.018	***	(0.00)
C2	Age-squared	->	Wage (log)	0.000	***	(0.00)
C3	Experience	->	Wage (log)	0.017	***	(0.00)
C4	Experience-squared	->	Wage (log)	0.000	***	(0.00)
C5	Tenure	->	Wage (log)	0.006	***	(0.00)
C6	Temporary contract	->	Wage (log)	-0.155	***	(0.04)
C7	Full-time contract	->	Wage (log)	-0.063	***	(0.01)
C8	Public sector or NGO	->	Wage (log)	-0.022	*	(0.01)
C9	Firm size	->	Wage (log)	0.081	***	(0.00)
C10	Major: (3) Humanities	->	Wage (log)	-0.003		(0.05)
C11	Major: (4) Social sciences	->	Wage (log)	-0.059	*	(0.03)
C12	Major: (5) Sciences	->	Wage (log)	0.057		(0.03)
C13	Major: (6) Engineering	->	Wage (log)	-0.075	**	(0.03)
C14	Major: (7) Agriculture	->	Wage (log)	-0.274	***	(0.04)
C15	Major: (8) Health	->	Wage (log)	0.021		(0.03)
C16	Major: (9) Services	->	Wage (log)	-0.262	***	(0.03)

Notes: Wages have been log-transformed, as has field saturation. Estimates from a path analysis estimated from pooled sample. Unstandardized coefficients shown.
Source: OECD, PIAAC (2012).

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Table 7. The relationship between field-of-study, qualifications mismatch and wages by country (part I/III)

Country	Intercept		Field-of-study mismatch only		Overqualification and Field-of-study mismatch		Overqualification only		Age		Age-squared		Experience	
	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
Australia	1.98 ***	(0.16)	0.02	(0.02)	-0.19 ***	(0.03)	-0.17 ***	(0.03)	0.02 **	(0.01)	0.00 ***	(0.00)	0.02 ***	(0.01)
Austria	2.45 ***	(0.13)	0.00	(0.02)	-0.22 ***	(0.03)	-0.14 ***	(0.02)	0.01	(0.01)	0.00 ***	(0.00)	0.01 **	(0.00)
Canada	1.90 ***	(0.11)	-0.02	(0.02)	-0.33 ***	(0.02)	-0.24 ***	(0.02)	0.03 ***	(0.01)	0.00 ***	(0.00)	0.01 ***	(0.00)
Cyprus*	1.96 ***	(0.25)	-0.06	(0.03)	-0.37 ***	(0.05)	-0.24 ***	(0.05)	0.03 *	(0.01)	0.00 *	(0.00)	0.01	(0.01)
Czech Republic	2.40 ***	(0.19)	0.00	(0.03)	-0.22 ***	(0.04)	-0.19 ***	(0.04)	-0.01	(0.01)	0.00	(0.00)	0.02 **	(0.01)
Denmark	2.37 ***	(0.12)	0.02	(0.01)	-0.21 ***	(0.02)	-0.18 ***	(0.02)	0.03 ***	(0.01)	0.00 ***	(0.00)	0.00	(0.00)
England/N. Ireland (UK)	1.67 ***	(0.12)	-0.01	(0.02)	-0.26 ***	(0.03)	-0.24 ***	(0.03)	0.04 ***	(0.01)	0.00 ***	(0.00)	0.01 **	(0.00)
Estonia	2.42 ***	(0.21)	-0.08 **	(0.03)	-0.43 ***	(0.03)	-0.24 ***	(0.03)	-0.02	(0.01)	0.00	(0.00)	0.03 ***	(0.01)
Finland	2.45 ***	(0.12)	0.04 *	(0.02)	-0.19 ***	(0.03)	-0.14 ***	(0.02)	0.02 *	(0.01)	0.00 ***	(0.00)	0.01 **	(0.00)
Flanders (Belgium)	2.74 ***	(0.17)	-0.01	(0.02)	-0.17 ***	(0.02)	-0.09 ***	(0.03)	0.00	(0.01)	0.00	(0.00)	0.02 ***	(0.00)
France	2.33 ***	(0.15)	0.03	(0.01)	-0.16 ***	(0.02)	-0.16 ***	(0.02)	0.01	(0.01)	0.00	(0.00)	0.01 **	(0.00)
Germany	2.05 ***	(0.18)	0.00	(0.02)	-0.33 ***	(0.04)	-0.17 ***	(0.03)	0.03 **	(0.01)	0.00 ***	(0.00)	0.01	(0.01)
Ireland	2.08 ***	(0.22)	-0.10 ***	(0.03)	-0.34 ***	(0.03)	-0.27 ***	(0.03)	0.04 ***	(0.01)	0.00 ***	(0.00)	0.02 ***	(0.01)
Italy	2.67 ***	(0.27)	-0.09 **	(0.03)	-0.17 ***	(0.04)	-0.13 **	(0.05)	-0.01	(0.02)	0.00	(0.00)	0.03 ***	(0.01)
Japan	1.75 ***	(0.17)	0.04	(0.03)	-0.24 ***	(0.03)	-0.21 ***	(0.03)	0.01	(0.01)	0.00	(0.00)	0.02 ***	(0.01)
Korea	2.07 ***	(0.34)	-0.03	(0.03)	-0.30 ***	(0.05)	-0.22 ***	(0.06)	0.02	(0.02)	0.00	(0.00)	0.02 *	(0.01)
Netherlands	1.82 ***	(0.12)	0.00	(0.02)	-0.30 ***	(0.04)	-0.18 ***	(0.02)	0.05 ***	(0.01)	0.00 ***	(0.00)	0.01	(0.00)
Norway	2.46 ***	(0.09)	0.01	(0.02)	-0.18 ***	(0.02)	-0.16 ***	(0.02)	0.02 ***	(0.00)	0.00 ***	(0.00)	0.01 ***	(0.00)
Poland	2.05 ***	(0.21)	0.00	(0.03)	-0.31 ***	(0.04)	-0.25 ***	(0.04)	0.00	(0.01)	0.00	(0.00)	0.02 ***	(0.01)
Russian Federation**	1.23 *	(0.59)	-0.04	(0.04)	0.00	(0.05)	-0.08	(0.04)	0.00	(0.03)	0.00	(0.00)	0.01	(0.02)
Slovak Republic	2.60 ***	(0.24)	-0.03	(0.03)	-0.20 ***	(0.05)	-0.20 ***	(0.04)	-0.03 *	(0.01)	0.00	(0.00)	0.03 **	(0.01)
Spain	1.99 ***	(0.25)	0.01	(0.03)	-0.26 ***	(0.03)	-0.22 ***	(0.04)	0.02	(0.01)	0.00	(0.00)	0.02 **	(0.01)
Sweden	2.54 ***	(0.12)	0.05 **	(0.01)	-0.16 ***	(0.02)	-0.11 ***	(0.02)	0.01	(0.01)	0.00 ***	(0.00)	0.01 ***	(0.00)
United States	1.37 ***	(0.21)	0.01	(0.03)	-0.30 ***	(0.04)	-0.25 ***	(0.04)	0.05 ***	(0.01)	0.00 ***	(0.00)	0.00	(0.01)
Country Average	**2.14 *** **	**(0.05)**	**-0.01 * **	**(0.01)**	**-0.24 *** **	**(0.01)**	**-0.19 *** **	**(0.01)**	**0.01 *** **	**(0.00)**	**0.00 *** **	**(0.00)**	**0.02 *** **	**(0.00)**

Notes: Linear regression with log(wages) as the dependent variable. Models include dummy variables for educational attainment.
Source: OECD, PIAAC (2012).

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Table 7. The relationship between field-of-study, qualifications mismatch and wages by country (part II/III)

Country	Experience-squared		Tenure		Temporary contract		Full time contract		Public sector or NGO		Firm size	
	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
Australia	0.00	(0.00)	0.00	(0.00)	0.04	(0.03)	0.07 **	(0.02)	-0.01	(0.02)	0.07 ***	(0.01)
Austria	0.00 ***	(0.00)	0.01 ***	(0.00)	-0.12 **	(0.04)	0.06 **	(0.02)	-0.04 *	(0.02)	0.06 ***	(0.01)
Canada	0.00 ***	(0.00)	0.01 ***	(0.00)	-0.02	(0.03)	0.09 ***	(0.02)	0.05 ***	(0.02)	0.06 ***	(0.01)
Cyprus*	0.00	(0.00)	0.02 ***	(0.00)	-0.11	(0.06)	-0.17 **	(0.07)	0.17 ***	(0.03)	0.07 ***	(0.01)
Czech Republic	0.00	(0.00)	0.01 ***	(0.00)	-0.12 ***	(0.03)	-0.02	(0.05)	-0.05	(0.03)	0.06 ***	(0.01)
Denmark	0.00 ***	(0.00)	0.00 **	(0.00)	-0.02	(0.03)	0.01	(0.02)	-0.09 ***	(0.01)	0.03 ***	(0.00)
England/N. Ireland (UK	0.00 ***	(0.00)	0.01 ***	(0.00)	-0.03	(0.03)	0.11 ***	(0.03)	-0.07 **	(0.02)	0.05 ***	(0.01)
Estonia	0.00 ***	(0.00)	0.00 *	(0.00)	0.08 *	(0.04)	0.04	(0.04)	-0.18 ***	(0.02)	0.06 ***	(0.01)
Finland	0.00 ***	(0.00)	0.00	(0.00)	-0.05 *	(0.02)	0.01	(0.02)	-0.09 ***	(0.01)	0.06 ***	(0.01)
Flanders (Belgium)	0.00 **	(0.00)	0.01 ***	(0.00)	-0.10 ***	(0.03)	-0.02	(0.02)	-0.03	(0.01)	0.03 ***	(0.01)
France	0.00 ***	(0.00)	0.00 ***	(0.00)	-0.09 ***	(0.03)	0.02	(0.02)	-0.06 ***	(0.01)	0.04 ***	(0.01)
Germany	0.00 ***	(0.00)	0.01 ***	(0.00)	-0.13 ***	(0.03)	0.11 ***	(0.02)	-0.01	(0.02)	0.11 ***	(0.01)
Ireland	0.00 **	(0.00)	0.01 ***	(0.00)	-0.09 **	(0.03)	0.09 **	(0.03)	0.14 ***	(0.02)	0.03 ***	(0.01)
Italy	0.00 **	(0.00)	0.01 *	(0.00)	-0.07	(0.05)	-0.05	(0.04)	0.03	(0.03)	0.04 ***	(0.01)
Japan	0.00 *	(0.00)	0.01 ***	(0.00)	-0.10 ***	(0.03)	0.28 ***	(0.02)	0.04	(0.02)	0.08 ***	(0.01)
Korea	0.00	(0.00)	0.02 ***	(0.00)	-0.06	(0.04)	0.01	(0.05)	-0.05	(0.03)	0.08 ***	(0.01)
Netherlands	0.00 ***	(0.00)	0.00 *	(0.00)	-0.10 ***	(0.02)	0.03	(0.02)	0.00	(0.01)	0.05 ***	(0.01)
Norw ay	0.00 ***	(0.00)	0.00 *	(0.00)	-0.06 *	(0.02)	0.06 **	(0.02)	-0.11 ***	(0.01)	0.04 ***	(0.01)
Poland	0.00 *	(0.00)	0.00	(0.00)	-0.08 *	(0.03)	0.04	(0.06)	-0.03	(0.03)	0.08 ***	(0.01)
Russian Federation**	0.00	(0.00)	0.00	(0.00)	0.15 **	(0.06)	0.17	(0.09)	-0.18 *	(0.08)	0.05	(0.03)
Slovak Republic	0.00 *	(0.00)	0.00	(0.00)	-0.16 ***	(0.04)	0.08	(0.05)	-0.13 ***	(0.03)	0.06 ***	(0.01)
Spain	0.00	(0.00)	0.01 ***	(0.00)	-0.05	(0.04)	0.03	(0.04)	0.12 ***	(0.03)	0.07 ***	(0.01)
Sw eden	0.00 ***	(0.00)	0.00 *	(0.00)	-0.08 ***	(0.02)	0.01	(0.01)	-0.11 ***	(0.01)	0.03 ***	(0.01)
United States	0.00	(0.00)	0.01 ***	(0.00)	-0.12 *	(0.05)	0.17 ***	(0.04)	-0.07 **	(0.03)	0.08 ***	(0.01)
Country Average	**0.00 *****	**(0.00)**	**0.01 *****	**(0.00)**	**-0.06 *****	**(0.01)**	**0.05 *****	**(0.01)**	**-0.03 *****	**(0.01)**	**0.06 *****	**(0.00)**

Notes: Linear regression w ith log(w ages) as the dependent variable. Models include dummy variables for educational attainment.
Source: OECD, PIAAC (2012).

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Table 7. The relationship between field-of-study, qualifications mismatch and wages by country (part III/III)

Country	Numeracy		Major: (3) Humanities		Major: (4) Social sciences		Major: (5) Sciences		Major: (6) Engineering		Major: (7) Agriculture		Major: (8) Health		Major: (9) Services	
	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
Australia	0.15 ***	(0.02)	-0.01	(0.06)	0.15 **	(0.05)	0.15 *	(0.06)	0.25 ***	(0.05)	0.02	(0.10)	0.06	(0.04)	0.08	(0.05)
Austria	0.15 ***	(0.02)	-0.02	(0.05)	0.04	(0.03)	0.05	(0.06)	0.04	(0.03)	0.02	(0.06)	0.01	(0.04)	-0.04	(0.04)
Canada	0.22 ***	(0.01)	-0.04	(0.03)	0.02	(0.03)	0.04	(0.03)	0.13 ***	(0.03)	-0.04	(0.05)	0.03	(0.02)	-0.01	(0.03)
Cyprus*	0.16 ***	(0.03)	-0.02	(0.06)	-0.07	(0.06)	-0.01	(0.06)	-0.05	(0.06)	-0.03	(0.10)	-0.21 ***	(0.06)	-0.13	(0.07)
Czech Republic	0.12 ***	(0.03)	0.07	(0.07)	0.08 *	(0.04)	0.11	(0.08)	0.09	(0.05)	0.01	(0.06)	0.01	(0.06)	0.00	(0.06)
Denmark	0.10 ***	(0.02)	0.05	(0.03)	0.16 ***	(0.02)	0.18 ***	(0.02)	0.15 ***	(0.02)	0.09 *	(0.04)	0.04 **	(0.02)	0.11 ***	(0.02)
England/N. Ireland (UK)	0.25 ***	(0.02)	0.11 ***	(0.03)	0.14 ***	(0.03)	0.17 ***	(0.04)	0.12 ***	(0.04)	-0.11	(0.09)	0.09 **	(0.04)	0.13	(0.18)
Estonia	0.27 ***	(0.03)	0.04	(0.05)	0.02	(0.04)	0.10 *	(0.05)	0.13 ***	(0.04)	0.02	(0.04)	0.08	(0.04)	0.07	(0.05)
Finland	0.13 ***	(0.02)	-0.10 **	(0.03)	-0.09 ***	(0.03)	-0.04	(0.04)	-0.01	(0.03)	-0.11 **	(0.04)	-0.14 ***	(0.03)	-0.16 ***	(0.03)
Flanders (Belgium)	0.12 ***	(0.02)	0.02	(0.03)	0.03	(0.03)	0.09 ***	(0.03)	0.04	(0.03)	-0.02	(0.06)	-0.02	(0.02)	-0.09 *	(0.04)
France	0.11 ***	(0.02)	-0.04	(0.04)	-0.01	(0.03)	0.02	(0.03)	0.04	(0.03)	-0.01	(0.04)	0.00	(0.03)	0.00	(0.03)
Germany	0.15 ***	(0.02)	-0.17 **	(0.06)	-0.06	(0.05)	-0.02	(0.05)	-0.11 *	(0.05)	-0.40 ***	(0.10)	-0.09	(0.05)	-0.17 **	(0.05)
Ireland	0.16 ***	(0.03)	-0.08	(0.04)	-0.14 ***	(0.04)	-0.04	(0.04)	-0.11 *	(0.05)	-0.24 ***	(0.07)	-0.14 ***	(0.04)	-0.13 *	(0.05)
Italy	0.15 ***	(0.04)	0.05	(0.06)	0.06	(0.06)	0.06	(0.06)	0.10	(0.06)	-0.06	(0.10)	-0.02	(0.06)	-0.04	(0.06)
Japan	0.19 ***	(0.03)	0.07	(0.04)	0.10 **	(0.04)	0.13 *	(0.06)	0.08	(0.04)	0.03	(0.05)	0.07	(0.05)	0.00	(0.06)
Korea	0.15 ***	(0.05)	-0.08	(0.07)	0.00	(0.07)	-0.03	(0.07)	-0.01	(0.06)	-0.04	(0.09)	0.00	(0.09)	-0.15	(0.08)
Netherlands	0.14 ***	(0.02)	0.04	(0.05)	0.11 ***	(0.03)	0.12 **	(0.04)	0.08 *	(0.03)	0.04	(0.04)	0.11 ***	(0.03)	-0.01	(0.04)
Norway	0.13 ***	(0.01)	0.13 ***	(0.03)	0.13 ***	(0.02)	0.16 ***	(0.02)	0.19 ***	(0.02)	0.13 *	(0.06)	0.09 ***	(0.02)	0.13 ***	(0.03)
Poland	0.11 ***	(0.03)	-0.02	(0.06)	-0.05	(0.05)	-0.04	(0.05)	-0.02	(0.06)	-0.01	(0.08)	-0.15 *	(0.07)	-0.15 *	(0.06)
Russian Federation**	0.18 ***	(0.04)	0.01	(0.08)	0.05	(0.06)	0.17	(0.10)	0.05	(0.11)	-0.27	(0.14)	-0.17	(0.13)	-0.07	(0.09)
Slovak Republic	0.18 ***	(0.04)	0.07	(0.05)	0.17 ***	(0.05)	0.15 **	(0.05)	0.14 **	(0.05)	-0.02	(0.05)	0.02	(0.05)	-0.05	(0.05)
Spain	0.19 ***	(0.03)	0.07	(0.04)	0.00	(0.04)	0.03	(0.05)	0.06	(0.04)	-0.04	(0.07)	-0.04	(0.05)	-0.13 *	(0.06)
Sweden	0.08 ***	(0.02)	0.12 ***	(0.03)	0.17 ***	(0.02)	0.18 ***	(0.03)	0.18 ***	(0.02)	0.08 *	(0.03)	0.15 ***	(0.02)	0.15 ***	(0.03)
United States	0.23 ***	(0.03)	0.10	(0.06)	0.19 ***	(0.04)	0.22 ***	(0.05)	0.30 ***	(0.04)	0.20	(0.11)	0.20 ***	(0.05)	0.16 **	(0.05)
Country Average	**0.16 *** **	**(0.01)**	**0.02**	**(0.01)**	**0.05 *** **	**(0.01)**	**0.08 *** **	**(0.01)**	**0.08 *** **	**(0.01)**	**-0.03 * **	**(0.02)**	**0.00**	**(0.01)**	**-0.02**	**(0.01)**

Notes: Linear regression with log(wages) as the dependent variable. Models include dummy variables for educational attainment.
Source: OECD, PIAAC (2012).
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Table 8. The relationship between field-of-study, qualifications mismatch, major and wages.

	Model 1			Model 2			Model 3			Model 4		
	Beta		S.E.	Beta		S.E.	Beta		S.E.	Beta		S.E.
Intercept	3.00	***	(0.05)	2.67	***	(0.05)	2.61	***	(0.05)	2.46	***	(0.05)
Field of study mismatch only	0.02		(0.04)	-0.10	***	(0.02)	-0.16	***	(0.02)	0.05	**	(0.02)
x Skill transferability	-0.11		(0.08)	0.17	***	(0.04)						
x Major: (2) Teaching							0.11	**	(0.03)	-0.09	**	(0.03)
x Major: (3) Humanities							0.17	***	(0.03)	-0.06	*	(0.03)
x Major: (4) Social sciences							0.17	***	(0.03)	-0.11	***	(0.02)
x Major: (5) Sciences							0.17	***	(0.03)	-0.07	**	(0.02)
x Major: (6) Engineering							0.08	**	(0.03)	-0.04	*	(0.02)
x Major: (7) Agriculture							-0.07		(0.03)	0.07		(0.04)
x Major: (8) Health							0.29	***	(0.03)	-0.04		(0.02)
Field of study mismatch and overqualification	-0.33	***	(0.04)	-0.35	***	(0.03)	-0.26	***	(0.03)	-0.04	*	(0.02)
x Skill transferability	0.10		(0.09)	0.21	**	(0.07)						
x Major: (2) Teaching							-0.03		(0.04)	-0.24	***	(0.03)
x Major: (3) Humanities							0.04		(0.03)	-0.22	***	(0.03)
x Major: (4) Social sciences							0.03		(0.03)	-0.25	***	(0.03)
x Major: (5) Sciences							0.09		(0.04)	-0.23	***	(0.03)
x Major: (6) Engineering							-0.10		(0.04)	-0.21	***	(0.03)
x Major: (7) Agriculture							-0.17	**	(0.05)	-0.02		(0.04)
x Major: (8) Health							0.08	**	(0.03)	-0.20	***	(0.03)
Overqualification only	-0.23	***	(0.01)	-0.18	***	(0.01)	-0.23	***	(0.01)	-0.17	***	(0.01)
Skill transferability	-0.81	**	(0.03)	-0.24	**	(0.03)						
Field saturation (log)	0.01	**	(0.00)	0.01	**	(0.00)						
Major: (2) Teaching										0.10	**	(0.02)
Major: (3) Humanities										0.12	**	(0.02)
Major: (4) Social sciences										0.14	**	(0.01)
Major: (5) Sciences										0.14	**	(0.02)
Major: (6) Engineering										0.09	**	(0.01)
Major: (7) Agriculture										-0.09	**	(0.03)
Major: (8) Health										0.10	**	(0.01)
Female	-0.18	**	(0.01)	-0.15	**	(0.01)	-0.17	**	(0.01)	-0.15	**	(0.01)
Age	0.01	**	(0.00)	0.02	**	(0.00)	0.01	**	(0.00)	0.02	**	(0.00)
Age-squared	0.00	**	(0.00)	0.00	**	(0.00)	0.00	**	(0.00)	0.00	**	(0.00)
Experience	0.02	**	(0.00)	0.01	**	(0.00)	0.02	**	(0.00)	0.01	**	(0.00)
Experience-squared	0.00	**	(0.00)	0.00	**	(0.00)	0.00	**	(0.00)	0.00	**	(0.00)
Tenure	0.01	**	(0.00)	0.01	**	(0.00)	0.01	**	(0.00)	0.01	**	(0.00)
Temporary contract	-0.16	**	(0.02)	-0.06	**	(0.01)	-0.16	**	(0.02)	-0.06	**	(0.01)
Full time contract	-0.15	**	(0.01)	0.02	**	(0.01)	-0.16	**	(0.01)	0.02	**	(0.01)
Public or NGO employer	0.00		(0.01)	-0.02	**	(0.00)	-0.01		(0.01)	-0.01	*	(0.01)
Firm size	0.07	**	(0.00)	0.06	**	(0.00)	0.07	**	(0.00)	0.06	**	(0.00)
Numeracy	0.22	**	(0.01)	0.15	**	(0.01)	0.22	**	(0.01)	0.15	**	(0.01)
Education: < ISCED 2	-0.26	**	(0.02)	-0.32	**	(0.02)	-0.24	**	(0.02)	-0.31	**	(0.02)
Education: ISCED 2	-0.25	**	(0.01)	-0.26	**	(0.01)	-0.27	**	(0.01)	-0.25	**	(0.01)
Education: ISCED 3	-0.17	**	(0.02)	-0.15	**	(0.01)	-0.15	**	(0.02)	-0.14	**	(0.01)
Country fixed effects	NO			YES			NO			YES		
N	*52177*			*52177*			*52177*			*52177*		

Notes: Estimates from linear regressions log-wages as the dependent variable. Categories for field of study (major): (2) Teacher training and education science, (3) Humanities, languages and arts, (4) Social sciences, business and law, (5) Science, mathematics and computing, (6) Engineering, manufacturing and construction, (7) Agriculture and veterinary, (8) Health and welfare, and (9) Service. In regression models, (9) Services is the reference category for field of study and > ISCED 3 the reference category for educational attainment.
Source: OECD, PIAAC (2012).

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Table 9. Field-of-study mismatch and job satisfaction

	Job Satisfaction							
	Overall		Matched workers		Mismatched workers		Difference (matched - mismatched)	
	Percent	S.E.	Percent	S.E.	Percent	S.E.	Dif.	S.E.
Australia	81.3	1.1	82.8	1.7	79.7	1.5	-3.1	2.2
Austria	88.9	(0.7)	89.4	(0.8)	87.6	(1.4)	-1.7	(1.6)
Canada	82.4	(0.6)	84.6	(0.7)	78.7	(1.0)	-5.9 ***	(1.3)
Cyprus*	83.6	(1.2)	84.7	(1.6)	81.9	(1.8)	-2.8	(2.4)
Czech Republic	74.9	(1.3)	75.4	(1.6)	74.1	(2.1)	-1.3	(2.6)
Denmark	90.1	(0.6)	90.8	(0.7)	88.7	(1.2)	-2.1	(1.4)
England/N. Ireland (UK)	78.7	(0.8)	79.4	(1.4)	77.9	(1.4)	-1.4	(2.0)
Estonia	79.4	(0.6)	80.8	(0.8)	76.8	(1.3)	-4.0 **	(1.5)
Finland	84.9	(0.7)	86.2	(0.8)	80.3	(1.7)	-6.0 ***	(1.8)
Flanders (Belgium)	88.3	(0.7)	88.7	(1.0)	87.6	(1.1)	-1.1	(1.5)
France	78.7	(0.7)	79.4	(0.9)	77.7	(1.1)	-1.8	(1.5)
Germany	77.1	(0.9)	78.0	(0.9)	74.4	(1.9)	-3.6	(2.1)
Ireland	77.2	(1.2)	78.5	(1.5)	75.4	(1.9)	-3.1	(2.4)
Italy	78.7	(1.3)	82.3	(1.7)	75.0	(1.9)	-7.3 **	(2.5)
Japan	58.2	(1.2)	57.9	(1.6)	58.7	(1.9)	0.8	(2.4)
Korea	60.5	(1.0)	64.5	(1.3)	56.5	(1.6)	-7.9 ***	(2.0)
Netherlands	84.7	(0.7)	86.1	(0.8)	82.2	(1.5)	-3.9 *	(1.7)
Norway	90.1	(0.5)	90.2	(0.6)	89.7	(1.0)	-0.6	(1.2)
Poland	78.0	(1.0)	79.2	(1.2)	76.2	(1.5)	-3.0	(1.9)
Russian Federation**	61.4	(1.9)	61.7	(2.4)	60.9	(2.9)	-0.8	(3.8)
Slovak Republic	76.0	(0.9)	76.3	(1.2)	75.4	(1.5)	-1.0	(1.9)
Spain	80.9	(1.1)	83.1	(1.4)	78.0	(1.7)	-5.0 *	(2.2)
Sweden	86.4	(0.8)	87.3	(1.0)	84.5	(1.4)	-2.8	(1.7)
United States	78.7	(1.2)	83.6	(1.3)	72.8	(2.2)	-10.8 ***	(2.5)
Country Average	**79.1**	**(0.2)**	**80.5**	**(0.3)**	**77.1**	**(0.3)**	**-3.3**	**(2.0)**

Source: OECD, PIAAC (2012).

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Table 10. Field-of-study mismatch and job satisfaction accounting for overqualification

	Model 1		Model 2			
	Field of study mismatch		Field of study mismatch		Overqualification	
	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
Australia	-0.2	(0.2)	-0.1	(0.2)	-0.4 **	(0.1)
Austria	-0.2	(0.1)	0.0	(0.1)	-0.7 ***	(0.1)
Canada	-0.4 ***	(0.1)	-0.2 **	(0.1)	-0.7 ***	(0.1)
Cyprus*	-0.2	(0.2)	-0.1	(0.2)	-0.8 ***	(0.2)
Czech Republic	-0.1	(0.1)	0.0	(0.1)	-0.8 ***	(0.2)
Denmark	-0.2	(0.1)	-0.1	(0.1)	-0.8 ***	(0.1)
England/N. Ireland (UK)	-0.1	(0.1)	0.0	(0.1)	-0.5 ***	(0.1)
Estonia	-0.2 **	(0.1)	-0.1	(0.1)	-0.8 ***	(0.1)
Finland	-0.4 ***	(0.1)	-0.4 **	(0.1)	-0.3 *	(0.1)
Flanders (Belgium)	-0.1	(0.1)	0.0	(0.1)	-0.5 *	(0.2)
France	-0.1	(0.1)	-0.1	(0.1)	-0.4 ***	(0.1)
Germany	-0.2	(0.1)	-0.1	(0.1)	-0.4 **	(0.1)
Ireland	-0.2	(0.1)	0.0	(0.1)	-0.9 ***	(0.1)
Italy	-0.4 **	(0.1)	-0.2	(0.2)	-1.1 ***	(0.2)
Japan	0.0	(0.1)	0.1	(0.1)	-0.4 ***	(0.1)
Korea	-0.3 ***	(0.1)	-0.3 **	(0.1)	-0.5 ***	(0.1)
Netherlands	-0.3 *	(0.1)	-0.2	(0.1)	-0.4 **	(0.1)
Norway	-0.1	(0.1)	0.1	(0.1)	-0.8 ***	(0.2)
Poland	-0.2	(0.1)	-0.1	(0.1)	-0.8 ***	(0.1)
Russian Federation**	0.0	(0.2)	0.0	(0.1)	-0.4 **	(0.1)
Slovak Republic	-0.1	(0.1)	0.0	(0.1)	-0.6 ***	(0.1)
Spain	-0.3 *	(0.1)	-0.1	(0.2)	-0.7 ***	(0.2)
Sweden	-0.2	(0.1)	0.0	(0.1)	-0.9 ***	(0.1)
United States	-0.6 ***	(0.1)	-0.5 ***	(0.1)	-0.7 ***	(0.1)
Country Average	**-0.2 *****	**(0.0)**	**-0.1 *****	**(0.0)**	**-0.6 *****	**(0.0)**

Notes: Models 1 and 2 are logistic regression estimates (log-odds) with job satisfaction as a dichotomous variable. Model 1 includes field-of-study mismatch as the only covariate. Model 2 includes field-of-study mismatch and overqualification as covariates.

Source: OECD, PIAAC (2012).

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Table 11. Field-of-study mismatch and the likelihood of being unemployed or out of the labour force (part I/II)

	Unemployed or out of the labour force								
	Overall		Matched workers		Mismatched workers		Difference (mismatched - matched)		
	Percent	S.E.	Percent	S.E.	Percent	S.E.	Dif.		S.E.
Australia	11.6	(0.8)	9.8	(1.1)	13.4	(1.2)	3.6	*	(1.7)
Austria	13.7	(0.6)	13.0	(0.8)	15.6	(1.4)	2.6		(1.6)
Canada	13.2	(0.5)	11.7	(0.6)	15.5	(0.9)	3.8	***	(1.1)
Cyprus*	14.8	(1.0)	13.2	(1.2)	17.2	(1.7)	4.0	*	(2.1)
Czech Republic	20.6	(0.7)	21.0	(1.1)	19.8	(1.3)	-1.2		(1.7)
Denmark	16.6	(0.6)	15.4	(0.8)	18.8	(1.1)	3.4	*	(1.4)
England/N. Ireland (UK)	16.3	(0.5)	13.4	(0.9)	18.9	(0.9)	5.5	***	(1.3)
Estonia	14.1	(0.5)	13.0	(0.6)	16.1	(1.0)	3.1	**	(1.1)
Finland	15.6	(0.6)	14.8	(0.7)	18.3	(1.4)	3.4	*	(1.5)
Flanders (Belgium)	10.9	(0.5)	9.5	(0.7)	13.1	(0.9)	3.6	**	(1.2)
France	19.9	(0.5)	19.5	(0.7)	20.5	(0.8)	1.0		(1.1)
Germany	11.7	(0.7)	11.0	(0.8)	13.4	(1.4)	2.5		(1.6)
Ireland	20.1	(0.9)	17.4	(1.0)	23.6	(1.4)	6.3	***	(1.8)
Italy	19.8	(1.3)	14.8	(1.5)	24.3	(1.9)	9.5	***	(2.4)
Japan	8.5	(0.6)	7.2	(0.9)	10.0	(1.1)	2.7		(1.4)
Korea	14.6	(0.9)	10.1	(1.0)	18.8	(1.3)	8.7	***	(1.6)
Netherlands	10.7	(0.6)	9.7	(0.8)	12.7	(1.0)	3.0	*	(1.3)
Norw ay	10.8	(0.6)	8.0	(0.7)	15.8	(1.1)	7.8	***	(1.3)
Poland	18.0	(0.8)	15.9	(1.0)	20.8	(1.3)	4.8	**	(1.6)
Russian Federation**	16.7	(1.1)	14.4	(1.5)	19.6	(1.4)	5.2	**	(2.0)
Slovak Republic	19.9	(0.8)	19.8	(1.1)	20.1	(1.1)	0.3		(1.6)
Spain	22.0	(0.9)	16.2	(1.2)	28.2	(1.5)	12.0	***	(1.9)
Sw eden	14.3	(0.6)	11.4	(0.7)	19.5	(1.2)	8.1	***	(1.4)
United States	15.4	(0.9)	11.1	(1.0)	20.1	(1.3)	9.0	***	(1.6)
Country Average	**15.4**	**(0.2)**	**13.4**	**(0.2)**	**18.1**	**(0.3)**	**4.7**	*******	**(0.3)**

a) Percentages for w orkers w ho are out of employment because they reported having resigned.
b) No mismatched w orkers reported having resigned in the Russian Federation. Standard errors cann
Percentage calculated over individuals currently employed or, among those unemployed or out of the labour force, those w ho w ere employed in the past five years. (c) The estimate is not reported
Source: OECD, PIAAC (2012).
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Table 11. Field-of-study mismatch and the likelihood of being unemployed or out of the labour force (part II/II)

	Reason for stopping work: "I resigned" [a]							
	Overall		Matched workers		Mismatched workers		Difference (mismatched - matched)	
	Percent	S.E.	Percent	S.E.	Percent	S.E.	Dif.	S.E.
Australia	9.1	(2.1)	8.8	(3.0)	9.3	(2.9)	0.5	(4.2)
Austria	6.0	(1.3)	5.4	(1.4)	7.5	(2.5)	2.1	(2.9)
Canada	4.7	(0.8)	4.1	(1.1)	5.4	(1.4)	1.2	(1.7)
Cyprus*	9.6	(2.1)	5.8	(2.2)	14.1	(4.0)	8.3	(4.5)
Czech Republic	3.2	(0.8)	3.5	(0.9)	2.6	(1.6)	-0.9	(1.8)
Denmark	6.3	(1.0)	5.3	(1.4)	7.6	(1.6)	2.3	(2.1)
England/N. Ireland (UK)	6.7	(1.2)	6.3	(1.7)	7.0	(1.7)	0.8	(2.4)
Estonia	10.5	(1.3)	10.4	(1.9)	10.6	(2.1)	0.1	(2.9)
Finland	4.7	(0.9)	4.7	(1.0)	4.8	(1.9)	0.1	(2.2)
Flanders (Belgium)	2.2	(0.8)	0.6	(0.5)	4.1	(1.7)	3.5 **	(1.7)
France	4.3	(0.7)	4.9	(1.2)	3.6	(1.0)	-1.3	(1.5)
Germany	5.3	(1.5)	3.6	(1.3)	9.1	(3.2)	5.5	(3.5)
Ireland	2.2	(0.6)	2.3	(0.9)	2.1	(0.9)	-0.2	(1.3)
Italy	7.6	(2.1)	6.1	(2.5)	8.5	(2.8)	2.4	(3.8)
Japan	12.2	(2.9)	18.4	(5.3)	6.8	(2.4)	-11.6 *	(5.8)
Korea	4.8	(1.1)	3.1	(1.6)	5.6	(1.5)	2.5	(2.2)
Netherlands	7.3	(1.6)	6.5	(2.3)	8.4	(2.8)	1.9	(3.6)
Norway	11.1	(2.1)	12.6	(3.3)	9.8	(2.3)	-2.9	(4.0)
Poland	6.1	(1.1)	5.1	(1.8)	7.2	(1.6)	2.1	(2.4)
Russian Federation**	0.2	(0.2)	c	c	0.3	(0.4)	c	c
Slovak Republic	2.3	(0.6)	3.1	(1.0)	1.0	(0.7)	-2.1	(1.3)
Spain	2.7	(1.0)	2.7	(1.6)	2.7	(1.1)	0.0	(2.0)
Sweden	12.1	(1.8)	13.2	(2.6)	11.0	(2.3)	-2.2	(3.5)
United States	6.1	(1.5)	2.4	(1.5)	8.4	(2.2)	6.0	(2.7)
Country Average	**6.1**	**(0.3)**	**6.0**	**(0.4)**	**6.6**	**(0.4)**	**0.8**	**(0.6)**

a) Percentages for workers who are out of employment because they reported having resigned.
b) No mismatched workers reported having resigned in the Russian Federation. Standard errors canno
Percentage calculated over individuals currently employed or, among those unemployed or out of the labour force, those who were employed in the past five years. (c) The estimate is not reported
Source: OECD, PIAAC (2012).
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Table 12. Likelihood of being unemployed or out of the labour force by individual, job and field characteristics

	Model 1		Model 2		Model 3		Model 4		Model 5	
	Beta	S.E.	Beta	S.E.	Beta	S.E.	Beta	S.E.	Beta	S.E.
Intercept	-1.87 ***	(0.01)	-1.96 ***	(0.05)	-4.42 ***	(0.15)	-2.96 ***	(0.20)	-3.55 ***	(0.22)
Field of study mismatch	0.37 ***	(0.02)	0.30 ***	(0.02)	0.21 ***	(0.03)	0.20 ***	(0.03)	0.21 ***	(0.03)
Education: < ISCED 2			0.69 ***	(0.09)	0.78 ***	(0.11)	0.60 ***	(0.11)	0.71 ***	(0.12)
Education: ISCED 2			0.55 ***	(0.03)	0.59 ***	(0.04)	0.47 ***	(0.04)	0.48 ***	(0.04)
Education: ISCED 3			0.44 ***	(0.04)	0.44 ***	(0.06)	0.35 ***	(0.07)	0.31 ***	(0.07)
Major: (2) Teaching			-0.05	(0.07)	-0.16	(0.08)	-0.10	(0.08)	0.04	(0.08)
Major: (3) Humanities			0.09	(0.06)	-0.17 *	(0.09)	-0.08	(0.09)	0.09	(0.07)
Major: (4) Social sciences			-0.14 **	(0.05)	-0.23 ***	(0.06)	-0.12	(0.06)	0.03	(0.06)
Major: (5) Sciences			-0.08	(0.05)	-0.02	(0.07)	0.11	(0.07)	0.15 *	(0.07)
Major: (6) Engineering			-0.31 ***	(0.04)	-0.13	(0.07)	-0.06	(0.07)	0.01	(0.06)
Major: (7) Agriculture			-0.33 ***	(0.08)	-0.27 *	(0.11)	-0.22 *	(0.11)	-0.18	(0.11)
Major: (8) Health			-0.26 ***	(0.06)	-0.37 ***	(0.08)	-0.34 ***	(0.08)	-0.22 **	(0.08)
Age					0.03 ***	(0.00)	0.03 ***	(0.00)	0.03 ***	(0.00)
Female					0.50 ***	(0.04)	0.45 ***	(0.04)	0.45 ***	(0.04)
Numeracy							-0.50 ***	(0.04)	-0.45 ***	(0.05)
Hours worked per week					0.01 ***	(0.00)	0.01 ***	(0.00)	0.01 ***	(0.00)
Tenure					0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
Public or NGO employer					-0.10 *	(0.04)	-0.09 *	(0.04)	-0.13 ***	(0.04)
Field saturation (log)					0.05 *	(0.02)	0.04	(0.02)		
Skill transferability					-0.64 ***	(0.19)	-0.55 **	(0.19)		
Country fixed effects	NO		NO		NO		NO		YES	
N	*71467*		*71467*		*71467*		*71467*		*71467*	

Notes: Estimates from logistic regressions (log-odds) with worker status (unemployed or out of the labour force vs. employed). Categories for field of study (major): (2) Teacher training and education science, (3) Humanities, languages and arts, (4) Social sciences, business and law, (5) Science, mathematics and computing, (6) Engineering, manufacturing and construction, (7) Agriculture and veterinary, (8) Health and welfare, and (9) Service. In regression models, (9) Services is the reference category for field of study and > ISCED 3 the reference category for educational attainment. Field-of-study mismatch is calculated for individuals based on their last reported job. Percentage calculated over individuals currently employed or, among those unemployed or out of the labour force, those who were employed in the past five years.
Source: OECD, PIAAC (2012).

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Table 13. Field-of-study mismatch and time unemployed or out of the labour force

	Average time since last job ended					
	Previously mismatched workers		Previously matched workers		Difference (matched - mismatched)	
	Percent	S.E.	Percent	S.E.	Dif.	S.E.
Australia	3.1	(0.2)	3.1	(0.2)	0.0	(0.3)
Austria	3.2	(0.2)	3.3	(0.1)	-0.1	(0.2)
Canada	3.3	(0.1)	3.1	(0.1)	0.2	(0.1)
Cyprus*	3.1	(0.2)	3.3	(0.1)	-0.3	(0.2)
Czech Republic	3.2	(0.1)	3.4	(0.1)	-0.2	(0.2)
Denmark	3.1	(0.1)	3.3	(0.1)	-0.2	(0.1)
England/N. Ireland (UK)	3.7	(0.1)	3.3	(0.1)	0.3	(0.2)
Estonia	3.3	(0.1)	3.4	(0.1)	-0.2	(0.1)
Finland	2.9	(0.1)	3.3	(0.1)	-0.3 *	(0.2)
Flanders (Belgium)	3.5	(0.2)	3.4	(0.1)	0.1	(0.2)
France	2.3	(0.1)	2.5	(0.1)	-0.1	(0.1)
Germany	3.5	(0.2)	3.5	(0.1)	0.0	(0.2)
Ireland	3.5	(0.1)	3.4	(0.1)	0.1	(0.1)
Italy	3.5	(0.2)	3.7	(0.2)	-0.2	(0.2)
Japan	3.2	(0.3)	3.5	(0.6)	-0.3	(0.7)
Korea	2.9	(0.1)	3.0	(0.1)	-0.1	(0.2)
Netherlands	3.3	(0.2)	3.1	(0.1)	0.1	(0.2)
Norway	3.3	(0.2)	3.3	(0.1)	0.0	(0.2)
Poland	3.4	(0.1)	3.3	(0.1)	0.1	(0.2)
Russian Federation**	2.5	(0.1)	2.6	(0.3)	0.0	(0.3)
Slovak Republic	3.4	(0.1)	3.3	(0.1)	0.1	(0.2)
Spain	3.3	(0.1)	3.2	(0.2)	0.1	(0.2)
Sweden	3.0	(0.2)	2.8	(0.1)	0.2	(0.2)
United States	3.4	(0.1)	3.1	(0.2)	0.4	(0.2)
Country Average	**3.2**	**(0.0)**	**3.2**	**(0.0)**	**0.0**	**(0.2)**

Note: Field-of-study mismatch is calculated for individuals based on their last reported job. Percentage calculated over individuals currently employed or, among those unemployed or out of the labour force, those who were employed in the past five years.
Source: OECD, PIAAC (2012).

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Table 14. National costs of field-of-study mismatch (part I/IV)

	Number of workers			Earnings and productivity costs			Hours worked per year	Total earnings and productivity loss per year	
	Total number of matched workers by field of study and qualifications	Total number of mismatched workers by field of study but not qualifications	Total number of mismatched workers by field and qualification	Average hourly earnings for matched workers	Penalty (in %) for mismatched workers by field of study but not qualifications	Penalty (in %) for mismatched workers by field of study and qualifications	Average hours worked per year for matched workers (52 x reported weekly hours)	Earnings / productivity loss per year for field mismatched but not overqualified workers (in million USD)	Earnings / productivity loss per year for field mismatched and overqualified workers (in million USD)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Australia	1584 465	1101733	739 210	22.8	0.00	-0.20	1776	0	2 964
Austria	1549 508	488 354	262 310	21.1	0.00	-0.22	1846	0	1101
Canada	4 724 734	2 053 696	1530 945	25.6	0.00	-0.34	1878	0	12 457
Cyprus1	81370	43 683	14 807	21.2	0.00	-0.35	1833	0	102
Czech Republic	1788 568	982 574	368 352	9.5	0.00	-0.24	2 029	0	855
Denmark	982 760	428 845	185 968	26.4	0.00	-0.21	1801	0	917
England/N. Ireland	5 873 236	4 659 446	3 005 484	22.4	0.00	-0.25	1844	0	15 400
Estonia	183 113	85 523	49 611	11.0	-0.08	-0.42	1922	69	224
Finland	1096 127	268 803	108 686	20.2	0.04	-0.20	1830	- 195	399
Flanders (Belgium)	929 774	517 503	159 471	24.2	0.00	-0.16	1788	0	555
France	5 615 691	3 741684	2 579 897	18.1	0.00	-0.16	1767	0	6 576
Germany	16 094 650	4 377 465	2 670 886	21.6	0.00	-0.33	1838	0	17 558
Ireland	379 207	184 522	160 199	28.3	-0.08	-0.32	1737	380	1243
Italy	3 946 679	3 064 423	1380 481	20.0	-0.08	-0.17	1790	4 657	4 276
Japan	10 897 986	7 811059	5 556 245	20.1	0.00	-0.25	2 098	0	28 837
Korea	4 341495	3 569 069	1556 920	22.1	0.00	-0.30	2 088	0	10 933
Netherlands	2 712 502	1149 866	449 102	24.9	0.00	-0.30	1620	0	2 746
Norway	960 938	372 868	189 600	26.7	0.00	-0.17	1793	0	765
Poland	5 644 429	3 410 149	1080 074	10.5	0.00	-0.30	1918	0	3 320
Russian Federation	15 725 069	9 977 060	5 171260	5.2	0.00	0.00	1908	0	0
Slovak Republic	874 965	502 019	149 579	9.4	0.00	-0.24	1982	0	335
Spain	3 854 356	2 013 883	1669 465	19.7	0.00	-0.24	1820	0	7 199
Sweden	1704 008	655 139	324 102	19.7	0.04	-0.17	1881	- 529	1012
United States	31534 983	21230 440	11036 792	29.3	0.00	-0.32	2 097	0	107 800
Country Average	**5 128 359**	**3 028 742**	**1683 310**	**20.0**	**-0.01**	**-0.24**	**1870**	**183**	**9 482**

Source: OECD, PIAAC (2012).

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Table 14. National costs of field-of-study mismatch (part II/IV)

	Sunk education costs				Yearly education costs	
	Years of training not transferrable for field of study mismatched only: ISCED3	Years of training not transferrable for field of study mismatched only: ISCED5	Years of traning not transferrable for field of study mismatched and overqualified: ISCED3	Years of traning not transferrable for field of study mismatched and overqualified: ISCED5	Cost of provision of education at the ISCED 3 level	Cost of provision of education at the ISCED 5 level
	(10)	(11)	(12)	(13)	(14)	(15)
Australia	0.25	0.50	0.50	0.75	10 350	15 142
Austria	0.25	0.50	0.50	0.75	12 551	15 007
Canada	0.25	0.50	0.50	0.75		22 475
Cyprus1	0.25	0.50	0.50	0.75		
Czech Republic	0.25	0.50	0.50	0.75	6 546	7 635
Denmark	0.25	0.50	0.50	0.75	11 747	18 977
England/N. Ireland (UK)	0.25	0.50	0.50	0.75	10 452	15 862
Estonia	0.25	0.50	0.50	0.75	6 444	6 501
Finland	0.25	0.50	0.50	0.75	9 162	16 714
Flanders (Belgium)	0.25	0.50	0.50	0.75	11 004	15 179
France	0.25	0.50	0.50	0.75	10 877	15 067
Germany	0.25	0.50	0.50	0.75		
Ireland	0.25	0.50	0.50	0.75	11 380	16 008
Italy	0.25	0.50	0.50	0.75	8 607	9 580
Japan	0.25	0.50	0.50	0.75	9 957	16 015
Korea	0.25	0.50	0.50	0.75	8 060	9 972
Netherlands	0.25	0.50	0.50	0.75	11 838	17 161
Norway	0.25	0.50	0.50	0.75	13 852	18 512
Poland	0.25	0.50	0.50	0.75	5 483	8 866
Russian Federation	0.25	0.50	0.50	0.75	4 100	7 039
Slovak Republic	0.25	0.50	0.50	0.75	4 806	6 904
Spain	0.25	0.50	0.50	0.75	9 608	13 373
Sweden	0.25	0.50	0.50	0.75	10 185	19 562
United States	0.25	0.50	0.50	0.75	12 464	25 576
Country Average	**0.25**	**0.50**	**0.50**	**0.75**	**9 499**	**14 415**

Source: OECD, PIAAC (2012).

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Table 14. National costs of field-of-study mismatch (part III/IV)

	Mismatched workers by education level						Total education costs	
	Percentage of mismatched workers by field of study but not qualification (ISCED3)	Percentage of mismatched workers by field of study but not qualification (ISCED5)	Percentage of mismatched workers by field of study and qualification (ISCED3)	Percentage of mismatched workers by field of study and qualification (ISCED5)	Gratuates per year from ISCED 3 (terminal)	Graduates per year from ISCED 5 (terminal)	Sunk costs in education for field of study but matched by qualification (in million USD)	Sunk costs in education for field of study mismatched and overqualified (in million USD)
	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
Australia	26.7	29.2	19.4	18.8	157 535	271 050	283	295
Austria	17.5	18.0	9.7	11.2	66 284	48 894	41	41
Canada	24.6	20.4	19.3	14.9	m	227 133	m	m
Cyprus1	40.2	22.6	6.6	11.2	m	m	m	m
Czech Republic	26.7	30.6	10.2	11.8	53 909	99 839	56	34
Denmark	22.1	26.1	16.0	7.6	26 489	49 247	56	31
England/N. Ireland (UK)	32.8	20.8	22.7	20.7	147 407	537 482	405	599
Estonia	21.9	22.3	14.5	12.5	m	m	m	m
Finland	13.9	17.9	6.2	6.8	55 821	51 380	38	24
Flanders (Belgium)	27.8	31.1	12.9	6.1	71 148	35 426	55	30
France	20.0	30.5	24.1	9.5	647 623	411 482	519	517
Germany	14.1	19.6	10.7	8.3	595 524	466 645	m	m
Ireland	24.2	21.3	20.6	18.6	60 874	44 853	47	69
Italy	40.3	17.8	16.9	14.5	321 738	385 510	243	254
Japan	35.6	21.8	18.1	20.4	517 212	668 820	650	841
Korea	46.8	30.5	12.0	16.4	165 548	412 846	313	234
Netherlands	26.4	22.3	9.7	9.3	105 829	137 746	138	90
Norway	23.6	17.1	17.3	8.3	19 011	40 099	32	28
Poland	33.7	27.6	8.1	11.9	121 806	643 802	338	215
Russian Federation	15.6	30.2	25.6	11.9	m	m	m	m
Slovak Republic	28.6	30.5	7.3	13.4	22 973	73 781	34	22
Spain	26.7	22.4	33.0	14.4	192 154	284 461	220	286
Sweden	25.6	17.3	12.2	10.7	12 702	60 945	45	41
United States	40.8	23.7	15.6	15.3	m	2 610 313	m	m
Country Average	**27.3**	**23.8**	**15.4**	**12.7**	**176 926**	**360 084**	**195**	**203**

Source: OECD, PIAAC (2012).

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Table 14. National costs of field-of-study mismatch (part IV/IV)

	Unemployment							Total cost per year
	Number of unemployed matched workers	Increased risk of unemployment for mismatched workers	Estimated number of unemployed workers due to mismatch	Increased time in unemployment for previously mismatched workers (in years)	Unemployment benefits per unemployed	Lost income tax and social contributions per unemployed	Total unemployment cost (in million USD)	Total cost per year (in million USD)
	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)
Australia	282 667	0.37	120 774	0.00	8 336	11 011	0	8 818
Austria	316 738	0.00	0	0.00	17 568	16 408	0	2 611
Canada	877 895	0.25	164 225	0.00	20 191	8 495	0	m
Cyprus1	15 401	0.14	1 528	0.00	m	m	m	m
Czech Republic	609 847	0.00	0	0.00	11 197	5 117	0	2 161
Denmark	217 724	0.14	18 550	0.00	26 314	19 500	0	2 269
England/N. Ireland (UK)	1 380 765	0.20	365 616	0.00	5 248	12 262	0	35 818
Estonia	39 212	0.11	3 198	0.00	10 066	4 327	0	m
Finland	239 345	0.26	21 406	-0.32	23 489	14 710	- 258	459
Flanders (Belgium)	127 648	0.48	44 207	0.00	20 097	23 074	0	1 536
France	2 277 279	0.00	0	0.00	24 254	11 895	0	18 329
Germany	2 711 012	0.00	0	0.00	19 879	22 245	0	m
Ireland	116 029	0.45	47 688	0.00	11 754	7 014	0	3 826
Italy	945 200	0.61	645 634	0.00	17 474	11 493	0	20 352
Japan	1 336 393	0.00	0	0.00	18 869	9 931	0	65 126
Korea	604 703	0.91	652 603	0.00	16 635	5 839	0	24 605
Netherlands	367 334	0.26	56 321	0.00	41 935	21 462	0	6 634
Norw ay	108 855	0.77	48 984	0.00	34 394	16 503	0	1 826
Poland	1 396 696	0.20	220 612	0.00	6 170	6 147	0	9 402
Russian Federation	3 659 905	0.45	1 594 650	0.00	m	m	m	m
Slovak Republic	285 693	0.00	0	0.00	9 451	4 309	0	951
Spain	987 783	0.80	751 164	0.00	18 677	8 474	0	16 927
Sw eden	267 434	0.42	65 093	0.00	19 924	13 354	0	1 395
United States	5 341 948	0.71	3 881 935	0.00	18 824	10 913	0	m
Country Average	**1 021 396**	**0.31**	**362 675**	**-0.01**	**18 216**	**12 022**	**- 12**	**12 391**

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Table 14. National costs of field-of-study mismatch (notes)

(1) Estimated from PIAAC, sum of weights of matched workers by field of study and qualification (includes underqualified workers)
(2) Estimated from PIAAC, sum of weights of field-of-study mismatched workers who are not overqualified (includes underqualified workers)
(3) Estimated from PIAAC, sum of weights of field-of-study mismatched workers who are also overqualified
(4) Estimated from PIAAC, average hourly wage for matched workers (includes bonuses)
(5) Estimated from PIAAC, coefficient for mismatched workers by field but not overqualified from a linear regression on log(wages) including controls for mismatch and overqualification, gender, age, experience, temporary contract, fulltime contract, public/ngo, firm size, educational attainment and numeracy skills level. Only statistically significant estimates are reported.
(6) Estimated from PIAAC, coefficient for field-of-study and qualification mismatch from the same model as (5). Only statistically significant estimates are repo
(7) Estimated from PIAAC, average hours worked per week among matched workers, multiplied by 48 weeks to have a yearly scale. Value for Australia imputed based on country average.
(8) Product of (2), (4), (5) and (7) (earnings for mismatched workers) minus the product of (1), (4) and (7) (earnings of matched workers). Assumes that all workers work 48 weeks, that wage differences between matched and mismatched workers represent productivity losses and that if workers had studied in the field where they are now working there would be no changes to the wage structure in that field.
(9) Product of (3), (4), (6) and (7) (earnings for mismatched workers) minus the product of (1), (4) and (7) (earnings of matched workers). Assumes that all workers work 48 weeks, that wage differences between matched and mismatched workers represent 50% of productivity losses and that if workers had studied in the field where they are now working there would be no changes to the wage structure in that field.
(10) Assumes that given the theoretical length of ISCED 3 studies, 1/2 of the duration is dedicated to field-specific studies
(11) Assumes that given the theoretical length of ISCED 5 studies, 1/2 of the duration is dedicated to field-specific studies
(12) Assumes that given the theoretical length of ISCED 3 studies, all of the duration is dedicated to field-specific studies
(13) Assumes that given the theoretical length of ISCED 5 studies, all of the duration is dedicated to field-specific studies
(14) Data from Education at a Glance 2013 (OECD, 2013d), Indicator B1.1a, expenditure per student per year, secondary education (annual, equivalent USD using PPPs). Assumes that expenditure for workers that will end up being mismatched is the same as for matched workers. For England/N.Ireland (UK) and Flanders (Belgium), that expenditure per student is similar for these than for other regions.
(15) Data from Education at a Glance 2013 (OECD, 2013d), Indicator B1.1a, expenditure per student per year, tertiary education including R&D activities (annual, equivalent USD using PPPs). Assumes that expenditure for workers that will end up being mismatched is the same as for matched workers. For England/N.Ireland (UK) and Flanders (Belgium), that expenditure per student is similar for these than for other regions
(16) Estimated from PIAAC, percentage of field-of-study mismatched not overqualified workers with ISCED 3 as the highest qualification
(17) Estimated from PIAAC, percentage of field-of-study mismatched not overqualified workers with ISCED 5 as the highest qualification
(18) Estimated from PIAAC, percentage of field-of-study mismatched and overqualified workers with ISCED 3 as the highest qualification
(19) Estimated from PIAAC, percentage of field-of-study mismatched and overqualified workers with ISCED 5 as the highest qualification
(20) Estimated from Education at a Glance 2013 (OECD, 2013d), as the total number of graduates from ISCED 3 minus the total number of persons entering ISCED 5 programmes (data from 2011). Data for England/N.Ireland (Flanders) estimated as the product of the number of graduates from the United Kingdom (Belgium) and the proportion of the total from the United Kingdom (Belgium) in England/N.Ireland (Flanders) (OECD Regional Database). Assumes that the cohort of ISCED 3 graduates equals the cohort of ISCED 5 enrolees (which is not the case because some ISCED 3 graduates go on to work and then come back into education, but because of the lack of other data, this assumption is needed). That graduation rates in the region are similar to those of regions not covered.
(21) Data from OECD Education database; Data for England/N.Ireland (Flanders) estimated as the product of the number of graduates from the United Kingdom (Belgium) and the proportion of the total from the United Kingdom (Belgium) in England/N.Ireland (Flanders) (OECD Regional Database). Assumes that graduation rates in Flanders (Belgium) and England / N. Ireland (UK) are similar to those of regions not covered in these countries.
(22) Product of (10), (14), (16) and (20) plus the product of (11), (15), (17) and (21). Assumes that 40% of graduates who enter the workforce in a mismatcl
(23) Product of (12), (14), (18) and (20) plus the product of (13), (15), (19) and (21). Assumes that 40% of graduates who enter the workforce in a mismatc
(24) Estimated from PIAAC, sum of weights of matched workers who are unemployed
(25) Estimated from PIAAC, coefficient for mismatched workers by field from a logistic regression on likelihood of unemployment including controls for gender, age, experience, temporary contract, fulltime contract, public/ngo, firm size, field of study, tenure, educational attainment and numeracy skills level. Only statistically significant estimates are reported.
(26) Product of (24) and (25)
(27) Estimated from PIAAC, difference in the time since last worked between previously field-of-study matched and field-of-study mismatched workers.
(28) Data from Society at a Glance. Assumes that workers are single-person households, unmarried with no children and received the wages of the average worker; original data in local currency converted using PPPs with exchange rates.
(29) Data from Society at a Glance. Assumes that workers are single-person households, unmarried with no children and received the wages of the average worker; original data in local currency converted using PPPs with exchange rates.
(30) Product of (26), (27) and the addition of (28) and (29)
(31) Sum of (8), (9), (22), (23) and (29)

Table 15. National costs of field-of-study mismatch as a percentage of GDP

	GDP	Total earnings and productivity loss per year		Total education costs		Total unemp. cost	Total cost per year
	GDP 2012 (Millions of US $ constant PPP, current prices)	Earnings / productivity loss per year for field mismatched but not overqualified workers	Earnings / productivity loss per year for field mismatched and overqualified workers	Sunk costs in education for field of study but matched by qualification	Sunk costs in education for field of study mismatched and overqualified		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Australia	1 520 944	0.0000	0.0019	0.0002	0.0002	0.0000	0.0023
Austria	394 457	0.0000	0.0028	0.0001	0.0001	0.0000	0.0030
Canada	1 821 446	0.0000	0.0068	m	m	0.0000	m
Cyprus*	22 767	0.0000	0.0045	m	m	m	m
Czech Republic	196 446	0.0000	0.0044	0.0003	0.0002	0.0000	0.0048
Denmark	315 164	0.0000	0.0029	0.0002	0.0001	0.0000	0.0032
England/N. Ireland (UK)	1 349 214	0.0000	0.0114	0.0003	0.0004	0.0000	0.0122
Estonia	22 376	0.0031	0.0100	m	m	0.0000	m
Finland	247 143	-0.0008	0.0016	0.0002	0.0001	-0.0010	0.0000
Flanders (Belgium)	216 457	0.0000	0.0026	0.0003	0.0001	0.0000	0.0030
France	2 611 220	0.0000	0.0025	0.0002	0.0002	0.0000	0.0029
Germany	3 425 955	0.0000	0.0051	m	m	0.0000	m
Ireland	210 638	0.0018	0.0059	0.0002	0.0003	0.0000	0.0083
Italy	2 013 264	0.0023	0.0021	0.0001	0.0001	0.0000	0.0047
Japan	5 937 763	0.0000	0.0049	0.0001	0.0001	0.0000	0.0051
Korea	1 129 599	0.0000	0.0097	0.0003	0.0002	0.0000	0.0102
Netherlands	770 066	0.0000	0.0036	0.0002	0.0001	0.0000	0.0039
Norway	500 030	0.0000	0.0015	0.0001	0.0001	0.0000	0.0016
Poland	490 207	0.0000	0.0068	0.0007	0.0004	0.0000	0.0079
Russian Federation**	2 017 470	0.0000	0.0000	m	m	m	m
Slovak Republic	91 349	0.0000	0.0037	0.0004	0.0002	0.0000	0.0043
Spain	1 322 481	0.0000	0.0054	0.0002	0.0002	0.0000	0.0058
Sweden	523 941	-0.0010	0.0019	0.0001	0.0001	0.0000	0.0011
United States	16 244 600	0.0000	0.0066	m	m	0.0000	m
Country Average	**1 808 125**	**0.0002**	**0.0045**	**0.0002**	**0.0002**	**0.0000**	**0.0047**

Note: (1) Data from Belgium (Flanders) and England / N. Ireland (UK) from 2011 adjusted to 2012 USD.
Source: OECD.Stats (CXC); OECD Regional Database for Belgium (Flanders) (2011) and England / N. Ireland (UK) (2011) and Table 13.

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**The data from the Russian Federation are preliminary and may be subject to change. Readers should note that the sample for the Russian Federation does not include the population of the Moscow municipal area. The data published, therefore, do not represent the entire resident population aged 16-65 in Russia but rather the population of Russia excluding the population residing in the Moscow municipal area. More detailed information regarding the data from the Russian Federation as well as that of other countries can be found in the Technical Report of the Survey of Adult Skills (OECD, 2013a).

Table 16. Comparison of estimates related field-of-study from PIAAC and the European Labour Force Survey (part I/II)

	Gender		Age		EdCat4		Mismatch		Saturation (2)		Saturation (3)	
	EULFS Mean	PIAAC Mean	EULFS Mean	PIAAC Mean	EULFS Mean	PIAAC Mean	EULFS Mean	PIAAC Mean	EULFS Mean	PIAAC Mean	EULFS Mean	PIAAC Mean
Austria	0.47	0.48	39.43	39.60	2.62	2.59	26.00	27.82	0.70	0.71	0.53	0.43
Cyprus*	0.50	0.47	38.66	37.73	3.13	3.30	35.11	38.37	0.50	0.71	1.53	1.01
Czech Republic	0.44	0.45	40.77	40.17	2.47	2.49	29.72	38.21	0.88	0.94	0.59	0.80
Denmark	0.50	0.50	42.34	41.78	2.92	3.03	28.52	35.17	0.35	0.85	0.82	0.73
Estonia	0.55	0.57	41.93	41.32	3.18	3.30	36.79	35.08	0.62	0.65	0.75	0.62
Finland	0.52	0.53	42.27	42.06	3.08	3.21	23.76	22.70	0.34	0.62	0.60	0.54
France	0.50	0.48	39.50	39.14	2.89	2.91	39.59	42.36	0.09	0.53	1.28	0.59
Germany	0.48	0.48	42.48	42.72	2.76	2.83	25.44	26.17	1.11	0.56	0.44	0.48
Ireland	0.55	0.54	37.99	36.92	3.80	3.73	31.53	41.46	0.58	0.75	0.67	0.98
Italy	0.47	0.50	40.63	39.55	2.70	2.56	35.90	49.43	0.19	0.49	0.78	1.70
Netherlands	0.50	0.48	40.34	39.12	3.03	3.00	34.06	33.33	1.13	0.70	0.44	0.43
Norway	0.49	0.50	42.01	40.78	3.15	3.02	42.09	33.33	0.84	0.60	1.34	0.63
Slovak Republic	0.46	0.47	40.41	40.37	2.46	2.55	31.01	38.00	0.94	0.85	0.48	0.93
Spain	0.52	0.51	39.61	39.47	3.62	3.38	33.75	43.64	0.63	0.62	0.69	1.26
Sweden	0.51	0.50	41.53	41.67	2.95	2.93	31.43	33.72	0.83	0.75	0.76	0.74

	Saturation (4)		Saturation (5)		Saturation (6)		Saturation (7)		Saturation (8)		Saturation (9)	
	EULFS Mean	PIAAC Mean	EULFS Mean	PIAAC Mean	EULFS Mean	PIAAC Mean	EULFS Mean	PIAAC Mean	EULFS Mean	PIAAC Mean	EULFS Mean	PIAAC Mean
Austria	0.61	0.61	0.14	0.17	0.99	0.98	0.47	0.46	0.46	0.42	0.28	0.29
Cyprus*	0.73	0.30	0.62	0.92	0.80	0.67	0.18	0.17	0.40	0.34	0.16	0.16
Czech Republic	0.53	0.50	0.24	0.23	1.01	1.00	0.62	0.90	0.50	0.29	0.24	0.32
Denmark	0.71	0.41	0.30	0.56	0.81	0.66	0.50	0.47	0.66	0.50	0.13	0.33
Estonia	0.40	0.42	0.39	0.41	0.73	0.75	0.50	0.63	0.40	0.41	0.29	0.29
Finland	0.50	0.49	0.24	0.21	0.81	0.86	0.44	0.50	0.65	0.71	0.27	0.21
France	0.80	0.37	0.59	0.79	0.98	0.64	0.56	0.54	0.58	0.63	0.15	0.39
Germany	0.59	0.61	0.27	0.41	0.89	0.95	0.30	0.31	0.67	0.71	0.18	0.16
Ireland	0.47	0.47	0.60	1.28	0.54	0.66	0.33	0.46	0.55	0.56	0.13	0.22
Italy	0.61	0.39	0.27	1.09	1.04	0.53	0.37	0.52	0.37	0.44	0.13	0.19
Netherlands	0.52	0.52	0.24	0.56	0.65	0.79	0.35	0.57	0.82	0.79	0.24	0.10
Norway	0.47	0.48	0.48	0.63	0.47	1.03	0.44	0.34	0.41	0.54	0.10	0.09
Slovak Republic	0.49	0.33	0.21	0.72	1.09	0.87	0.85	0.99	0.42	0.41	0.23	0.42
Spain	0.56	0.47	0.59	0.94	0.68	0.83	0.23	0.26	0.54	0.57	0.11	0.09
Sweden	0.51	0.53	0.27	0.32	0.85	0.84	0.40	0.46	0.65	0.58	0.17	0.13

(2) Teacher training and education science
(3) Humanities, languages and arts
(4) Social sciences, business and law
(5) Science, mathematics and computing
(6) Engineering, manufacturing and construction
(7) Agriculture and veterinary
(8) Health and welfare
(9) Service

Source: OECD, PIAAC (2012); 2012 European Labour Force Survey.

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Table 16. Comparison of estimates related field-of-study from PIAAC and the European Labour Force Survey (part II/II)

	Major (2)		Major (3)		Major (4)		Major (5)		Major (6)		Major (7)		Major (8)		Major (9)	
	EULFS Mean	PIAAC Mean	EULFS Mean	PIAAC Mean	EULFS Mean	PIAAC Mean	EULFS Mean	PIAAC Mean	EULFS Mean	PIAAC Mean	EULFS Mean	PIAAC Mean	EULFS Mean	PIAAC Mean	EULFS Mean	PIAAC Mean
Austria	5.24	5.49	3.76	3.06	29.38	31.74	2.10	2.27	36.79	34.15	3.07	2.96	7.01	6.83	12.66	13.51
Cyprus*	4.55	9.95	11.31	10.30	39.69	23.67	8.05	15.12	21.92	21.71	0.85	0.90	4.57	6.05	9.07	12.31
Czech Republic	5.06	5.50	2.68	3.39	20.64	20.66	3.17	2.91	47.12	46.51	5.23	5.69	6.40	2.79	9.69	12.55
Denmark	5.72	12.03	6.78	6.65	30.61	18.88	5.20	10.12	25.01	21.81	2.71	3.26	18.73	13.99	5.23	13.27
Estonia	6.49	6.54	6.26	5.67	21.30	22.67	4.67	5.14	36.86	36.28	4.73	4.91	6.16	6.72	13.53	12.06
Finland	3.62	6.01	5.91	5.37	21.62	20.85	3.90	3.36	31.51	33.84	3.28	3.27	17.53	17.31	12.63	10.00
France	0.99	5.11	8.21	5.81	34.63	18.58	8.40	12.33	29.12	23.17	2.82	3.71	9.98	11.95	5.84	19.35
Germany	6.23	4.14	3.64	3.30	30.64	29.41	3.66	4.73	33.81	35.64	2.12	2.17	11.53	12.78	8.36	7.84
Ireland	8.05	9.64	6.49	8.95	33.17	24.43	8.27	16.40	18.32	14.74	1.96	1.88	15.65	14.57	8.09	9.40
Italy	2.51	5.00	7.58	15.32	37.33	22.48	6.20	22.91	29.33	14.95	2.83	3.14	7.30	7.29	6.91	8.90
Netherlands	8.43	8.10	4.63	3.80	30.48	33.21	4.20	8.01	18.47	18.61	2.42	3.67	19.76	20.00	11.61	4.60
Norway	13.47	8.82	12.80	6.49	24.51	21.98	8.61	8.08	16.52	29.42	2.82	2.38	16.36	18.19	4.91	4.64
Slovak Republic	5.56	6.00	1.66	5.50	18.08	14.04	2.58	9.10	50.47	35.94	5.71	7.04	6.15	6.68	9.80	15.69
Spain	9.05	9.50	7.08	12.88	30.72	24.40	9.88	13.23	20.90	20.98	1.70	1.31	14.73	13.53	5.92	4.18
Sweden	9.77	9.46	5.99	6.01	21.99	22.35	4.36	5.85	28.89	29.24	2.19	2.79	19.28	18.16	7.53	6.15

	FieldofWork (2)		FieldofWork (3)		FieldofWork (4)		FieldofWork (5)		FieldofWork (6)		FieldofWork (7)		FieldofWork (8)		FieldofWork (9)	
	EULFS Mean	PIAAC Mean	EULFS Mean	PIAAC Mean	EULFS Mean	PIAAC Mean	EULFS Mean	PIAAC Mean	EULFS Mean	PIAAC Mean	EULFS Mean	PIAAC Mean	EULFS Mean	PIAAC Mean	EULFS Mean	PIAAC Mean
Austria	7.07	6.96	6.73	7.04	43.88	47.43	14.03	14.01	36.47	34.35	6.88	6.02	14.55	14.91	43.87	43.54
Cyprus*	8.99	13.15	7.01	9.11	53.10	54.85	13.56	15.02	25.91	25.05	3.85	3.89	12.43	16.21	48.61	45.83
Czech Republic	5.63	5.64	4.95	3.82	35.26	38.10	13.07	11.63	47.51	47.01	8.66	6.01	12.78	10.04	39.46	38.47
Denmark	15.85	13.36	7.68	8.18	40.71	39.15	17.24	16.87	30.18	29.71	5.98	6.77	27.24	26.80	34.98	35.33
Estonia	9.63	9.56	8.07	8.40	41.05	41.71	10.56	10.99	39.59	38.44	7.49	6.80	14.17	15.02	33.68	31.96
Finland	9.99	8.93	9.70	9.46	37.97	38.72	14.27	14.09	35.62	35.14	7.52	6.83	26.00	23.82	40.05	41.14
France	11.55	8.81	6.18	9.52	41.86	45.84	14.42	14.50	29.65	31.48	5.43	6.76	17.78	17.54	41.70	44.72
Germany	4.92	6.38	8.75	6.92	48.37	47.18	12.88	10.30	37.03	36.81	7.97	7.35	16.75	18.28	46.15	47.61
Ireland	12.83	12.39	9.20	8.68	47.41	48.76	12.51	11.63	22.51	23.27	5.61	4.76	25.58	25.87	38.56	42.80
Italy	9.36	10.67	8.00	8.84	51.99	53.02	20.70	19.00	26.43	26.88	6.47	5.26	16.52	16.70	45.10	45.45
Netherlands	6.46	10.66	10.95	10.44	51.10	55.67	14.90	12.83	25.37	22.53	7.27	6.18	22.34	24.44	41.10	44.73
Norway	14.39	15.14	8.71	9.58	43.42	41.24	16.88	13.05	32.23	26.88	5.81	6.37	27.03	34.21	35.69	41.09
Slovak Republic	5.90	7.01	3.63	5.28	33.27	35.18	11.57	12.39	45.80	43.63	6.81	7.76	14.82	15.92	41.72	36.01
Spain	13.65	15.12	9.86	9.32	41.55	46.37	15.65	14.51	25.60	23.62	6.69	7.65	24.51	23.10	36.61	42.72
Sweden	11.37	11.82	7.37	7.73	38.72	37.00	15.16	16.97	31.70	33.09	5.51	6.27	28.53	28.29	38.03	38.74

(2) Teacher training and education science
(3) Humanities, languages and arts
(4) Social sciences, business and law
(5) Science, mathematics and computing
(6) Engineering, manufacturing and construction
(7) Agriculture and veterinary
(8) Health and welfare
(9) Service

Source: OECD, PIAAC (2012); 2012 European Labour Force Survey.

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ANNEX 4: VALIDATION OF FIELD-OF-STUDY MISMATCH AND FIELD SATURATION WITH THE EUROPEAN LABOUR FORCE SURVEY

102. Notwithstanding the richness of the PIAAC data to analyse worker mismatch in the context of broader attributes of the labour market like saturation and the transferability of skills, its sample size may restrict these analyses, particularly when it comes to fields-of-study or fields-of-work that are less represented in the observed sample (e.g. Agriculture and Veterinary, Humanities, Languages or Arts). The European Labour Force Survey (EULFS) allows to validate PIAAC estimates of field-level characteristics in fields that are less represented in the sample because the EULFS has larger sample sizes per country than PIAAC does, ensuring a higher sample size within each field. Comparisons are restricted to the 14 countries that participated in the EULFS and PIAAC in 2012 and have occupation data at the 3-digit ISCO code in the three surveys: Austria the Czech Republic, Denmark, Estonia, France, Germany, Ireland, Italy, the Netherlands, the Slovak Republic, Spain and Sweden.

103. Field-of-study mismatch and field-related attributes can be estimated in both surveys as both PIAAC and the EULFS code occupations at the three-digit ISCO-08 level and measure field-of-study coded in nine categories. Importantly, however, questionnaire differences in the way field-of-study was asked difficult these comparisons. While PIAAC asks all respondents and bases field-of-study in terms of subjective appreciation and asks respondents to place their field-of-study in one of the nine categories, EULFS asks respondents who earned a degree in the last two years about their specific field-of-study and codes it into one of the nine categories in the database cleaning and production stage.

104. In PIAAC, respondents were asked in question B_Q01b "What was the area of study, emphasis or major for your highest level of qualification? If there was more than one, please choose the one you consider most important," with the instruction to survey takers to "1. Hand show card 2. If there was more than one area of study associated with the one qualification, this refers to the most important. 3. If there was more than one qualification at this level, this question refers to the area of study for the most recent." Respondents were thus asked to choose one of the following field of studies: (1) General programmes, (2) Teacher training and education science, (3) Humanities, languages and arts, (4) Social sciences, business and law, (5) Science, mathematics and computing, (6) Engineering, manufacturing and construction,(7) Agriculture and veterinary, (8) Health and welfare, (9) Service.

105. In the EULFS, respondents were asked about the highest degree they obtained and then offered a list of all degrees for the respondent to identify their specific degree. These questions are country-specific and, in Denmark, for example, respondents that completed a degree in the last two years are asked to report whether the degree they completed is (1) 1st to 6th grade, (2) 7th to 10th grade, (3) Upper secondary education, Higher preparatory examination, STX, HF, (4) Higher commercial examination, HHX, (5) Higher technical education HTX, (6) Access to engineering, FIF, Diploma engineer 1 year, Engineer 1½ years, Admission course to forest and landscape engineer, (7) Customs assistant, Customs officer, basic customs education and training, Labour market study technician, Production assistant, (8) Upper secondary education is not required. Basic vocational education, Shop assistant education, Clerical education. Craftsmen's education and training, Educational assistant, social and health education, zoo inspector, Farmer, Fisherman, Driver, Post office clerk, Salvage-corps man, Security guard, (9) Upper secondary education is required: Bilingual commercial correspondent, basic education, Specialised business studies, Bachelor of Economics, Real estate agent, Customers inspector, Customers secretary, Education at university level, Innovation and entrepreneurship, edp education, Specialised technical studies, Mechanical engineering, Workshop employee, Electrician, Laboratory technician, Technician, Designer, Technologist, Office B-line, (10) Higher education: University graduate, Bachelor, Master, Primary and lower secondary school teacher, Qualified nurse, Bachelor of Science, Bachelor of commerce, Office A-line, (11) Researcher (PhD.), (12) Other education and training. Depending on the respondents answer to each of these 12 categories, respondents are offered a reference list of categories, ranging from 4 categories

of technical or customs education to 1299 higher education degrees. These responses are then coded to determine respondents' field-of-study in terms of nine country-comparable categories.

106. If any discrepancies arise in the estimates related to field-of-study mismatch and field characteristics stem from PIAAC and the EULFS they could be due to 1) the EULFS filters the measurement of field-of-study to individuals who graduated in the past two years while PIAAC does not and/or 2) that PIAAC relies on subjective assessments of field-of-study while EULFS relies on a normative approach. Estimates from PIAAC and EULFS will thus differ if there are age, period or cohort differences in field characteristics (from (1)) or if certain or all individuals differ in the way they characterise their field-of-study with respect to the normative criteria used by the EULFS (from (2)).

107. Table 16 shows the estimates for field-of-study mismatch. It shows that they are consistent across the two surveys in Austria, Estonia, France, Germany, the Netherlands and Sweden. PIAAC estimates of field-of-study mismatch are greater in than those of EULFS in the Czech Republic (by 9 percentage points), Denmark (7 percentage points), Ireland (10 percentage points), Italy (14 percentage points), Norway (9 percentage points), the Slovak Republic (7 percentage points) and Spain (10 percentage points). Despite these inconsistencies, the correlation at the country level between the prevalence of field-of-mismatch estimated in PIAAC and the EULFS is 0.59.

108. Field saturation measures are generally consistent across fields and countries but some inconsistencies arise. For (2) teacher education and training, saturation levels measured in the EULFS and PIAAC are generally similar, with the exception that while the EULFS detects a shortage of workers trained as teachers, PIAAC identifies a relative shortage of teachers in Germany and the Netherlands, EULFS detects a relative surplus. For (3) humanities, languages and arts, EULFS detects a relative shortage but PIAAC a relative surplus in France and Norway. For (5) science, mathematics and computing, PIAAC detects relative saturation in Italy and Ireland with the EULFS detecting relative shortages in those countries. For (6) engineering, construction and manufacturing, (7) agriculture and veterinary and (8) health and welfare, results are generally consistent across the two surveys. In these three fields and (9) services, both the EULFS and PIAAC detect shortages in all countries.

109. Notwithstanding these relatively uncommon inconsistencies in the measurement of saturation levels across surveys, the country-level correlation between field-specific saturation levels across surveys is high, at above 0.6 for five fields. It is 0.34 in (9) services, but less than that in (3) humanities, languages and arts, (4) social sciences, business and law, and (6) engineering, manufacturing and construction.

110. Similar patterns emerge when comparing the percentage of mismatched workers by field-of-study or by occupational group across the two surveys.

111. These findings indicate that results are generally consistent across surveys, but that the PIAAC sample for (3) humanities, languages and arts, (4) social sciences, business and law, and (6) engineering, manufacturing and construction may be not comparable to the EULFS because either (a) sample size is too low and estimates are unreliable, and/or (b) this field is particularly sensitive to the measurement differences of the EULFS and PIAAC. Table 17 provides the sample sizes used to calculate field saturation and skill transferability measures in PIAAC.

ANNEX 5: COMPLEMENTARY NOTES

Notes regarding Cyprus

Readers should note the following information provided by Turkey and by the European Union Member States of the OECD and the European Union regarding the status of Cyprus:

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.

Throughout this report, including the main body, boxes and annexes, Cyprus is accompanied by a (*) symbol pointing to these notes.

*****A note regarding the Russian Federation***

The data from the Russian Federation are *preliminary* and may be subject to change. Readers should note that the sample for the Russian Federation does not include the population of the Moscow municipal area. The data published, therefore, do not represent the entire resident population aged 16-65 in Russia but rather the population of Russia *excluding* the population residing in the Moscow municipal area. More detailed information regarding the data from the Russian Federation as well as that of other countries can be found in the *Technical Report of the Survey of Adult Skills* (OECD, 2013a).

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