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Should governments of OECD countries worry about graduate over-education?

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Abstract

To assess potential public concerns, this paper examines theory and evidence surrounding graduate over-education in this era of HE massification. We use a new index of graduate jobs to derive our measure of graduate over-education. We find that its prevalence across 21 countries is correlated with the aggregate supply-demand imbalance, but not with indicators of labour market flexibility. It has general effects on pay and job satisfaction. External benefits (social trust, volunteering and political efficacy) are found to be associated with higher education in most countries, mediated at best only partially through employment in a graduate job. Taken together with existing studies, we argue that in the massification era over-education is a useful indicator of the extent of macro-economic disequilibrium in the graduate labour market. We conclude that, in addition to its concern with graduate employability, higher education policy should be based on social returns and should recall higher education's wider purposes.

1. Introduction: who's worried about over-education?

We are living through an era of worldwide ‘massification’ of higher education (Marginson 2016), the consequence of which is an unprecedented generalised expansion across developed (and many developing) countries in the proportion of highly educated workers. Across the OECD between 2000 and 2014 the proportion of 25-34 year olds with tertiary education rose by an average of 15 percentage points to around 41 per cent (OECD 2015: 44). There was much variation between countries, ranging from Finland where the increase was low (it started from a high level) to countries like South Korea and Poland where the rise exceeded 25 percentage points. This transformation has been generally welcomed and in most cases actively supported by policymakers but also poses the question of how far graduates can find employment to match their education level, and the extent to which many find themselves ‘over-educated’ or ‘under-employed’.¹ Should governments worry about the spectacle of bartenders and office clerks apparently wasting their university education? Should they be concerned that extended higher education without commensurate employment breeds mass disillusion? Are young people nowadays taking more of a risk by investing in higher education? This paper examines theory and evidence surrounding over-education, and studies the prevalence of graduate over-education across 21 countries, and its potential broad policy implications.

Academic scholars have concerned themselves with the spectre of over-education for some decades (McGuinness 2016; Leuven and Oosterbeek 2011), though typically concern has been higher among heterodox economists and sociologists than within the mainstream of neoclassical economics. In some countries worries about over-education have emerged openly in public discourse. Thus, the media (as revealed through Google search) in the US, the UK and Canada have explored the difficulties of recent graduates in finding well-paid jobs and the potential implications for family formation, housing and repayment of student debt (e.g. Burnett 2015; Ferro 2015; Leonhardt 2014; Thompson 2015; Williams 2015. *The Economist* (28 March 2015), in its main feature, asks of the global massification of university participation: ‘Is it worth it?’ In Japan the bulk recruitment of students before graduation by large employers (a policy now abolished in South Korea) is a continued cause of stress: graduates without an employment contract at the time of graduation fear lifelong precarious employment. The concern over post-college employment could not be said to be universal. In other countries public worry has often focused, as in Denmark and Finland, on the consequences of post-recession austerity for HE systems and the implications for the viability of some higher

¹ Over-education is defined as the state where an individual has achieved an education level higher than that which is required for the job. One synonym used in this paper is ‘underemployment’, though this term in some other studies has an alternative interpretation in terms of working time preference matching. Another synonym is ‘overqualification’. A different type of mismatch, which we shall not pursue here, is that of ‘horizontal mismatch’ where the subject or type of education does not match the job needs.

education institutions or for student support. In Germany media concern surrounds the changing roles of vocational and academic education (e.g. Füller 2013; Mühl 2015). Nevertheless, the instrumental orientation that sees higher education's purpose as a route to good and secure employment appears to be widespread.

Concern with over-education has fed its way only patchily and indirectly into the policymaker's world. Some countries do collect data on the employment of recent graduates, and agencies write reports about recent graduate cohorts, but with few tangible policy outcomes (e.g. Statistics Canada 2014; Abel et al. 2014; Bildungsbericht 2014; European Commission 2015; ONS 2013). For example, the EU commission reports the proportion of recent graduates who are in non-graduate jobs, but unlike for participation rates in tertiary education and subsequent employment rates, there is no policy target for over-education. Obama's US administration wants 'college for all'. Nevertheless, there are broader attempts to reform HE systems, such as through the EU Bologna process, to enhance the employability of graduates (European Commission 2015), and the employment success of universities' graduates has become an increasingly important metric (consider, for example, the foundation and growth of the AlmaLaurea consortium), entering into increasingly important global rankings.

The paper is organised as follows. The next section sets the scene by briefly summarising what is known about the determinants and consequences of over-education, including its relationships with skill heterogeneity and with skills underutilisation. While our summary will draw on studies from a number of countries, international studies that compare the prevalence and consequences across countries are scarce. Indeed, very little is reliably known about how much over-education varies across countries, and the factors behind such variation. Also insufficiently studied are the potential social effects of over-education: though it is known that graduate education has a number of social benefits above the conventional private returns in the labour market, what is unknown is the extent to which, if at all, higher education's social returns can be realised when graduates fail to find graduate jobs.

These issues, which should be important background for a proper evaluation of the policy stance towards over-education, are examined in Section 3, for 22 countries in the OECD that participated in the first wave of the Programme for International Assessment of Adult Competences (PIAAC), also termed the Survey of Adult Skills (SAS). We make use of a new three-digit occupation classification in each country of 'graduate jobs', derived using skills utilisation data from the survey. The classification, which has been empirically validated elsewhere (Henseke and Green 2014; 2015), keeps the measurement close to the concept. Section 4 then considers general consequential implications for any government's policy stance concerning graduate education and over-education.

2. Theoretical frameworks and evidence surrounding over-education

The aim of this section is to interrogate theory and existing evidence for what they imply, if anything, about the significance of over-education for the widespread policy of encouraging the expansion of higher education.

2.1 Theory and evidence about over-education

According to all economic theories of a dynamic labour market, there will always be some degree of mismatch between educational achievements and job requirements. Some people's education will exceed requirements and they will be underemployed; others' vice versa. The normal adjustments of a functioning labour market should operate to reduce imbalances as they appear. In the short term workers and firms respond to market signals: firms by recruiting or retrenching, workers through job search, mobility or training. Job requirements themselves become elastic, as employers design jobs to suit their workers and prevailing technologies, while job-holders mould their jobs towards their own skills. In the long term, if there are imbalances between the supply of graduates and the demand to fill graduate jobs, the returns to higher education will change and young people will modify their education and training plans. Since all such adjustments are by no means instantaneous, frictional mismatches – including underemployment – remain (in parallel with frictional unemployment). From the perspective of human capital theory, education-job mismatches among graduates are largely temporary, or else no more than an artificial conceit masking skill gaps between the matched and mismatched. An additional consideration, from this perspective, is the phenomenon of credentialism, whereby college credentials signal abilities correlated with academic performance. In such a world, over-education is interpreted as an equilibrium phenomenon, with education settling at an above-optimum level (e.g. Charlot and Decreuse 2010). Thus, graduate over-education is theorised conventionally as essentially frictional underemployment plus an additional hard-to-measure amount associated with signalling.²

Scientific interest in over-education stems, not from a denigration of the value of education as merely a signal for what is important to employers, but from scepticism that labour markets are systematically functional in the way described above (see McGuinness 2006 for an overview). According to one set of views, jobs are technologically determined, and the labour market is a competition between workers to get them. From a more sophisticated perspective, both workers and jobs adjust, but the labour market is conceived as an imperfect assignment process allocating workers to jobs, and jobs to workers (Sattinger 1993). Either theory allows that over-

² Recent studies have been directed at theorising the wage effects of over-education (and undereducation) as emerging from equilibrium wage bargaining (Sattinger and Hartog 2013).

education can not only occur, but be persistent, genuine (i.e. reflecting underutilisation of skill) and substantive.

The concern with over-education endures in the literature of heterodox economics and sociology because of a series of negative conclusions about the conventional perspective on this issue. Some of this concern arises from empirical studies of recent decades. Consider first the question of whether graduate over-education is temporary or persistent. Earlier studies had suggested that there was an element of job search and/or learning involved in accepting a position below one's educational level. Subsequent studies have thrown doubt on this conclusion, however, and longitudinal studies since have generally found a high degree of state dependence (that is, persistence) in being over-educated (e.g. Clark et al. 2014 for USA; Diem and Wolter 2014 for a cohort of recent Swiss graduates; Kiersztyn 2013 for Poland; Mavormaras et al. 2013 for Australia). It seems that being obliged to accept a lower-status job to end unemployment at the start of the career slows down the transition into an education adequate job compared to a longer initial search period (Baert et al. 2013).

A second negative empirical conclusion surrounds the question of skills heterogeneity. Studies in a few countries have demonstrated that skill, among graduates, is a robust determinant of the likelihood of their being over-educated for their job (Green and McIntosh 2007). It is also well-known that estimates of the over-education wage penalty may be biased because of unobserved endogenous factors that affect both over-education status and wages. None, however, has demonstrated that *all*, or even most, mismatch is down to such heterogeneity. No reliable piece of evidence has refuted that a substantial proportion of over-educated workers would be able to pursue a more skilled job.³ Most graduates in non-graduate jobs would be able to perform at least some graduate jobs, if given the opportunity of acquiring the necessary on-the-job skills.

The skills heterogeneity question is linked to the view that it may, for some purposes, be more fruitful for analysts to focus on skills, rather than educational, mismatch (e.g. Allen and van der Velden 2001; Green and McIntosh 2007; Quintini 2011a). Studies of self-report indicators of skills underutilisation have indicated that these may be better than over-education as predictors of labour market penalties. Nevertheless, further development of graduate skills mismatch has been hampered by lack of any scientific consensus about what constitute adequate, meaningful indicators. Subjective measures have been derived from sometimes ill-advised survey questions that place undue emphasis on the respondent's own skills, inviting social esteem bias: to illustrate, one such measure, in SAS's background questionnaire,

³ Fixed effects models in Tsai (2010; Quintini 2011b), using the contested 'realised matches' approach to measure required schooling, show the estimated effects of both education and over-education being reduced by more than half. However, this method works only through job moves which are endogenous, and assumes wages change immediately after job moves, both of which are likely to induce downward bias.

implied that nearly nine in 10 workers experienced skill underutilisation, a result which could not be interpreted meaningfully. Capturing domain-specific skills mismatch has also so far proved difficult. Thus, although a useful goal would be to analyse and interpret over-education primarily through the lens of skill underutilisation, this objective is yet to be achieved by researchers working in this field.

A third adverse conclusion about the conventional complacency on over-education surrounds the practical claim that the elasticity of jobs and flexible labour markets make it nigh on impossible to delineate the education or skill requirements of jobs in any objective manner. Some have likened the specification of educational requirements to an aspiration for Soviet-style manpower planning (McMahon 2009: 110). Yet the growth of task-based analyses of jobs belies that comparison: these demonstrate the value of both educational requirement and task measures for understanding both changing skills demands and distributional trends (e.g. Spitz-Oener 2006).

In the assessment of Leuven and Oosterbeek (2011), disputed measurement methods (including undue reliance on the 'realised matches' indicators of required education) and the problem of not finding adequate exogenous instruments to identify wage effects lead to a pessimistic prognosis for whether over-education has much of use to contribute to understanding of modern labour markets. It is also sometimes advanced that it is better to consider evidence on trends in the economic returns to graduation, rather than evidence on over-education. This preference stems from the view that one can have more confidence in estimates of the returns than in indicators of jobs' educational requirements, and from reliance on an equilibrium perspective. Yet in our view these two approaches – educational mismatch and rates of return – should not be regarded as substitutes. Especially in the current era, with the extraordinary change in the supply of graduates juxtaposed against the uncertain employment effects of the fourth industrial revolution, examination of past rates of return is a potentially unreliable guide. A full-information approach that integrates *both* price and quantity in a complementary analysis promises more insight. Even if young people do respond appropriately to market signals for higher education, the responses are typically governed on a longer time horizon than that of the macro-social changes now occurring following HE massification. Increased over-education could be expected from HE massification, especially where high-skill demand growth is sluggish, and should be monitored for the suggestive information it provides about potential future price changes. Indeed, it would be misleading to examine the issue of the overall balance of supply and demand for graduates *solely* through a backward-oriented estimate of the rate of return. Since pay is not just determined by higher education qualifications, labour market reactions are likely to be slow and mixed.

Not least, one should ask: whose rate of return? In an increasingly mass, globalised market for graduates the trends for the average rate of return – as typically reported – may differ markedly from those at the top and bottom ends of the spectrum.

Recently, differentiation has been recorded along a number of dimensions, including the subject and grade of degree, and, potentially, type of university (Webber 2014; Walker and Zhu 2011; Dale and Krueger 2014). Strohush and Wanner (2015), for example, found that although on average a US college education pays, by 2010 there were significant groups who would have been better off not attending college. In a significant number of studies, the differentiations appear to be growing. The evidence also points, moreover, to a (related) increasing pay penalty for over-educated graduates compared with matched graduates (Green and Zhu 2010). The foregoing arguments imply that over-education can be a useful analytical concept, where the phenomenon comprises not only the outcome of a micro-economic matching process but also a macro-economic *disequilibrium*. This is especially the case at a time of rapid growth in the supply of graduate labour. This perspective takes graduate underemployment to be similar, in its macroeconomic and involuntary character, to unemployment. Its analytical value rests neither on an equilibrium view of the labour market, nor on the extent of credence afforded to signalling as a description of the function of higher education (McMahon 2009: 111). Research is now also showing that graduate over-education became more prevalent in Britain between 1992 and 2006, while overall education rose in Germany between 1991 and 1999 (Green 2013: 131). Similar trends for general over-education have been observed for Poland (Kiersztyn 2013) and Sweden (Korpi and Tåhlin 2009). These countries are probably not alone. What might lie behind this growth? There are no studies providing estimates of how much is an optimal amount of graduate mismatch, and how much, therefore, might be too much. The growth of over-education might be taken as an indication that the economy is moving away from its optimum, reflecting a deterioration of the efficiency of its labour market institutions for matching workers to jobs. However, in the absence of other evidence for such a deterioration, a more likely explanation is that the growth reflects an increasing aggregate imbalance between graduate labour and graduate jobs.

Recent studies have also found that, using consistent measures, over-education markedly differs across countries. The OECD's Survey of Adult Skills indicates that the incidence of over-education as reported by workers' reports of their jobs' educational requirements ranges from 13 per cent of the overall workforce in Italy to as much as 31 per cent in Japan (OECD 2013: 171).⁴ Such large cross-national variation might be due to national differences in skills matching institutions (reflecting the characteristics of both the education system and labour market institutions). Some existing studies have implicated labour market rigidities as captured by employment protection regulations or by union density, and education system characteristics such as the general/specialised orientation of higher education. Other work in the context of skills mismatch suggests potential effects from product market regulations, housing market regulations or managerial quality on the individual probability of working in well-matched jobs (McGowan and Andrews 2015).

⁴ In an earlier study using a very different measure the range is even greater, from below 10 to more than 40 per cent (Quintini 2011).

It is also plausible to expect that, where the demands for high-level skills and the supply of graduates have expanded at varying speeds, any supply-demand imbalances that arise will increase the prevalence of over-education; support for this expectation is forthcoming from Verhaest and Van der Velden (2013) and Verhaest et al. (2015), who proxy the imbalance by the standardised stock of graduates relative to expenditure on R&D. A further macroeconomic factor is the state of the business cycle at the time when individuals first enter the labour market, which has been shown to correlate negatively with the incidence of over-education (ibid). However, the existing cross-national evidence on graduate over-education is based almost exclusively on data from alumni who graduated in 1999/2000 and their labour market circumstances five years later in 15 countries. So far, we know very little about the drivers of cross-national variation in over-education in general populations of graduates.

2.2 Over-education and the purpose of higher education

Our argument so far has concluded that it *is* relevant and potentially useful to examine over-education, including its growth and distribution, and its effects on employment outcomes. Yet it is equally important not to translate concern about over-education automatically into an argument against higher education. To do so would be to neglect the wider purposes of education as a preparation for life and as a potentially lifelong process and the public good character of higher education. Rather than the development of specialised professional skills, higher education's contribution to character formation, civic engagement and involvement in knowledge creation through the development of reasoning powers by critical investigation and independent research was traditionally the dominant role of higher education in (western) societies (Altbach et al. 2009). Relatedly, there is robust evidence that higher education is associated with reduced crime rates, lower incarceration costs, lower welfare costs, enhanced health, reduced mortality, reduced calls on social medical expenditures, enhanced social trust, and increased civic participation (McMahon 2009: 201-27; Huang et al. 2009, 2011, 2012; Lochner 2011; Hout 2012; Borgonovi and Burns 2015; Hooghe et al. 2015)⁵; sometimes these external benefits are held to be reflected in others' pay (Moretti 2004). With long lags, higher education is also associated with the development of democracy (McMahon 2009: 202-6), though it may also be associated with violent conflict and arising social demand for democracy if the massification of higher education is not met by appropriate employment opportunities (Campante and Chor 2011). While these associations do not always reflect a causal impact of higher education, collectively they strongly suggest that the over-education debate, both in academic scholarship and public discourse, is too narrowly focused on the employment effects of higher education.

⁵ It is not always possible to distinguish education effects from those of, specifically, higher education.

Typically, the studies of the external benefits of higher education do not examine whether they are mediated by employment or quality of employment. A partial exception is Huang et al. (2011), who find that a 'life experience' indicator, where the class of job is one of several components, does not mediate the impact of college education on social trust. Nevertheless, a question arises as to whether the higher education of graduates who do not subsequently gain graduate jobs contributes external benefits to other members of society. Are crime rates, public health, social trust, participation and other social outcomes still improved? If the external benefits derive from the higher education itself and subsequent non-work life experiences, then the over-educated graduate would contribute no less than the matched graduate. It is even conceivable that graduates in non-graduate jobs would have time to contribute more external benefits, for example through volunteer activities. Conversely, it might be that graduates in non-graduate jobs become disillusioned, lack opportunities for ongoing work-based learning, and come to be quite similar (as regards external contributions to society) to their non-graduate co-workers doing the same jobs as themselves. The resolution of this empirical question, hitherto unexamined, would seem important to the case for ongoing expansion of higher education.

3. Graduate over-education across the OECD: determinants and consequences

Our conclusion so far is that the evidence and arguments presented in studies of over-education do indeed raise concerns about public policies for ever ongoing expansion of higher education. It is suggested that, at least in respect of studying the links between higher education and employment-related outcomes, over-education estimates can be a useful complement to analyses of the rate of return. Moreover, over-education is associated with some individual costs in terms of those employment outcomes, including lower pay and job satisfaction. Our knowledge of these costs across nations at different stages of higher education expansion and economic development is somewhat piecemeal, so a useful addition will be to document these costs across many countries in a consistent manner. We know from previous studies that there may be substantial variation across countries in the prevalence of over-education, but we lack recent estimates of graduate over-education and its employment effects in many countries. We also lack empirical evidence surrounding the relationship of over-education, if any, to non-employment private benefits and to the external benefits of higher education.

Therefore, in this section we use consistent data for 21 countries, available in the OECD's Survey of Adult Skills (SAS), to address the questions:

- Which countries are experiencing high and low levels of over-education among their graduates? To what extent is the over-education linked to skill differences between matched and over-educated graduates?

- Is a high prevalence of over-education associated with substantial excess supply of graduates, or with labour market institutions that might inhibit or improve skills matching?
- Across countries, what are the private penalties among graduates for being over-educated, and what nonetheless are the benefits of graduation, even if over-educated?
- Are there external benefits from higher education, even if graduates find themselves in non-graduate jobs?

3.1 The measurement of over-education

SAS covers a target population of those over 16 but we confine our analysis to those aged 25-65 years old (OECD 2013). By age 25, almost all have completed full-time education, while those working after the age of 65 are in a selective minority. SAS consists of a survey covering job tasks and educational requirements, several key outcomes – including earnings, health and social trust – and many background characteristics. The survey is complemented by proficiency tests of literacy and numeracy (OECD 2012)⁶. From the background survey, we are also able to include an index of ‘elaborate learning’. Elaborate learning is based on work by Kirby et al. (2003). It is conceptualised as personality traits in SAS and captures how employees approach learning in the workplace (OECD 2013). Elaborate learning has been shown to correlate, for example, with informal learning (Ferreira Sequeda et al. 2015). Respondents’ educational attainment is collected using each country’s own codes, then reclassified to the International Standard Classification of Education 1997 (ISCED). We define a ‘graduate’, for the purposes of this paper, as anyone who has achieved at least ISCED level 5A. Respondents’ jobs are coded using the International Standard Classifications of Occupations in its 2008 revision.

To measure the educational requirements of a job, several approaches have been made in the literature. One school of thought prefers to use the ‘realised matches’ approach, coding the education requirement of each occupation according to the modal level, or some close variant. We have argued elsewhere that this method risks tautology when badly implemented, that it is unsuitable to examining change, and that it is particularly inappropriate when comparing educational requirements across nations (Green 2013). It is rarely validated independently. Any method which draws on evidence about the skill requirements of jobs is preferable in principle. In some cases expert methods can be deployed, but these often lack transparency and, again, are ill-suited to cross-national comparisons. The advantage of the task-based data in SAS is that they can be used to derive consistent cross-national indices of skill requirements. In Henseke and Green (2016 forthcoming) we follow this principle

⁶ Problem-solving competences in ‘technology-rich environment’ is also collected, but is not universally available.

to derive an indicator for 'graduate job', based on the evidence of high levels of several skill domains: *information processing* (literacy, numeracy, computer use), *orchestration skills* (communicating, organising own work and work of others) as well as *job autonomy*. These graduate skill requirements are used in a probit model as predictors of the probability that an individual reports that a graduate qualification is required for the job. A latent graduate skills requirement index is thereby calculated for each individual from the probit estimation. In the second stage this index is averaged within each three-digit occupation. Finally, in the third stage a conventional cluster k-medians analysis is deployed to separate all three-digit occupations into two clusters: graduate and non-graduate jobs. The resulting classification, termed ISCO(HE)08, is given in the appendix. It displays a plausible distribution across the major occupation groups, and is found to be a better predictor of wages and other outcomes than traditional classifications (Henseke and Green 2016).

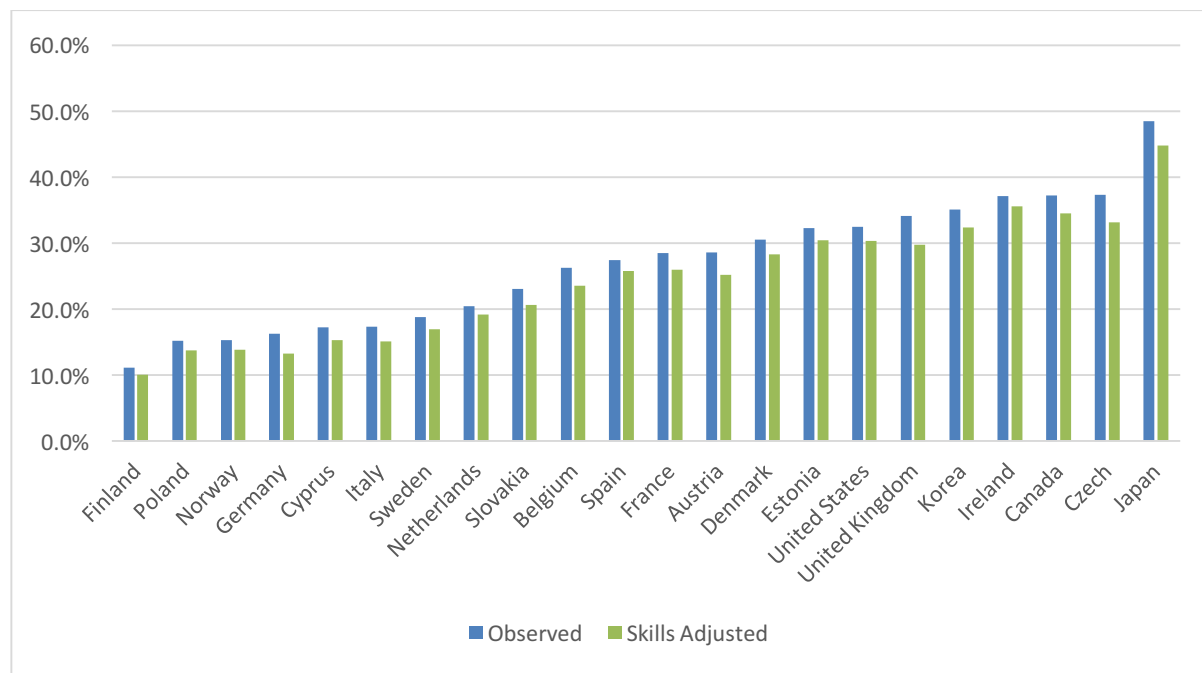
Having classified all jobs as graduate or non-graduate, it is straightforward to define graduate over-education as occurring where a graduate is in a non-graduate job. Some previous studies attempt to go further and sub-divide over-education according to whether it is 'genuine' (or 'real'), or just 'apparent' (or 'formal'), according to whether over-educated people are underutilising their skills. Such studies require independent estimates of skills mismatch which, as noted above, remain a contested area. In this paper, however, while we do examine the role of skills heterogeneity, we focus on over-education in total and its potential links to policy.

3.2 How over-education varies across nations

We now address our first question. Figure 1 shows that there is large cross-national variation in the incidence of graduate over-education: ranging from 11 per cent in Finland to almost 50 per cent in Japan. It is notable that Anglophile countries (UK⁷, USA, Ireland and Canada) are positioned at the upper end of the spectrum. The Nordic countries, with the exception of Denmark, find themselves at the opposite end of the spectrum. However, no simple conventional classification of countries fits the variation overall. Other countries' labour markets that have also apparently absorbed HE graduates well include Poland (15 per cent), Germany (16 per cent), Cyprus (17 per cent) and Italy (17 per cent), while at 38 per cent over-education appears more problematic in the Czech Republic.

⁷ In SAS, the UK comprised England and Northern Ireland only, since Wales and Scotland were not sampled.

Figure 1 Proportion of over-educated graduates, observed and skills adjusted



Base: Employed graduates from higher education aged 25-65 years.

Table 1. Over-education among graduates and the role of skills heterogeneity

CNTRY	(1) % Over- educated	(2) Numeracy	(3) Literacy	(4) Elaborate Learning	(5) % Over- educated (adjusted)
Austria	28.6%	-0.00295***	-0.00307***	-0.0213	25.2%
Belgium	26.3%	-0.00101*	-0.000900	-0.0523***	23.6%
Canada	37.2%	-0.00199***	-0.00244***	-0.0401***	34.5%
Cyprus	17.3%	-0.00125*	-0.00114*	-0.0184	15.3%
Czech	37.3%	-0.00106#	-0.000615	-0.0211	33.2%
Denmark	30.5%	-0.00192***	-0.00226***	-0.0545***	28.3%
Estonia	32.3%	-0.00166***	-0.00214***	-0.0500***	30.4%
Finland	11.1%	-0.00135**	-0.00103*	-0.00994	10.1%
France	28.5%	-0.00180***	-0.00152***	-0.0442***	26.0%
Germany	16.3%	-0.00257	-0.00304**	-0.0114	13.3%
Ireland	37.1%	-0.000520	-0.000976	0.00648	35.6%
Italy	17.4%	-0.00121***	-0.00105**	-0.0276*	15.1%
Japan	48.5%	-0.00206***	-0.00109#	-0.0214#	44.8%
Korea	35.1%	-0.00193***	-0.00265***	-0.0489**	32.4%
Netherlands	20.5%	-0.00129**	-0.00172***	-0.0366***	19.2%
Norway	15.3%	-0.00109**	-0.00121**	-0.00488	13.9%
Poland	15.2%	-0.000929**	-0.000864*	-0.0423***	13.8%
Slovakia	23.1%	-0.000849#	-0.000384	-0.0223#	20.6%

Spain	27.4%	-0.00110 [*]	-0.00120 [*]	-0.0118	25.8%
Sweden	18.8%	-0.00215 ^{***}	-0.00175 ^{***}	-0.0257 [#]	17.0%
England/N.Irl	34.1%	-0.00255 ^{***}	-0.00290 ^{***}	-0.0369 ^{**}	29.8%
USA	32.5%	-0.00240 ^{***}	-0.00214 ^{***}	-0.0237 [#]	30.3%

Note: Column (1) states the proportion of over-educated graduates. Columns (2), (3) and (4) summarise the marginal effects of cognitive and non-cognitive skills on the individual probability of over-education in a sample of employed graduates aged 25-65 years. The marginal effects are calculated from probit estimations of the graduate job indicator on a set of control variables (age group, dependent children dummy and a cohabitation dummy, all fully interacted with a gender dummy) all interacted with the skill variable relevant for each column. The adjusted proportions of over-educated graduates in column (5) were predicted from coefficients of a logit regressions including the controls and all the skill domains jointly, assuming mismatched graduates were endowed with the average skill levels of matched graduates. [#] p<0.1 * p<0.05 ** p<0.01 *** p<0.001

Graduate over-education, as noted earlier, is sometimes cast without evidence as entirely a symptom of skills heterogeneity, implying that only less capable graduates become sorted into less skills-demanding jobs. In the same vein, policy initiatives to reduce over-education tend to focus only on an assumed lack of employability skills among graduates (e.g. European Commission 2015: 68). We consider in Table 1 how much the varying incidence of graduate over-education can be accounted for in terms of skill heterogeneity, using the information on literacy and numeracy skills as well as the elaborate learning trait.

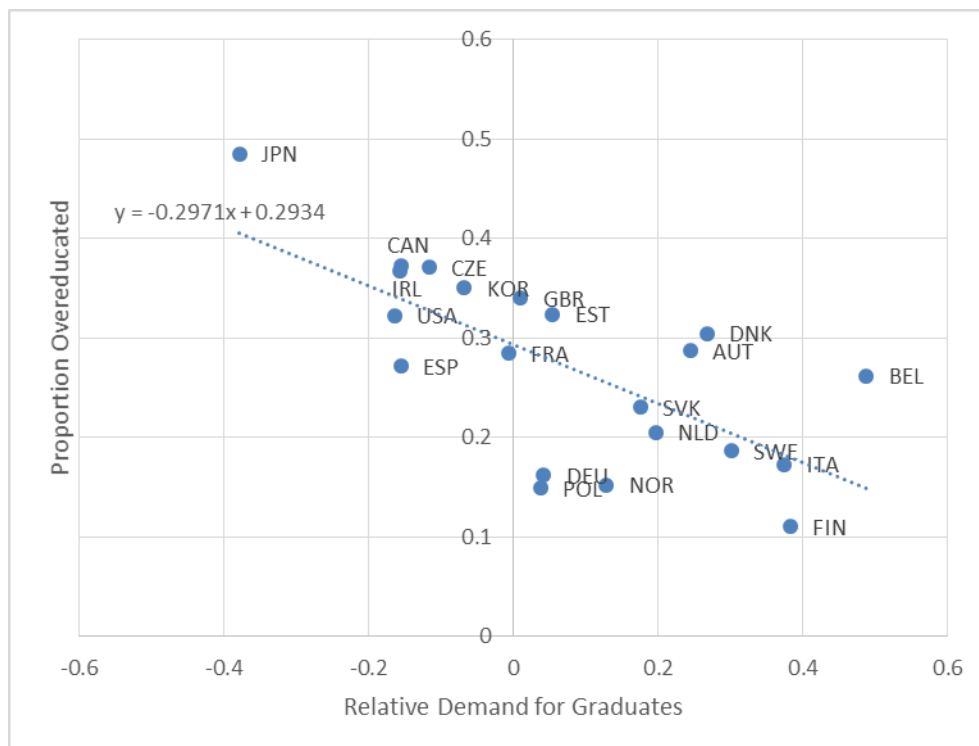
Column (1) reports the observed incidence of over-education, as shown in Figure 1. Columns (2) to (4), respectively, show the marginal effects of numeracy, literacy and elaborate learning skills on the individual propensity to work in a non-graduate job. Firstly, in every country, except for Ireland, at least one skill domain correlates significantly with the likelihood of over-education. The point estimates of cognitive skills are largest in Austria, Germany (though the coefficient of numeracy is insignificant in the latter) and Britain. Sweden, Denmark, the US, Canada and Korea also have relative large effects of cognitive skills on the propensity of mismatch. Ireland, Slovakia, Czech, Poland, Belgium, Italy and Spain are on the other end of the spectrum – suggesting that over-education is more often ‘genuine’ in these countries. The pattern is different for elaborate learning skills, where the scale was statistically associated with the likelihood of over-education in only 10 out of the 22 countries. Estimated effects were largest in France, Korea, Estonia, Belgium and Denmark.

Finally, column (5) reports a simple accounting decomposition exercise. It shows the counterfactual proportion of over-education in each country if mismatched graduates had the same skill level as the average matched graduate. Results are from within-country estimations of the over-education indicator on all the skill domains and demographic controls. Comparing columns (1) and (5), it can be seen that, though the incidence of over-education would be reduced, the differences between observed and counterfactual incidence of over-education are quite small for most countries. The comparison is also illustrated in Figure 1, which shows the skills-adjusted bars alongside the frequency bars. In 14 out of 22 countries, adjusting for skills reduces the predicted incidence of over-education by less than 10 per cent. The relative drop in over-education after accounting for skills heterogeneity was

largest in Germany, Italy and the UK, perhaps reflecting greater heterogeneity in these HE systems. Nevertheless, skill differences not only fail to account for a substantial fraction of over-education within countries, they also make little difference to the range of variation across countries.

We assess next the case that variations in the aggregate excess supply of graduates, relative to the number of graduate jobs, may lie behind the cross-national variation. Figure 2 plots the relative demand for graduates, i.e. the number of graduate jobs in the labour force (without current vacancies) over the supply of graduates, against the proportion of mismatched graduates for 21 OECD countries. In the majority of countries the relative demand is positive, with more graduate jobs than there are graduates. The exceptions are Japan, Ireland, Canada, USA, Spain, Czech Republic and Korea. The plot shows a strong negative relationship: countries with a low relative demand for graduates have higher proportions of underemployed graduates. The regression line indicates that a 10 percentage increase in relative demand for graduates is associated with a relative drop in graduate over-education by three percentage points.

Figure 2: Over-education and the relative demand for graduates



Of course, the simple correlation between relative demand and over-education, while statistically significant and quantitatively large, could be a reflection of other correlated factors or of aggregation at the country level. Other factors would seem to be relevant, not least because not every country is situated close to the regression line on Figure 2. Germany, Poland and Norway form a cluster with unusual low proportions of over-education given the relative demand, while Denmark and Austria

have higher proportions of underemployed graduates than suggested by the relative demand.

The main potential theoretical candidate for other factors to explain the variations is skills matching efficiencies. Following earlier studies, to capture matching efficiency we use two possible indicators: the strictness of Employment Protection Legislation (EPL) for people in permanent jobs and coverage of union wage bargaining agreements. Table 2 reports the results of simple regressions of three determinants of the log of over-education across countries: relative demand EPL and wage bargaining coverage. Each measure by itself is negatively associated with the proportion of over-education. Column (1) shows the negative effect of relative demand illustrated already in Figure 2. But also countries with higher EPL or higher wage bargaining coverage have lower proportions of graduate over-education (columns 2 and 3). Both variables explain a similar fraction of the variation in graduate over-education across countries. However, if we combine all variables only the measure of relative demand emerges as a significant predictor of over-education (column 4). Compared to the bivariate regression, the point estimate is slightly reduced to -0.9. But conditional on relative demand there is no evidence that either EPL or union power correlates with level of over-education among graduates in these countries. This finding also holds when either EPL or union power are entered separately with relative demand into the regression and neither changes when we swap the observed proportion of over-education with residual over-education after adjusting for skills and demography. Differences in search frictions do not account for variations in graduate over-education, which corroborates previous cross-national studies (Verhaest 2013; Verhaest et al. 2015).

Table 2: Country differences in the propensity of graduate over-education

	(1) Log(over- educated)	(2) Log(over-educated)	(3) Log(over-educated)	(4) Log(over-educated)
Relative Demand	-1.099* (0.305)			-0.942 [#] (0.454)
EPL		-0.271* (0.110)		-0.147 (0.115)
Union Coverage			-0.00617* (0.00247)	0.000473 (0.00339)
<i>N</i>	21	21	21	21
<i>R</i> ²	0.407	0.241	0.247	0.460
adj. <i>R</i> ²	0.375	0.201	0.207	0.365

OLS regression of the proportion of over-educated graduates at country level on the relative demand for graduates, EPL, and Union Coverage. EPL for workers on permanent positions is taken from the OECD. Figures on Union Coverage of wage bargaining are from the most recent issue of the Visser database (Visser, 2015). List of countries: AUT, BEL, CAN, CZE, CZE DEN, EST, FIN, FRA, DEU, IRL, ITA, JPN, KOR, NLD, NOR, POL, SVK, ESP, SWE, GBR, USA. Standard errors in parentheses [#] $p < .1$, * $p < .05$, ** $p < 0.01$, *** $p < 0.001$

3.3 The private and social effects of graduate over-education

Higher education is held to increase individuals' chances of access to better paid jobs, to improve healthiness and to generate external benefits for society. We now use the SAS data to address our third and fourth policy-related research questions. We provide consistent estimates across 21 countries of the pay and non-pay penalties for graduates of being over-educated, and simultaneously the benefits from being a graduate for those working in non-graduate jobs. The estimates do not establish causal processes, since, as is well-known, both education and over-education status are potentially endogenous, introducing potential biases. Comparisons between countries are nevertheless made, on the assumption that the sources of endogeneity and bias are similar across countries and that therefore the differences in the estimates are informative. We also present consistent estimates, for the first time in any country, of the effects of higher education on three indicators of external benefit: social trust, civic participation and political efficacy.⁸

Table 3 summarises the relative differences between matched and mismatched graduates (MG vs. MiG) and the relative differences between mismatched graduates and matched non-graduates (MiG vs. MnG) with respect to earnings, job satisfaction, self-reported health, social trust, civic participation and political efficacy.

In every country for which we have pay information, matched graduates have a significantly higher probability of working in high paid jobs (Table 3, column 2, MG vs. MiG) and a lower risk of working in low paid jobs, as compared with mismatched non-graduates (column 1). The effects are large. In Cyprus, for example, the 'penalty' associated with being over-educated is that the probability of being in the top two earnings quintiles is lower by 35 log points (41 per cent). This finding generalises to all examined countries a common conclusion from previous single-country studies. The penalty turns out to be lowest in Korea and greatest in Finland.

Comparing the earnings of mismatched graduates to those of matched non-graduates (MiG vs. MnG), provides a more mixed picture. On the basis of previous literature, there is expected to be a pay advantage for graduates over non-graduates, even in non-graduate jobs. In part such a difference is attributable to the inevitable within-group skill heterogeneity in a simple graduate/non-graduate dichotomy.⁹ The advantage is confirmed for the majority of countries: it mostly does pay to be a graduate, even if you are not in a graduate job. In the US, for example, among those doing non-graduate jobs, graduates' chances of being in the lowest two earnings quintiles are lower than those of non-graduates by 15 log points (16 per

⁸ Each of these three can also be construed as having some private benefit.

⁹ We excluded from all these estimates any controls for skill differences between groups, since those differences between graduates and non-graduates are endogenous, being in part attributable to the higher education. Nevertheless, as a robustness check in separate runs we included skills controls. This made little or no difference to the estimates of over-education penalties, but as expected lowered somewhat the estimates of the MiG vs. MnG gaps.

cent). Yet there are exceptions: for graduates in non-graduate jobs in Cyprus, Finland, Germany and Italy there is no evidence that higher education delivers any pay advantages above secondary or professional tertiary education.

Previous single-country studies typically have found that there is greater job satisfaction among well-matched workers than mismatched workers. We can again confirm this finding for graduates across most of the PIAAC countries: in 17 out of 22 countries, matched graduates report significantly less dissatisfaction with their current job than over-educated graduates. In the remaining countries the difference is either not, or only weakly, statistically significant. In contrast, differences between graduates and non-graduates within non-graduate jobs are scarce, with the exception that with non-graduate jobs in Austria, Denmark and Britain there are significantly higher levels of dissatisfaction among over-educated graduates than among non-graduates.

Table 3: Differences in earnings, job satisfaction and social capital by educational attainment and over-education status

		(1)	(2)	(3)	(4)	(5)	(6)	(7)
		Pr(low earnings)	Pr(high earnings)	Pr (unsatisfied with current job)	Health	Social Trust	Civic Participation	Political Efficacy
AUT	MG vs MiG	--	--	-0.0911*	--	0.183	-0.0300	0.0613
	MiG vs MnG	--	--	0.0738*	--	0.970***	0.0560	0.142**
BEL	MG vs MiG	-0.0937*	0.154***	-0.0473	0.00688	0.0631	0.0613	0.00567
	MiG vs MnG	-0.172***	0.263***	0.0378	0.335***	1.092***	0.0820#	0.262***
CAN	MG vs MiG	--	--	-0.0840***	0.196***	0.403***	0.0839***	0.0206
	MiG vs MnG	--	--	0.0240	0.0949*	0.488***	0.110***	0.140***
CYP	MG vs MiG	-0.237***	0.347***	-0.150**	0.318**	0.380**	0.0773#	0.0239
	MiG vs MnG	-0.0786	0.0898#	0.0903#	-0.0406	0.0128	0.113**	0.0249
CZE	MG vs MiG	-0.122*	0.235***	-0.0910*	0.161	0.268	0.0976*	0.0672
	MiG vs MnG	-0.148**	0.146**	-0.00378	0.307*	0.656***	0.0297	0.175**
DNK	MG vs MiG	-0.204***	0.273***	-0.0932***	0.0907	0.514***	0.0170	0.0416
	MiG vs MnG	-0.0369	0.124***	0.0842**	0.122	0.694***	0.0328	0.0254
EST	MG vs MiG	-0.192***	0.209***	-0.130***	0.109#	0.355***	0.0823**	0.135***
	MiG vs MnG	-0.0993**	0.113***	0.0258	0.294***	0.540***	0.104***	0.106***
FIN	MG vs MiG	-0.363***	0.397***	-0.0738*	0.353**	0.627**	0.0217	0.114**
	MiG vs MnG	-0.0368	0.0468	0.0429	0.103	0.439*	0.0989#	0.0842*
FRA	MG vs MiG	-0.278***	0.367***	-0.0740**	0.208**	0.471***	0.0115	0.00697
	MiG vs MnG	-0.0764**	0.124***	0.0268	0.0579	0.895***	0.0985**	0.119***

DEU	MG vs MiG	-0.271***	0.372***	-0.0871#	0.198 [#]	0.604**	0.0540	0.0336
	MiG vs MnG	0.0107	0.0253	0.0677	0.146	0.529**	0.0859	0.174**
IRL	MG vs MiG	-0.185***	0.302***	-0.131***	0.184 [#]	0.375*	0.0657#	0.0834*
	MiG vs MnG	-0.228***	0.242***	0.0435	0.129	0.499***	0.0369	0.103**
ITA	MG vs MiG	-0.280***	0.257***	-0.121*	0.0397	0.266	0.0345	-0.0319
	MiG vs MnG	0.00615	0.0768	0.0825	0.0827	0.436	0.0759	0.170**
JPN	MG vs MiG	-0.164***	0.295***	-0.106***	-0.001	0.104	-0.00958	0.0283
	MiG vs MnG	-0.108***	0.108***	-0.00836	0.120 [^]	0.565***	0.0618*	0.161***
KOR	MG vs MiG	-0.113***	0.127***	-0.169***	0.206 ^{^^}	0.116	0.0324	0.0344
	MiG vs MnG	-0.127***	0.189***	-0.0456	0.0428	0.367***	0.126***	0.0714*
NLD	MG vs MiG	-0.297***	0.311***	-0.0636**	0.327 ^{^^^}	0.290*	0.0624	0.112**
	MiG vs MnG	0.0207	0.0991**	0.0464#	-0.0204	0.867***	0.0349	0.0684#
NOR	MG vs MiG	-0.315***	0.294***	-0.0490#	0.004	0.673***	0.0282	0.142***
	MiG vs MnG	-0.0596	0.0795#	0.0356	0.278 ^{^^}	0.839***	0.0284	0.0811#
POL	MG vs MiG	-0.235***	0.290***	-0.0537	0.234 [^]	0.422**	0.0991*	0.0654
	MiG vs MnG	-0.153**	0.172***	-0.0465	0.187 [^]	0.338*	0.106*	0.189***
SVK	MG vs MiG	-0.0910*	0.150**	-0.0472	0.0166	0.256#	0.0404	0.0125
	MiG vs MnG	-0.214***	0.244***	-0.0650#	0.400 ^{^^^}	0.266*	0.135**	0.186***
ESP	MG vs MiG	-0.136***	0.252***	-0.0910**	-0.004	0.913***	0.105***	0.0757#
	MiG vs MnG	-0.138***	0.162***	0.0363	0.0885	0.0501	-0.00268	0.0106
SWE	MG vs MiG	-0.340***	0.312***	-0.0784*	0.196 [#]	0.543**	-0.0406	0.0165
	MiG vs MnG	-0.0414	0.101**	0.0552#	-0.0171	0.615***	0.0850*	0.126**
GBR	MG vs MnG	-0.259***	0.343***	-0.0828*	0.102	0.382**	0.0963**	0.0369
	MiG vs MnG	-0.0375	0.104**	0.0724*	0.218 ^{^^}	0.537***	0.122***	0.153***
USA	MG vs MnG	-0.179***	0.305***	-0.128***	0.206 [^]	0.549***	0.0216	0.0477
	MiG vs MnG	-0.149***	0.157***	0.0385	0.409 ^{^^^}	0.513***	0.210***	0.145***

Note: Estimation sample of employed adult population in age-group 25-65 with at least lower secondary levels of education. Outcomes are: (1) annual earnings in bottom two income quintiles, (2) annual earnings in the top two income quintiles, (3) not satisfied or extremely satisfied with current job, (4) self-assessed health in five categories, (5) sum score over two four-level Likert items on the general trustworthiness of people, (6) at least some volunteer work in the last 12m, (7) binary item that distinguishes between respondent who agree to the statement 'People like me don't have any say about what the government does' vs. those that disagree. Table displays the estimated marginal effects after either OLS (column 4), probit (columns 1, 2, 3, 6 and 7) or on the linear index after ordered probit (column 4). Estimations including controls (age-groups, cohabitation status, and dependent children dummy, all fully interacted with a gender dummy). Mismatched (underqualified) non-graduates were included in the regressions, but their coefficients are omitted for brevity. [#] $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

A further private benefit of higher education, though with additional external benefits, is health, which is captured in SAS by a categorical self-assessment of general health (column 4). This indicator of latent health has been shown to predict the onset of morbidities and future health care utilisation (Doiron et al. 2015).¹⁰ Health as a facet of individual productive capacity has been found to affect labour supply and occupational choice and may thus be inversely related with both educational attainment and labour market positioning (Jones et al. 2010; Korpi and Tåhlin 2009). If graduates in poor health sort into (less demanding) non-graduate jobs, we might expect a downward bias on the differences between mismatched graduates and matched non-graduates, while the difference between matched and mismatched graduates would be exaggerated. In general, in most but not every country (exceptions are Denmark, Germany, Ireland, Italy, Spain and Sweden), we find significant health differences between the types of labour. The differences between mismatched graduates and matched non-graduates are largest in the US, Slovakia, Belgium (Flanders) and the Czech Republic. Health differences between matched and mismatched graduates are largest in Finland, Netherlands and Cyprus. We now extend these analyses of private benefits explicitly to potential external benefits. If higher education has notable external benefits, even for those that are mismatched in employment, the case for the policy of higher education expansion is strengthened.

Looking first at generalised social trust (column 5), we find that mismatched graduates report higher social trust levels than matched non-graduates in 20 out of 22 countries. In Canada, for example, the effect of higher education raises social trust by 0.49, which is 25.5 per cent of the standard deviation. The largest effect is in Belgium, the least in Cyprus. It can be seen also that matched graduates had even higher values of social trust than mismatched graduates in most countries (15 out of 22). However, the social trust gap between matched graduates and mismatched graduates in most of the countries was quantitatively less important than the differences between mismatched graduates and matched non-graduates.

Civic participation measures whether the respondent has worked voluntarily for a non-profit organisation in the 12 months preceding the survey. In 12 countries graduates were more likely to volunteer than non-graduates (column 6). In addition, in six countries we find statistically significant differences among graduates by mismatch status (Canada, Czech, Estonia, Poland, Spain and Britain), with matched graduates were more likely to volunteer than mismatched graduates.

Finally, we observe statistically significant advantages for graduates in perceiving high levels of political efficacy in 19 of the 22 countries (column 7). For example, graduates in France, whether or not they are in a graduate job, are 10 percentage

¹⁰ We are aware of the potential measurement errors in the variables due to shifts in reference points across socio-economic groups and across countries. However, we are not attempting to deal with this issue here.

points more likely than matched non-graduates to exhibit a high level of political efficacy. In only five cases does it make a significant difference to graduates' political efficacy to be doing a graduate job. In Germany, for example, the estimated coefficient is just three log points and insignificantly different from zero.

4. Conclusion: consequences for policy on higher education

While some academic writers have worried about over-education for some time, in the wake of the 2008 economic crisis the media, serving an aspiring middle class, now frequently raises concerns about graduate job prospects, and questions the value of going to university. Official concern among policymakers remains relatively rare or is manifested obliquely in the concern for 'employability skills', not least because for most countries policy is oriented towards a continued expansion of university education. The pejorative aspect of the term 'over-education' no doubt generates potential embarrassment for governments that are committed to a skills-based strategy for economic growth.

Against this backdrop we have in this paper drawn on theory and evidence pertaining to 21 OECD countries (and Cyprus), in an attempt to find evidence-based answers to the broad policy question that animates this paper: should governments worry about over-education? We find that there is a legitimate concern with over-education, and do not subscribe to other economists' or government policymakers' sanguine view that it is sufficient to monitor the average rate of return to higher education. We have argued the importance of taking over-education or underemployment seriously, treating it as a macro-economic disequilibrium phenomenon that may be especially prominent in and following an era of higher education massification. We have then contributed to the literature by deploying a new skills-based indicator of graduate jobs to study graduate over-education and its effects consistently across 22 countries, all but one of which have greatly increased their stocks of higher-educated labour in recent years.

There are some potentially serious limitations to these analyses, principally that we have not attempted to address the potential endogeneity of higher education and over-education status, not least because to do so consistently over such a range of countries raises major practical difficulties. Nevertheless, we hold that the estimates, even when not adjusted for endogeneity, can have predictive value and are at least suggestive that a causal influence lies behind them, deriving ultimately from the proposition that a person's productivity is affected by the job they are in as much as by their own skills, and that graduates have a comparative advantage in graduate jobs. There could also be some remaining skills gaps, not registered by SAS, between matched and over-educated graduates.

Our key findings are threefold:

- Over-education matters a lot for individuals' pay in every country, and for another employment-related outcome (job satisfaction) in most. In all but two countries examined, there is a positive pay benefit for being a graduate even in a non-graduate job compared to non-graduates in the same jobs. In only some countries is there also a broader health benefit for the over-educated graduate.
- The prevalence of over-education varies substantially between countries. The single factor to account for this variation is the aggregate relative high skills demand – the aggregate proportion of graduate jobs relative to graduate labour supply. Beyond that, there is little evidence that the cross-country variation arises from differences in labour market skills matching institutions, or from the relative proficiencies of matched and mismatched graduates. One might agree for other reasons with OECD policy recommendations, that governments should aim to improve their information, advice and guidance services, while also invoking policies to raise the skills of the weaker graduates, and improve systems for recognising foreign qualifications (Quintini 2011a); however, our evidence does not give much confidence that these could make much of a difference in the aggregate.
- Notwithstanding the above, our evidence both confirms previous studies that have shown social returns to higher education to be greater than private returns, and finds that higher education delivers external benefits *even for those that become over-educated*, though in some countries rather less than for those who are matched to graduate jobs.

These findings suggest broad policy directions, rather than specific recommendations surrounding higher education regulation or funding mechanisms. One can advocate that concerned governments should monitor graduate jobs, and by extension graduate over-education, to help provide information (as a public good) about higher education prospects. Such information should help to illuminate both the present and the future prospects for the return on higher education investment. Where possible more detailed information can also be provided, surrounding levels and subjects of study.

One focus of concern should be the aggregate imbalance between the stocks of graduates and of graduate jobs. With governments neither willing nor in all probability able to curtail the growth of higher education participation (Marginson 2016), intervention policies can be targeted also on the demand side of the labour market, through policy approaches that can alter the levels of demand for highly-educated workers. If governments were able to progress beyond a now traditional

neoliberal stance, they could include technology and industrial policies as part of the potential armoury of interventions.

While the above is not always feasible, it should be possible for governments also to re-orient the emphases surrounding the purposes of higher education, focusing higher education towards broader educational objectives, and accepting that higher education has considerable value independent of resulting employment prospects. This conclusion questions the central prominence given to employability policies, while recognising that such policies can be important components of policies for social inclusion. Governments might also re-visit the advisability of their subject-based priorities. Typically the emphasis on STEM subjects, for example, has been premised on estimates of private rates of return, coupled with evidence from industry about the importance of scientific innovation. It is not clear, however, whether the subjects would differ in the same way in respect of their social rates of return, there being scarce research to go on. In short, concern about growing over-education and graduate employment prospects should be counterbalanced by renewed commitment to, and research about, the purposes and non-production benefits of higher education, and a contestation of the widespread tendency to orient education and training narrowly and exclusively to the purposes of employment.

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Appendix: list of graduate jobs

This appendix lists occupation minor groups which are, at least in some countries, classified as graduate jobs.

Table A.1: Graduate jobs in major groups 1-5 (=1 graduate job, =0 non-graduate job)

ISCO 2008 Minor Groups	AT	BE	CA	CY	CZ	DE	DK	EE	ES	FI	FR	IR	IT	JP	KO	NL	NO	PL	SE	SK	UK	US
111 Legislators and senior officials	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1
112 Managing directors and chief executives	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
121 Business services and administration managers	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
122 Sales, marketing and development managers	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
131 Production managers in agriculture, forestry and fisheries	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1
132 Manufacturing, mining, construction, and distribution managers	0	1	0	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1
133 Information and communications technology service managers	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
134 Professional services managers	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
141 Hotel and restaurant managers	0	1	0	1	0	0	0	0	0	1	0	0	1	1	0	0	0	1	1	1	0	0
142 Retail and wholesale trade managers	0	1	0	1	0	0	1	0	0	1	1	0	1	1	1	0	0	1	0	1	0	0
143 Other services managers	0	1	0	1	1	0	1	1	1	1	1	0	1	1	1	1	0	1	0	1	1	1
211 Physical and earth science professionals	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
212 Mathematicians, actuaries and statisticians	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
213 Life science professionals	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
214 Engineering professionals (excluding electrotechnology)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
215 Electrotechnology engineers	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
216 Architects, planners, surveyors and designers	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
221 Medical doctors	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
222 Nursing and midwifery professionals	1	0	1	1	0	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	0
223 Traditional and complementary medicine professionals	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

224 Paramedical practitioners	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1
225 Veterinarians	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
226 Other health professionals	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
231 University and higher education teachers	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
232 Vocational education teachers	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1
233 Secondary education teachers	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
234 Primary school and early childhood teachers	0	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
235 Other teaching professionals	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
241 Finance professionals	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
242 Administration professionals	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
243 Sales, marketing and public relations professionals	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
251 Software and applications developers and analysts	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
252 Database and network professionals	0	1	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1
261 Legal professionals	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
262 Librarians, archivists and curators	1	0	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1
263 Social and religious professionals	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1
264 Authors, journalists and linguists	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
265 Creative and performing artists	0	0	0	1	0	1	1	0	0	1	1	0	0	0	1	0	0	0	1	0	1	0
311 Physical and engineering science technicians	0	1	0	1	0	0	0	1	0	1	0	0	0	1	1	1	1	1	1	1	0	0
312 Mining, manufacturing and construction supervisors	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	1	1	0	1	1	0
313 Process control technicians	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1	0
314 Life science technicians and related associate professionals	0	0	1	1	0	0	1	0	1	1	1	0	0	1	0	1	1	1	1	0	1	1
315 Ship and aircraft controllers and technicians	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	1	1	0	1	0
321 Medical and pharmaceutical technicians	0	0	0	1	0	0	0	0	0	1	0	1	1	0	0	1	1	0	1	0	0	0
322 Nursing and midwifery associate professionals	0	0	0	1	0	0	0	0	0	1	1	0	1	0	0	0	1	1	1	0	1	0
323 Traditional and complementary medicine associate professionals	0	0	0	1	0	0	0	0	0	1	0	0	1	0	0	0	1	1	1	0	1	0

324 Veterinary technicians and assistants	0	0	0	1	0	0	0	0	0	1	0	0	1	0	0	0	1	1	1	0	0	0
325 Other health associate professionals	0	0	0	1	1	0	0	0	0	1	0	0	1	0	0	0	1	1	1	0	1	0
331 Financial and mathematical associate professionals	0	1	0	1	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	0	1	0
332 Sales and purchasing agents and brokers	0	1	0	0	0	0	0	0	1	1	0	0	1	0	0	1	0	1	0	0	0	0
333 Business services agents	0	0	0	1	0	1	0	0	0	1	1	0	1	0	1	1	1	1	0	1	0	0
334 Administrative and specialised secretaries	0	0	0	1	0	1	1	0	1	1	0	0	1	0	1	0	0	1	0	1	0	1
335 Regulatory government associate professionals	0	0	0	1	0	1	0	0	1	1	0	0	0	1	1	1	1	1	1	1	1	1
341 Legal, social and religious associate professionals	0	0	0	1	0	0	0	0	1	1	0	0	1	1	1	0	1	1	1	0	0	0
342 Sports and fitness workers	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
343 Artistic, cultural and culinary associate professionals	0	0	0	1	0	0	0	0	1	0	0	0	1	0	0	0	1	1	0	0	0	0
351 Information and communications technology operations and user support technicians	0	1	0	1	1	0	0	0	1	1	1	1	1	1	1	0	0	1	0	1	0	0
352 Telecommunications and broadcasting technicians	0	1	0	1	0	0	1	0	1	1	0	1	0	0	0	0	0	1	0	1	0	0
411 General office clerks	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1	0	0	0	0
412 Secretaries (general)	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0
413 Keyboard operators	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0
421 Tellers, money collectors and related clerks	0	0	0	1	0	0	0	0	0	1	0	0	1	0	1	0	0	1	0	0	0	0
422 Client information workers	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
431 Numerical clerks	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0
432 Material-recording and transport clerks	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
441 Other clerical support workers	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0
511 Travel Attendants, Conductors and Guides	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0
512 Cooks	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
513 Waiters and Bartenders	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
514 Hairdressers, Beauticians and Related Workers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
515 Building and Housekeeping Supervisors	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
516 Other Personal Services Workers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0

521 Street and Market Salespersons	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
522 Shop Salespersons	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
523 Cashiers and Ticket Clerks	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
524 Other Sales Workers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
531 Child Care Workers and Teachers' Aides	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
532 Personal Care Workers in Health Services	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
541 Protective Services Workers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0

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