



Growth in within graduate wage inequality: The role of subjects, cognitive skill dispersion and occupational concentration



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HIGHLIGHTS

- The growth in graduate wage inequality has occurred mostly within degree subjects.
- This is related to an increased variance in ability of students within subjects.
- It is also related to a wider range of jobs entered by graduates from each subject.
- The first effect is more strongly associated with increased wage inequality.
- Wider ability variance is due to increased participation of lower ability students.

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ABSTRACT

Increasing participation in Higher Education, and the rising number of graduates in the labour markets of most developed countries, are likely to alter graduate wage distributions. Increasing wage inequality amongst graduates has been observed in a number of countries. This paper takes as an example the UK, where the increase in inequality has been amongst the highest, to investigate any potential link between these two phenomena of participation and inequality. Dividing graduates by subject of degree to provide more variation, we show that most of the increase in graduate wage inequality has occurred within subjects. We investigate two potential explanations, specifically the increase in the variance of childhood cognitive test scores amongst graduates in the same subject, and the widening variety of jobs performed by graduates with degrees in the same subject. The paper shows that both of these factors have played a role in explaining growing graduate wage inequality within subjects, though the largest is by far from the increased variance of test scores. The results also show that mean test scores are falling over time within every subject to a greater or lesser extent, suggesting that the widening variance of test scores is due to universities accepting individuals from lower in the ability distribution, as Higher Education participation has expanded.

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1. Introduction

The wage inequality literature in Economics has typically focussed on wage differentials *between* education groups, often between college graduates and non-graduates. The literature revealed a growth in such differentials in the 1980s and early 1990s, since when they have been largely flat, despite large increases in Higher Education (HE) participation (see, for example, Elias and Purcell, 2004; McIntosh, 2006; O'Leary and Sloane, 2005; Walker and Zhu, 2008 in the UK, and Card and Lemieux, 2001; Katz and Murphy, 1992; Topel, 1997 in the US).

However, simple focus on average differences between groups can miss some of the overall change in inequality. Wages also vary *within*

education categories, and it has been argued that much of the overall increase in wage inequality has been due to an increase in this residual inequality within education groups, for example by Juhn et al. (1993) and Katz (1999) in the US or Gosling et al. (2000) in the UK. This paper therefore analyses within-group wage inequality, in particular focussing on the graduate group given that they are the fastest growing educational grouping and so of particular interest. Lemieux (2006) also shows that, of all the education levels in the US, within-group wage inequality has risen the fastest for graduates (Table 1). The context of the current paper is the UK, which is a particularly interesting country for which to investigate this issue, given both the relatively large rise in wage inequality generally (see OECD, 2013), and also the fast increase in Higher Education participation, faster than most OECD countries with the exception of the Eastern European newer entrants to the OECD (see OECD, 2014).

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Table 1
Trends in the variance of graduate log earnings, 1994–2011.

| | 1994 | 2000 | 2005 | 2011 | 2011–1994 |
|------------------------------------|-------|-------|-------|-------|-----------|
| Overall variance (graduates) | 0.197 | 0.234 | 0.238 | 0.241 | 0.044 |
| Between subjects | 0.011 | 0.014 | 0.015 | 0.013 | 0.002 |
| Within subjects | 0.186 | 0.220 | 0.223 | 0.228 | 0.042 |
| Overall variance (full population) | 0.229 | 0.245 | 0.240 | 0.260 | 0.031 |

Notes: Source is the 1994–2011 Labour Force Surveys. Log weekly wages are deflated using the Retail Price Index and are bottom coded. These are for full time employees age 23 to 45.

In addition to documenting the growing wage inequality within this group, the original contribution of the paper will be to investigate *why* such wage inequality has grown. We will first show that most of the increase in graduate wage inequality has occurred within degree subjects, rather than between. This is the first paper in the literature, as far as we are aware, to consider changes in within-subject wage inequality. We then explore two possible explanations for this growing within-subject inequality, both linked to the expansion of the HE sector. Thus the fact that more individuals are now accepted onto degree courses may have altered selection onto different degree courses, whilst selection into occupations after graduating from a given subject may also be affected by the larger numbers graduating. Our results suggest that changing selection into subjects explains much of the growth in within-subject wage inequality, and hence also much of the growth in overall within-graduate wage inequality.

Subject of degree is therefore a key unit of observation in our analysis. Degree subject is a useful dimension along which to disaggregate graduates. Degree subject can determine both entry conditions into university and the occupational area after graduation, and thus is directly relevant to the two potential explanations of widening inequality mentioned above.¹ Students in the UK will typically go to university immediately after upper secondary education, at age 18. Entry to Higher Education is mostly determined by attainment in the examinations (Advanced Level qualifications, or 'A levels') taken at the end of the upper secondary education. Most students apply to the universities of their choice (up to a maximum of five) before taking these examinations, and receive an offer of the grades required to be accepted onto the course of their choice at that university. The grades required will typically vary both across and within universities, with the more prestigious universities and more popular courses requiring higher grades. Tuition fees were first introduced in 1998 at the level of £1000 per annum. There is currently a capped tuition fee regime, covered by student loans and repaid after graduation. The maximum fee chargeable was most recently increased to £9000 per annum in 2012. There can be variation in fees paid across universities, and within universities across subjects, though over half of all universities, including all of the most prestigious, charge the maximum amount for every subject. Most students apply for, and study a single subject throughout their time at university, though a minority will study two or more, usually related, subjects.² Student choices about subject to study will largely be based upon future employment and wage prospects, ability and interest in the subject, and the likely grade offer they will receive (with perhaps fees to be paid a consideration for those applying to the less prestigious universities).

Determining whether the growth in graduate wage inequality is between or within subjects is an important issue, since they point to different explanations of the rise in overall graduate wage inequality. If most of the increase was happening between subjects, this would point to

¹ Other dimensions along which graduates could be disaggregated include institution attended, and grade of degree achieved. However, neither directly influences the range of possible post-graduation occupations, whilst final grade is also unrelated to entry conditions. Furthermore, our data set does not contain any information on institution, and has information on grade for only a much shorter time period.

² These are the 'Combined Degrees' included in the analysis below.

changes in the relative wage returns to different degree subjects as being important, which in turn would suggest that relative demand and supply levels across subjects were changing. In fact, as mentioned above, our results show that most of the growth in graduate wage inequality has occurred within subjects, with relative wage returns to different degree subjects being largely flat over time. Hence, we look for causes of the increased within-subject inequality. There seem to be three possibilities in theory: (i) a widening inequality in the skills and abilities of students within each subject group, (ii) a growing variation in the quality of education provided within subject groups, or (iii) a greater variance in the occupations that graduates of each subject group select into. We do not consider institution quality (explanation (ii)) for a number of reasons. First, the subject groups analysed in this paper are at an aggregated level, and are likely to each be found in some form in every institution, so there has not been a widening in the distribution of institutional quality from new institutions providing a particular subject. Furthermore, though quality differences across institutions undoubtedly exist, there is no reason, or evidence, to suspect that such differences have grown wider. Previous evidence on subject of degree and institutional quality can be found in Chevalier (2011). Investigating the wage returns to degrees by subject, Chevalier finds that controlling for institutional quality³ has virtually no effect on the estimated coefficients, suggesting a lack of correlation between institutional quality and subjects offered and thus negating the need to control for such quality in the present context. A final reason for not considering this explanation is that none of our data sets name the institution attended by respondents. Our analysis therefore focuses on wider dispersion in student ability and graduate occupations, within subjects (explanations (i) and (iii)).

Student ability will be measured by age 10 test scores. There is good reason to focus on test scores at this young age. First, previous work has suggested that early skills and abilities have important consequences for adult outcomes.⁴ Second, the use of early test scores reduces any endogeneity issues. Later indicators, such as 'A level' public examinations taken at age 18 which qualify holders for entry to university, are likely to be co-determined along with university entry and wage outcomes, on the basis of motivation to succeed etc. Earlier test scores are much more likely to be exogenous to the university-entry decision. This paper is the first in the literature to empirically link early test scores to subject choice, to the best of our knowledge.

The diversity of jobs undertaken by graduates of a particular subject will be measured using an occupation concentration ratio, in particular the proportion of individuals with a degree in that subject working in one of the three most popular jobs for graduates of the degree subject.⁵ The paper will show later that not working in one of the most popular jobs for a subject is associated with a wage penalty, on average. Thus, a degree subject that becomes occupationally less concentrated over time may experience growing wage inequality, as more graduates suffer the wage penalty.

A small but growing number of studies in the economics literature have considered degree subjects and labour market outcomes, usually estimating wage differentials by subject. In the UK, for example, O'Leary and Sloane (2005) consider degree subject in their analysis of changing returns over time. Their focus is therefore mostly on between-subject changes rather than within-subject changes as studied here. Their results suggest widening wage dispersion between subjects, with returns to Maths and engineering degrees rising between 1994 and 2002, and returns to arts-based degrees falling. Their quantile regression results are relevant to our within-subject story, however,

³ Chevalier (2011) measures institutional quality by scores on the UK's Research Assessment Exercise, and by indicators of teaching quality such as student-teacher ratios and expenditure per student.

⁴ See for example Cunha and Heckman (2007), Heckman (2010) and Heckman et al. (2012).

⁵ The results are robust to alternative measures of the concentration of occupations amongst graduates within the same subject group, as discussed in detail in Sections 4 and 5 below.

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