Essays on the Wider Returns to Education

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Economics

Lancaster University

A thesis submitted for the degree of

Doctor of Philosophy

November 2022

Declaration

I declare that the work presented in this thesis is, to the best of my knowledge and belief, original and my own work. The material has not been submitted, either in whole or in part, for a degree at this, or any other university. This thesis does not exceed the maximum permitted word length of 80,000 words including appendices and footnotes, but excluding the bibliography. A rough estimate of the word count is: 31639

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Abstract

This thesis explores the wider returns to *Higher* Education and heterogeneity of effects by type of graduates within the UK context. The first analysis examines the the role of non-cognitive skills in the financial returns to Higher Education. It finds that the inclusion of non-cognitive skills, themselves jointly significantly positive, reduces the estimated graduate premia by an insignificant 1-2 percentage points from an average of 10-12%. Since employed estimation methods are not robust to selection on unobservables, bias-adjusted treatment effects are obtained (following Oster, 2019) which serve as lower bounds. Results are further decomposed by broad major group and elite university to analyse heterogeneous returns, and find large degree class differentials.

The second analysis explores the correlation between graduate status and a wide variety of non-pecuniary outcomes with particularly strong associations with BMI, risk, no. of children aged 0-4, and Political Interest. It demonstrates how effects vary according to subject and institutional selectivity, and finds that the differences in social returns across subjects, and across institutional selectivity, are entirely insignificant under a less parsimonious specification that controls for personal and parental background.

The third analysis treats wellbeing measures as catch-all variables that capture the wide variety of effects of a degree that might not be considered/covered otherwise. The results suggest that the graduate earnings premium underestimates the overall benefits of being a graduate since graduates feel that life is more worthwhile, are happier, have greater life satisfaction, although suffer from greater anxiety than do non-graduates. Although a mediating effect through income exists it does not eliminate the positive significant degree effects on wellbeing. The analysis also examines the traditional well-being U-shape in age - but finds that this seems to be a manifestation of cohort effects that have normally been ignored.

Publications

Chapter 2 is co-authored with Prof. Ian Walker:

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Chapter 1

Introduction

In this thesis I explore the wider returns to *Higher* Education and heterogeneity of effects by type of graduates within the UK context. I focus on three particular areas of research within this scope: the role of non-cognitive skills, the (relative) impacts on a multitude of private and social non-market benefits, and the impact on measures of subjective wellbeing as a 'catch-all' outcome.

The first analysis (Chapter 2) examines the the role of non-cognitive skills in the financial returns to Higher Education. Estimates of the graduate earnings premium typically do not control for the effect of non-cognitive skills. Since such skills are unobservable in most datasets there is a concern that existing estimates of the graduate premium are contaminated by selection on such unobservables. To assess the validity of estimates that do not control for non-cognitive skills I use data on a young cohort of individuals that allows us to control for the effects of the following non-cognitive skills: locus of control, conscienciousness, and self-esteem. I find that the inclusion of non-cognitive skills, themselves jointly significantly positive, reduces the estimated graduate premia by an insignificant 1-2 percentage points from an average of 10-12%. The second contribution is motivated by the greater reliance on administrative datasets in recent research that has focused on annual earnings rather than hourly wages and the results show that the graduate earnings differential is significantly greater than the wage differential. Since employed estimation methods are NOT robust to selection on unobservables, I further adopt (Oster, 2019) bias-adjustments to show that it would take an implausible degree of selection on unobservables to drive the estimated wage and earnings returns to zero, and that a plausible upper bound to returns is around one-quarter to one-third below the OLS returns. Results are further decomposed by broad major group and elite university to analyse heterogeneous returns, and find large degree class

differentials.

The second analysis (Chapter 3) explores the correlation between graduate status and a wide variety of non-pecuniary outcomes using the same rich dataset as above. The multitude of outcomes, arguably to varying degrees, both private and social outcomes, cover health dimensions such as general health, BMI, mental health, exercise, and sleep, family life, and fertility (i.e. marital status, No. of children), trust, risk and patience profiles, adult identities/beliefs about oneself, and social engagement and participation (volunteering, donating, demonstrating, interest in politics). The aim is to complement recent research on the pecuniary returns to HE which shows that these vary dramatically across subject and institutional selectivity ((Belfield et al., 2018b)). In particular, this analysis wishes to see if subjects (and institutions) that generate high pecuniary returns also generate better non-pecuniary returns. That is, does HE generate non-pecuniary returns that reinforce pecuniary returns, or non-pecuniary returns that counteract the pecuniary returns. The results suggest that the differences in social returns across subjects, and across institutional selectivity, are entirely insignificant under a less parsimonious specification that controls for personal and parental background. That is, the findings do not suggest that one can build a case for differential subsidies across HE subjects or across institutions. Similarly, the results for private returns across subjects and institution types do not suggest that these weaken the case for encouraging students to invest in courses that are likely to have high returns in terms of pecuniary returns alone. The strongest degree effects were found for outcomes such as BMI, risk, no. of children aged 0-4, and Political Interest, and somewhat weaker indications were observed for general health, exercise, sleep, alcohol use, patience, marital stauts, no. of children aged 5-11, adult identity, maturity, donating and demonstrating.

The third analysis (Chapter 4) treats wellbeing measures as catch-all variables that capture the wide variety of effects of a degree that might not be considered/covered in analyses such as Chapter 3. Using a large pooled cross-section dataset that is unusually rich in information on individual well-being the data shows that graduates feel that life is more worthwhile, are happier, have greater life satisfaction, but suffer from greater anxiety than do non-graduates. Differences in the raw data are attenuated by allowing for income differentials, but many are not eliminated. Furthermore the dataset is large enough to decompose by gender, birth cohorts, degree subject, and gender. This reveals for example, that the anxiety effect is largely driven by Arts graduates, while STEM graduates are less anxious than non-graduates - suggesting anxiety is driven by the greater job insecurity of employed Arts graduates. The results suggest that the graduate earnings premium underestimates the overall benefits of being a graduate but that pecuniary differences by subject

group are *reinforced* by non-pecuniary aspects of well-being. We further exploit two periods of rapid expansion in the British Higher Education ((HE) system that drove large gains in educational attainment in the 1960s and again in the early 1990s to elicit causal estimates. In doing so, we find even larger significant wellbeing effects for marginal students. The research here suggests that graduate well-being differences driven by earnings differentials are reinforced by beneficial non-pecuniary effects on well-being. Finally, the analysis also examines the traditional well-being U-shape in age - but finds that this seems to be a manifestation of cohort effects that have normally been ignored.

Chapter 2

The Graduate Wage and Earnings Premia and the Role of Non-Cognitive Skills

2.1 Introduction

The financial returns to higher education has been the subject of considerable research. There is mounting evidence that the graduate earnings premium has remained large despite considerable supply side increases across successive birth cohorts from the 60's to the 80's in the US and from the 70's to the 90's in the UK (see Ashworth and Ransom, 2018 and Blundell, Green, and Jin, 2016). Some recent research is underpinned by administrative data, such as Bhuller, Mogstad, and Salvanes, 2017 in Norway, and Belfield et al., 2018a in England, which both allow for more detailed research into the heterogeneity of returns. Administrative data sources usually contain only younger workers and so typically report lower estimates of graduate premia. However, almost all such work excludes consideration of non-cognitive skills. Heckman, 2000 emphasised the need for estimates of the returns to both cognitive and non-cognitive skills and there is now considerable evidence that traits such as initiative, persistence, and motivation contribute to successful outcomes and recent research (for example Cunha and Heckman, 2007) suggests that "skills beget skills" implying that non-cognitive skills have a greater effect on the productivity and wage rates of graduates than of non-graduates.

The contribution of this paper is to estimate the effect of non-cognitive skills on both wages and earnings of graduates and non-graduates, using an unusually rich

cohort study, and to examine the robustness of graduate wage and earnings premia to the inclusion of measures of non-cognitive skills. Our work is partly motivated by the increasing reliance placed on detailed administrative datasets (for example Britton, Shephard, and Vignoles, 2015), which invariably do not contain either a measure of hourly earnings or information on non-cognitive skills. The usefulness of such administrative datasets for estimating graduate premia depend on their robustness. The effects on both of hourly wage and weekly (or annual) earnings are of interest, for different reasons, and our data allows us to compare these returns. Moreover, our data contains detailed information on non-cognitive skills.

The latest wave of the Longitudinal Study of Young People in England (LSYPE) contains early labor market outcomes on cohort members, at age 25, while earlier waves contain considerable detail on the characteristics and traits of these young people as adolescents. Detailed educational achievements are matched from administrative sources. This offers the opportunity to explore the relationship between adolescent non-cognitive skills (locus of control, work ethic, self-esteem) and the financial returns, at age 25, to an undergraduate degree. In addition, the data is sufficiently rich to explore the returns by institution type, broad degree major, and degree class.

We distinguish between the graduate hourly wages (for those in paid employment) premium, where our headline estimate is close to 10%, from the weekly earnings premium where our headline estimate is 18% - both estimated at this early stage of the life cycle. The significant difference between these two measures of the graduate premia suggest that graduates utilize their human capital to a greater extent than non-graduates, by working longer hours per week, in addition to receiving a higher hourly wage.

We also find locus of control and work ethic positively affect wages and earnings respectively, but it would appear that non-cognitive skills affect the wages and earnings of graduates and non-graduates to about the same extent. Thus, the inclusion of non-cognitive skills does not make a statistically significant difference to the estimated graduate wage and earnings premia, regardless of the specification. When we consider heterogeneity in graduate premia by institutional type (comparing a well-defined set of elite institutions from the rest), and by broad major group (comparing STEM, Arts & Humanities, and Social Sciences), we find large differentials within these cells. Nonetheless, the insensitivity of graduate premia to non-cognitive controls in the headline estimates remains unchanged. Finally, we also estimate the effect of degree class. UK undergraduate degrees are classified into "First class"(20% of this graduate cohort), "Upper Second" class (the next 50%), and below. Once we disaggregate the effect of an undergraduate

degree by degree class we find that non-cognitive skills are no longer significant determinants of graduate premia. This suggests that degree class acts as a sufficient statistic for non-cognitive skills. Our finding that controlling for degree class makes the inclusion of non-cognitive skills insignificant implies that graduate premia, estimated from administrative data that includes degree class information, may not suffer from omitted variable bias arising from an inability to control for non-cognitive skills. Since we rely on NO selection on unobservables, we employ Oster, 2019 tests and show that it would take an implausible degree of selection on unobservables to drive our estimates to zero, and our estimated lower bounds to returns are approximately one-quarter below the OLS estimates, whether non-cognitive skills are controlled for or not. While these differences are not significant, they are economically meaningful. Nonetheless, our estimates cannot claim to be causal because unobservables remain, no matter how rich the data. We think of our estimates as tightening the upper bound on returns.

The paper is structured as follows: Section 2 reviews related literature; Section 3 describes the data and variables; Section 4 discusses the method; and Section 5 presents and explains the results. Section 6 outlines the limitations, provides some directions for further research, and concludes.

2.2 Related Literature

It is common to assume that personality plays an important role in life and that certain personality traits like initiative, persistence, and motivation seem desirable for successful life-outcomes. Much of the psychology literature collapses the various facets of an individual's personality into the so-called Big Five personality traits: Openness to Experience, Conscientiousness, Extraversion, Agreeableness, and Neuroticism. This has become a widely used taxonomy of personality traits. Within these broader definitions are a number of more narrowly defined personality characteristics some of which are more relevant to the scope of this research than others. Competence, dutifulness, self-discipline, perseverance and work-ethic all represent different aspects of conscientiousness which has been shown to have a particularly strong association with successful outcomes in education (years of education, grades, test scores etc.) as well as successful labor market outcomes (Almlund et al., 2011). Almlund et al., 2011 also highlights locus of control and self-esteem as two further personality traits that have been shown to particularly influence job performance and predict wages (Judge and Hurst, 2007; Drago, 2011; Duncan and Dunifon, 1998). Heckman and Rubinstein, 2001 has attributed the lower wage GED graduates compared to high school graduates to the effect of non-cognitive skills. The former are high school dropouts that subsequently certify as

high school equivalents.

Heckman, Stixrud, and Urzua, 2006 exploit the National Longitudinal Survey of Youth 1979 (NLSY79), which includes the Rotter Locus of Control Scale and the Rosenberg Self-Esteem Scale as well as cognitive test scores, to explore the returns to non-cognitive skills in more detail. They address the econometric difficulties of endogenous schooling by estimating the distributions of latent cognitive and non-cognitive factors and use those to predict the test scores of the individuals so that schooling can no longer directly affect ability/test scores. Using measured test scores, corrected test scores, and the estimated latent cognitive and non-cognitive factors in the wage regression, the standardized OLS coefficients for non-cognitive ability vary by schooling level but are generally positive. Heckman, Stixrud, and Urzua, 2006 demonstrate that non-cognitive skills raise wages through a direct impact on productivity as well as indirectly through schooling and work experience, and that the most important of such skills are locus of control and self-esteem.

Heckman, Humphries, et al., 2010 is an extension to Heckman, Stixrud, and Urzua, 2006 and, besides looking at labor market outcomes (based on a model of sequential schooling decisions), it looks at further life outcomes, such as health, and social outcomes. Socio-emotional abilities are shown to be significant predictors of high school GPA, educational choices, and later life outcomes.

Flossmann, Piatek, and Wichert, 2007 uses the 1999 wave of the German Social Economic Panel (GSOEP) and follows the methodology in Heckman, Stixrud, and Urzua, 2006 closely. They find that non-cognitive skills also matter for the determination of wages in Germany and they also exploit attitudinal questions that are closely related to the locus of control to construct a simple additive index of the non-cognitive skills of the individual. They also obtain the distribution of the latent factor which is then used in the estimation to address endogeneity as well as measurement error concerns.

Lindqvist and Vestman, 2011 use administrative Swedish data and information from the compulsory military draft to study the effect of cognitive and non-cognitive ability on wages, unemployment and earnings. The non-cognitive ability measure comes from an interview carried out by a trained psychologist to assess the conscript's ability to function in armed combat. Lindqvist and Vestman, 2011 argue that the latter ability, which includes persistence, social skills and emotional stability, are also valued and rewarded in the labour market. The effects of cognitive ability and non-cognitive skills on wages and earnings are found to be similar, with cognitive ability being the stronger predictor. Cognitive ability is a stronger predictor of wages/earnings for skilled workers while non-cognitive skills have a stronger effect at the lower end of the earnings distribution. Non-

cognitive skills are also the stronger predictor of unemployment. Controlling for educational attainment, the relative importance of cognitive and non-cognitive ability is reversed. Edin et al., 2018 went on to study the relative returns to cognitive and non-cognitive skills over time using the same data. They observed an increase in the returns to non-cognitive skills from around 7% to 14% and explored the specific type of occupations that experienced greater increases in the relative returns to non-cognitive skills. The question, of how much the returns to educational attainment change when non-cognitive skills are accounted for, remains unanswered. Lin, Lutter, and Ruhm, 2018 uses NLSY79 to show the effects of cognitive skills (measured by AFQT) and finds that adding controls for non-cognitive skills (locus of control, self-esteem and sociability) reduces returns at age 25 from approximately 26% to 22% when NC skills are added.

Belfield et al., 2018a is the most recent, and comprehensive analysis of the graduate premium in the UK. While it uses an administrative dataset that contains extensive pre-treatment measures of cognitive ability it contains no controls for pre-treatment non-cognitive skills. Since that study used estimation methods that are not robust to selection on unobservables it is important to examine its potential robustness by using other data to explore the role of NC skills. The aim of this study is to explore the effect on non-cognitive skills on wages and earnings as well as the robustness of the estimates of returns to higher education to the inclusion of non-cognitive skills, and we do so using the most recent cohort data available for the UK. [1]

2.3 Data

Our data comes from the Longitudinal Study of Young People in England (LSYPE). This is a large-scale cohort study that follows the lives of around 16,000 people born in 1989-90 in England. Cohort members were aged 13-14 when the study began in 2004 and were interviewed every year until 2010, aged 19-20. The sampling was stratified with secondary schools being selected at random and from all schools, and pupils within each school selected at random. LSYPE selected observations to be representative of the English school population, but specific groups were oversampled - in particular, youths from low socioeconomic backgrounds and minorities (see Department for Education, 2010). More details can be found in Centre for Longitudinal Studies, 2018 and Anders, 2012. The LSYPE pupils were revisited in 2016, aged 25, to provide some insights into their lives as young adults. Treating the data as a cross-section provides information on the educational and labour market experiences, economic circumstances, family life, physical health

[1] Boero et al (2019) also find that non-cognitive skills do not affect the graduate premium.

and emotional wellbeing, social participation, attitudes of the individuals, and non-cognitive skills. The availability of survey questions in earlier waves about locus of control (LoC) and self-esteem makes these traits the most commonly studied non-cognitive skills in research on outcomes such as educational or economic success.

LSYPE achieved cross-sectional responses rates ranging from 48% (in Wave 8), to 84% (in Wave 2). For waves 1 to 7, the sample issued (response rate denominator) at each wave comprised respondents from the immediately preceding wave who agreed to be re-contacted. Despite reasonably good cross-sectional response rates, the sample size was reduced to 7,707 by Wave 8 from an initial 15,774 responses at Wave 1. The fact that many of the participants in Wave 8 had not participated in each wave, due to the sequential sampling method, means that out of the 7,707 Wave 8 participants, many do not have a complete history from participation in all waves. This type of attrition could pose a problem for our study if, conditional on observed covariates, attrition is related to higher education and wages/earnings.[2]

2.3.1 Degree Attainment

We define a graduate as an individual who has (successfully) completed at least an undergraduate degree.[3] Conditional on having obtained a degree, LSYPE also reports whether the individual has been awarded a degree by an elite "Russell Group" university (that approximately 25% of students attend) or otherwise. LSYPE wave 8 at age 25 further specifies the subjects that individuals studied at university - which we group into STEM, Social Sciences, Arts and Humanities, and other majors.[4]

Our data also records degree class obtained on course completion. Other explanatory variables used in the specifications are controls for gender (female=1), regional controls (which we collapse into North, South, versus Midlands) and controls for individual ethnicity (which we collapse into Non-white vs. White).

Figure 2.1 shows the HE participation rate in the overall sample of those in paid employment. The LSYPE participation rates, using survey weights, are broadly in

[2]While it is not possible to completely rule out this possibility, because it relates to unobserved selection, we conduct analyses with and without the survey weights provided, and we also fit a model predicting participation in the final sample, based on initial characteristics and the treatment variable. We find no statistically significant differences when we do so.

[3]We also include individuals having completed a postgraduate degree (e.g. MSc, PhD) but we do not condition on them in the analysis. That is, we think of our estimates as including the option value associated with the possibility of pursuing post-graduate qualifications.

[4]UK students typically specialise intensively in a single major throughout their three years of higher education, which typically occur straight from senior high school at age 18 or 19.

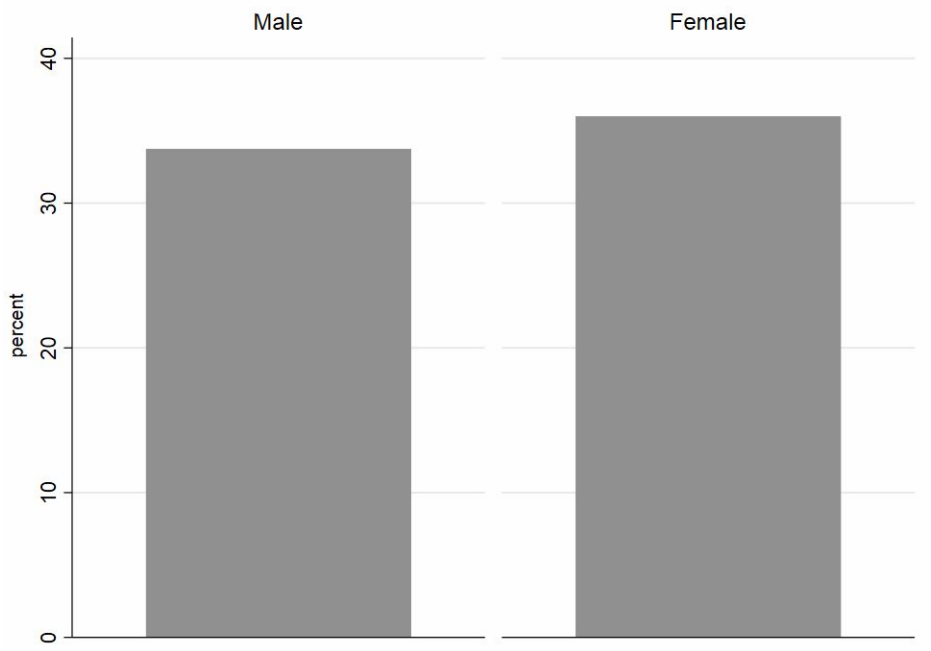
line with the aggregate data for the 2009/2010 university entrant cohort from HESA administrative (Department for Education, 2019).

Figure 2.2 shows the breakdown of HE graduates by elite (Russell Group) vs non-elite institutions, conditional on degree attainment.

Figure 2.3 shows the breakdown by majors which again matches the administrative data well.

Figure 2.4 shows the proportions obtaining a first class, upper second, and lower second / third class. [5]

Figure 2.1: Overall HE participation rate



[5]These figures are conditional on not dropping out by age 25. Drop out rates are around 6% and Walker and Zhu, 2013 find dropout earnings are close to those who never go to university.

Figure 2.2: HE participation rates including Russell vs other HEI proportions

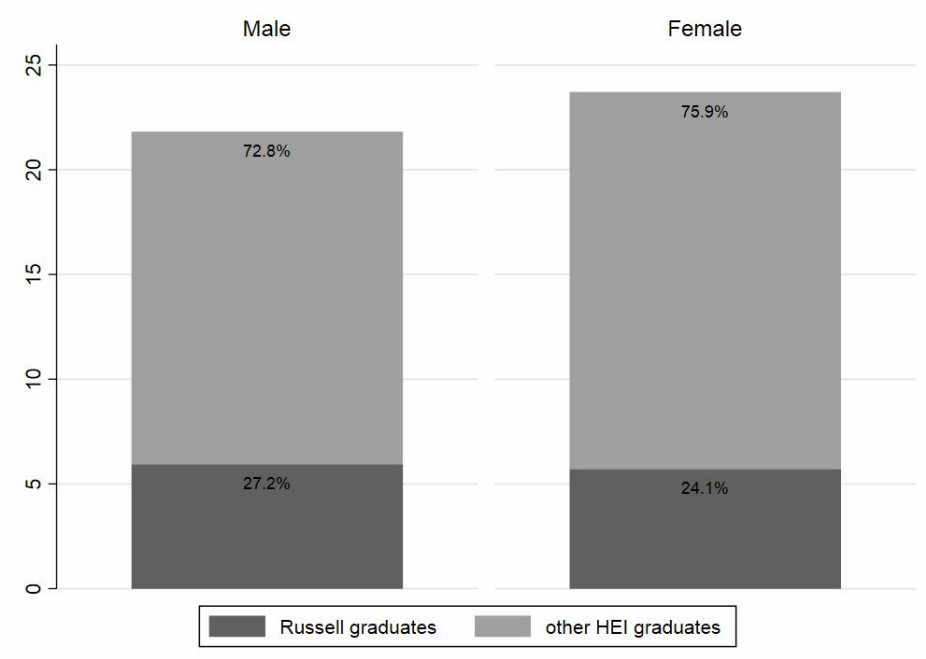


Figure 2.3: HE participation rates for subject groups

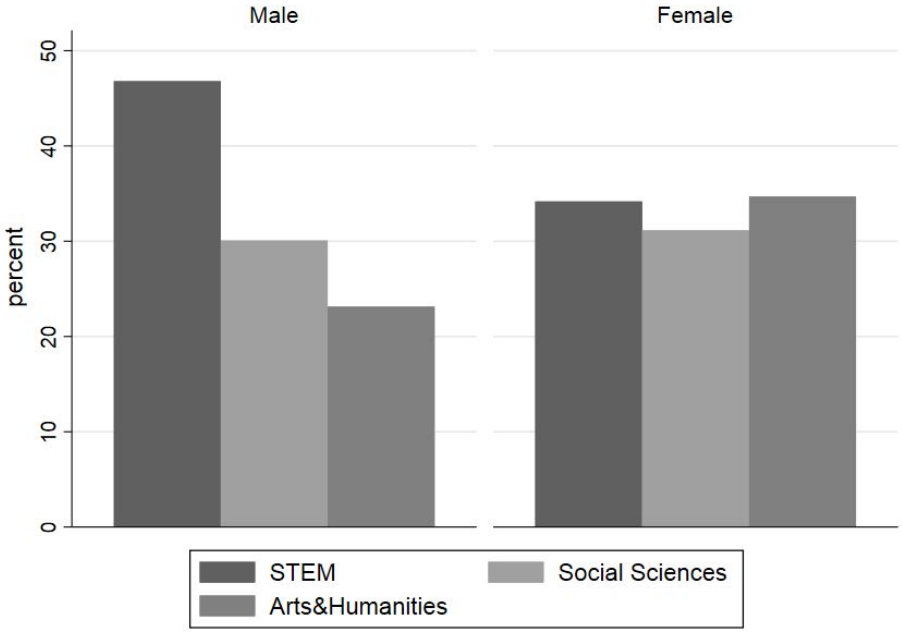
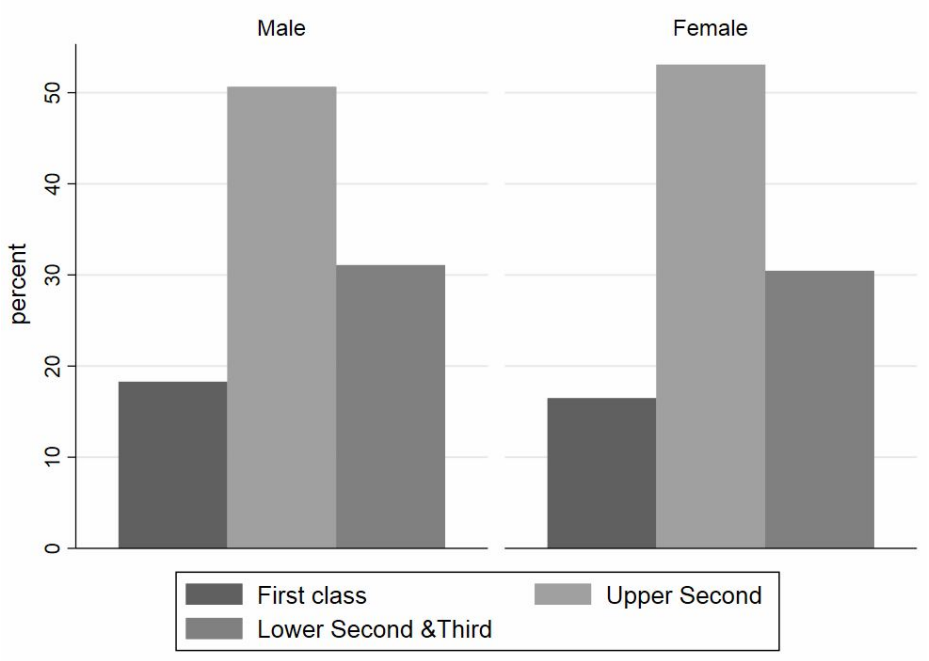


Figure 2.4: Degree class



2.3.2 Non-cognitive skills

LSYPE provides information on several aspects of the non-cognitive skills of respondents. A commonly used measure in this literature (not least because of its availability in recent datasets) is locus of control, first introduced by Rotter, 1966, which aims to reflect how much control individuals believe they have over their lives. LSYPE asks cohort members in Wave 2, Wave 4, Wave 7 and Wave 8 a series of attitudinal questions that are meant to capture the concept of locus of control. The questions/statements remain the same across the LSYPE waves and Table 2.1 gives an overview. The individual can either strongly agree (SA), agree (A), disagree (D), or strongly disagree (SD) with each statement which in turn are coded from 1 to 4 [6].

For the main analysis in this paper we standardize the overall score of the locus of control variable taken just from Wave 2 (aged 14/15), because the response rate in Wave 4 was low, and waves 7 and 8 pose a problem with endogeneity in this context

[6]Statements 1, 2 and 4 were recoded so that a higher overall score indicates a greater **internal** locus of control – meaning the individual has greater confidence in the fact that he/she can influence his/her destiny, and vice versa for a person with a low score and therefore a more external locus of control

since these scores would have been measured during the time of going to university. Summing the scores over the four statements in Wave 2 we construct an additive locus of control variable, with a minimum score of 4 and a maximum score of 16. On average, the wave 2 locus of control score is 11.98.

We further group attitudinal statements across the waves into the following topics: attitudes towards school, and questions that reflect self-esteem in Wave 4. The three attitudinal statements concerning feelings about school are seen in Table 2.2. We think that the questions asked about school-time reflect the pupil's own attitudes towards school and hence are an indication of the respondent's degree of conscientiousness or work ethic. For the directions of the statements to match up, we again invert the responses so that the higher the score on this scale the higher is work ethic in school and the more important school is to the individual. Table 2.3 provides an overview of questions on self-esteem, scores, and a derived additive variable that we generate from the four available statements, where a higher score on this scale implies higher self-esteem of the individual. As with locus of control and 'school importance', we standardize self-esteem for the main analysis.

Table 2.1: Locus of Control statements

No.	Locus of Control Statement	Score			
1	"If someone is not a success in life, it is usually their own fault"	SA (=4)	A (=3)	D (=2)	SD (=1)
2	"I can pretty much decide what will happen in my life"	SA (=4)	A (=3)	D (=2)	SD (=1)
3	"How well you get on in this world is mostly a matter of luck"	SA (=1)	A (=2)	D (=3)	SD (=4)
4	"If you work hard at something you'll usually succeed	SA (=4)	A (=3)	D (=2)	SD (=1)

SA – strongly agree, A – agree, D – disagree, SD – strongly disagree

additive variable (min=4, max=16)	N	mean	sd
w2locus	3751	11.98	1.60

Table 2.2: Statements on 'School Importance'

No.	Statement on feelings about school (wave 1, 2, 3)	Score			
1	"School is a waste of time for me"	SA (=1)	A (=2)	D (=3)	SD (=4)
2	"School work is worth doing"	SA (=4)	A (=3)	D (=2)	SD (=1)
3	"I work as hard as I can in school"	SA (=4)	A (=3)	D (=2)	SD (=1)

SA – strongly agree, A – agree, D – disagree, SD – strongly disagree

additive variable for each wave (min=3, max=12)	N	mean	sd
school importance wave 1	4751	10.33	1.35
school importance wave 2	4425	9.94	1.49
school importance wave 3	4393	10.07	1.46

Table 2.3: Statements on Self-Esteem

No.	Statements about individual's self-esteem	Score			
1	"Whether Young Person (YP) felt unhappy or depressed"	not at all (=4)	no more than usual (=3)	rather more than usual (=2)	much more than usual (=1)
2	"Whether YP has been losing confidence in self"	not at all (=4)	no more than usual (=3)	rather more than usual (=2)	much more than usual (=1)
3	"Whether YP has thought of themselves as a worthless person recently"	not at all (=4)	no more than usual (=3)	rather more than usual (=2)	much more than usual (=1)
4	"Whether YP has felt reasonable happy"	more so than usual (=1)	about the same as usual (=2)	less so than usual (=3)	much less than usual (=4)

additive variable (min=4, max=16)	N	mean	sd
self-esteem	4379	13.02	2.69

2.3.3 Outcome Variables

We are interested in the private financial returns to university degree attainment, and its sensitivity to the inclusion of non-cognitive controls. Earnings is the relevant dependent variable if the aim is to explore inequality and social mobility. On the other hand, the hourly wage is likely to be a better reflection of productivity. Thus, we use both the log weekly earnings and log hourly income from employment (at age 25) as outcomes. We compute the gross hourly wage, as the ratio of the gross weekly pay and hours worked per week. Administrative datasets usually provide only earnings data from tax records, so we compare estimates using log earnings (gross weekly pay) with those using log hourly earnings. Together, these two dependent variables allow us to explore the extent to which graduates earn more than non-graduates because they receive a higher wage, as well as because they may work longer hours per week.

Table 2.4: Income measures and non-cognitive skills by gender/degree

		hourly income (£)		weekly earnings (£)		hrs worked per week		Locus of Control		work ethics/ school importance		self-esteem	
		mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
Male	No Degree	11.09	4.69	451.68	203.03	41.24	11.52	10.46	4.32	8.26	3.81	11.08	5.74
	Degree	12.80	6.76	509.72	213.94	40.79	9.18	10.75	4.31	8.98	3.60	11.89	4.90
Female	No Degree	10.30	10.94	349.18	158.05	35.74	9.65	10.38	4.19	8.66	3.72	10.34	5.49
	Degree	11.97	12.27	445.43	180.87	39.34	9.34	10.49	4.22	9.04	3.74	10.65	5.13

Table 2.4 shows the mean of the hourly income, weekly earnings, and hours worked per week, as well as the mean of the locus of control, adolescent work ethic/school importance, and self-esteem score by gender and degree. The graduate hourly wage premium is very similar for both females and males (approx. £1.70 per hour). The graduate earnings premium is 28% for women (£96 per week), and 13% for men (£58). The weekly average hours differentials are 3.6 hours (10%) for females and -0.45 hours (-1%) for males. Table 2.4 also reports the average score for locus of control for both men and women. These are minimally larger for those with a degree compared to those without (6% of a SD for males and 3% for females). The same is true for the average score for school-importance/work ethic. Both men and women with a degree have a higher average score (19% of a SD for males and 10% for females) compared to individuals without a degree. The average score for self-esteem is also somewhat larger for graduates than non-graduates (14% of a SD for males and 6% of a SD for females).

2.3.4 Relationship between Income and Non-cognitive skills

As suggested above, earnings and wages are higher for graduates than non-graduates for both men and women. This section describes the relationship between the locus of control, work ethic and self-esteem with the mean of weekly gross income.

Figure 2.5 shows the mean of weekly gross pay at 25 for each possible overall locus of control score (at age 14/15) by gender and by subsequent degree status. In this, and subsequent figures, the bubble sizes reflect the cell sizes and the tails of the locus of control distribution were grouped due to very limited observation counts in the extremes. For graduates the relationship with locus of control is steeper for men than women. For non-graduates the relationship with locus of control is almost flat for both men and women. Thus, the college premium tends to be higher at the higher levels of locus of control (i.e. internal LoC) reflected in the fitted line (using the weighted data).

Figure 2.6 looks at earnings differences by type of HE institution conditional on having a degree. It makes a distinction between a degree obtained from an elite Russell Group university versus a degree obtained from a non-elite university. The relationship between earnings and locus of control, within graduates, is steeper for the elite than the non-elite HEIs, for both men and women. Thus, earnings differentials by HEI type, conditional on a degree, tend to be larger for those with high (i.e. internal) locus of control.

Similar relationships of weekly gross pay against self-esteem and against work ethic are illustrated in Figure 2.7 and Figure 2.8. While work ethic does show positive relationships with weekly earnings, much of this is driven by hours of work variation (see Appendix Figure A1). The effect of self-esteem is flat, conditional on having a degree, but is positive for non-graduates.

Finally, we also explore the relationship between locus of control and degree class in Figure 2.9. In the UK, university degrees are classified into: first class; upper second; lower second (which we merge with students with the lesser classes because of their small cell sizes). Figure 2.9 stacks the LoC cells by degree class and shows that the higher one's locus of control the higher is one's degree class. The distribution of locus of control is close to normal for each degree class. Conditional on locus of control, the proportion of students who obtain each degree class remains broadly constant, although the proportion of firsts seems slightly skewed to the right.

Figure 2.5: Mean of weekly gross pay (£) and Locus of Control (by gender and degree)

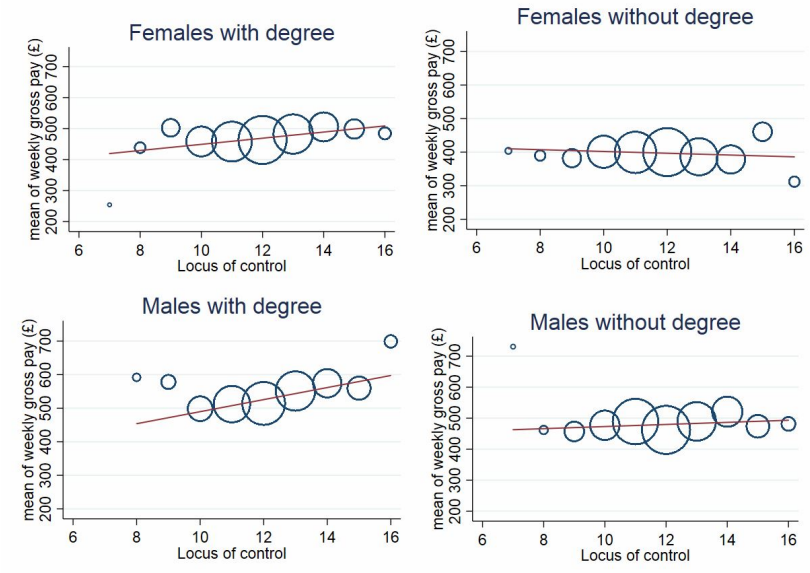


Figure 2.6: Mean of weekly gross pay (£) and Locus of Control (by gender and HEI type) conditional on having a degree

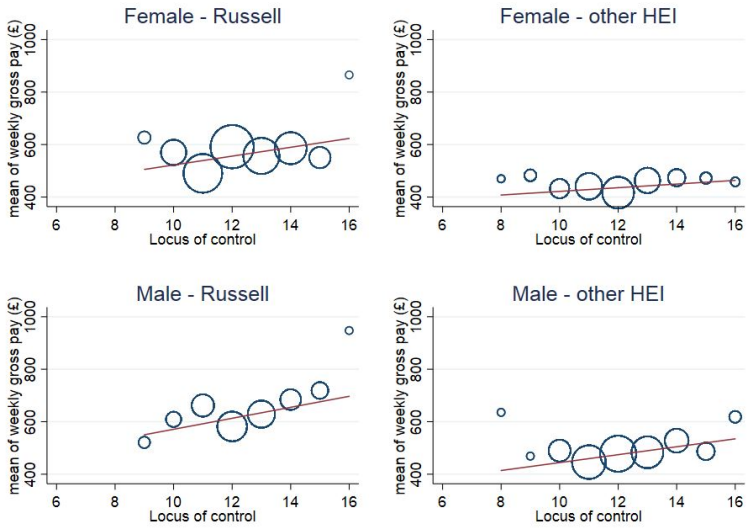


Figure 2.7: Mean of weekly gross pay (£) and Work Ethic (by degree attainment)

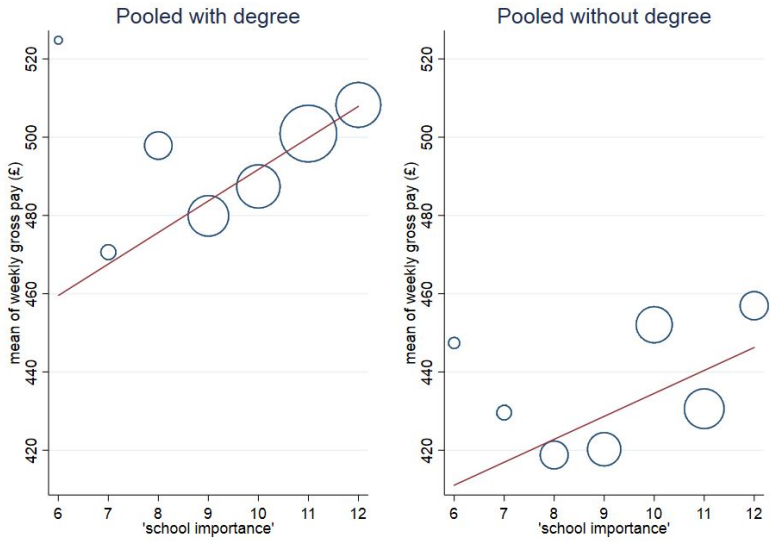


Figure 2.8: Mean of weekly gross pay (£) and Self-esteem (by degree attainment)

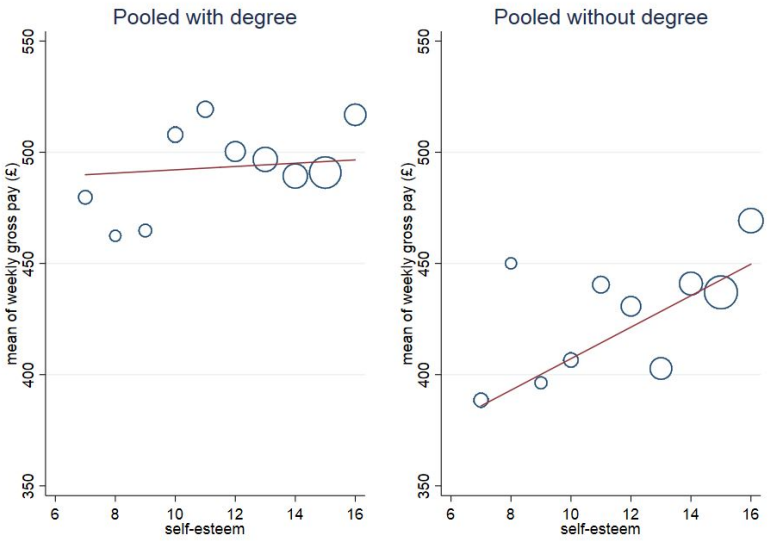
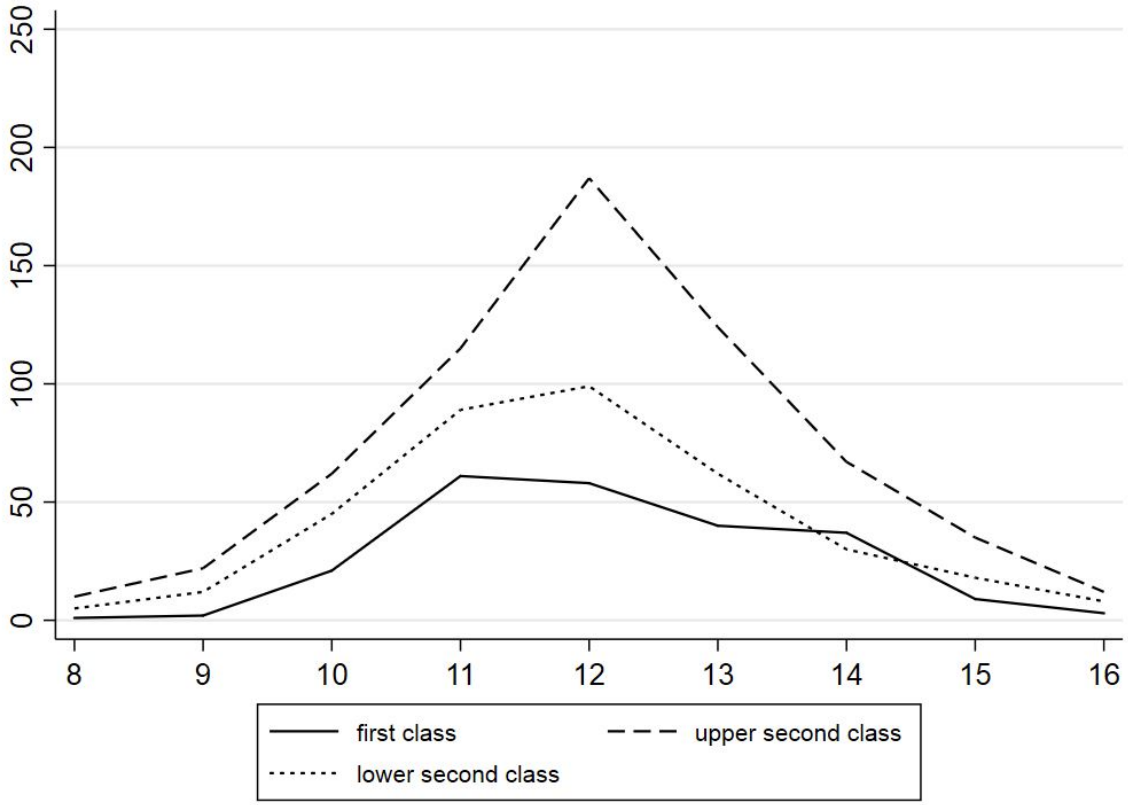


Figure 2.9: Degree classification across Locus of control



2.4 Methodology

To assess the effect of non-cognitive skills on wages at age 25 we augment a standard wage equation with measures of non-cognitive skills and we specify the following linear model:

$$y = \alpha + \mathbf{D}'\beta + \mathbf{NC}'\gamma + \mathbf{X}'\delta + \epsilon$$

where y is the outcome variable (either log hourly wage or log weekly earnings) of the individual; D indicates either a binary treatment control for having a degree, or the vector of multiple treatments of elite institution degree, other HEI degree; STEM degree, Social Science degree, Arts & Humanities degree; or degree classes, with no degree as the control group in all cases; NC is a vector of non-cognitive skills (as discussed in Section 2.3); and X is a vector of individuals' characteristics (controls for gender, ethnicity, and region). Our sample size does not provide the power to estimate separately by the elements of **D**.

We begin by estimating the equation using Ordinary Least Squares for single treatment models and Inverse Probability Weighted Regression Adjustment (IPWRA) estimation in the case of multiple treatment effects. Both methods rely on the conditional independence assumption and IPWRA weighs the data to give greater weight to individuals who have similar characteristics but receive different treatments.

The model is estimated for a sample of those in paid employment at age 25. The non-cognitive skills included in the main analysis are: standardized scores of the locus of control (measured at age 14/15 - a year before GCSEs), work ethic, and self-esteem (as discussed in Section 2.3) [7]. We also vary the definition of non-cognitive skills (whose results are also presented in Section 2.5). Rather than using the definition of each NC skill based on the addition of scores for several questions, we instead also obtain standardized measures through principle component analysis.[8]

We estimate single treatment models (degree or no degree) and multiple treatment models (elite institution degree, other HEI degree, or none; and STEM degree, Social Science degree, Arts & Humanities degree, or none; and their interactions), and degree classes interacted with NC skills.

To model the probability of being in the treatment groups in IPWRA we control for the main and second parent's education, and the individual's gender, ethnicity, and current region. We present estimates that control for non-cognitive skills alongside estimates of a conventional model that does not include them.[9]

[7] Non-cognitive skills used in the analysis are recorded at age 14-16, long prior to the degree treatment, to reduce the possible correlation with the anticipation of attending university. We base this presumption on the argument that non-cognitive skills are likely to undergo only modest changes on average between 16 and 18 (Caliendo, Cobb-Clark, and Uhlendorff, 2015)

[8] We further include 'missing-dummies' in the OLS specification with the aim of retaining sample size. We control for missingness in the case of HEI type and for missing observations across the non-cognitive skills mentioned previously. We acknowledge that including these dummies may give biased estimates if the observations are not missing at random. We have also estimated all specifications without these dummies, as well as dropped those observations by missingness, and we find that the wage and earnings premia estimates are not significantly affected. Not controlling for missing NC skills, negligibly affects NC skill estimates, and affects the degree estimate by inflating it by 0.5 percentage points. Not controlling for degree-missingness but controlling for NC skills-missingness, increases the degree-estimate by 0.5 percentage points as well and reduces the LOC-estimate by 1 percentage point. Not controlling for degree-missingess or NC skill-missingess has similarly small effects. We also drop the observations affected by missingness. In addition, we find our results are not sensitive to including additional controls for parental background, such as parental education. Nor are the results sensitive to the inclusion of school fixed effects. Results are available upon request.

[9] We also estimate using Propensity Score Matching (PSM) using the Stata code *teffects psmatch*. The results obtained are presented in Tables A.1 and A.2 of Appendix A as they are very similar to

2.4.1 Inverse Probability Weighted Regression Adjustment

Inverse Probability Weighted Regression Adjustment (IPWRA) is an alternative bias-reducing method. IPWRA, akin to PSM, accounts for the nonrandom treatment assignment using a multinomial logit first stage - but it does so by *weighting* the control and treatment groups to make them more comparable. That is, in contrast to PSM, the IPWRA method fits the conditional model for the outcome by weighting observations instead of matching them.

IPWRA is characterized by the double-robust property, meaning that if either treatment model or outcome model are misspecified (but not both) the estimates of the treatment effects will nevertheless be consistent. The outcome is modelled by controlling for non-cognitive skills, gender, region, and the treatment is modelled by controlling for non-cognitive skills, parents' education, gender, and region. To compare how much the treatment effect is affected by the inclusion of non-cognitive skills we estimate with and without non-cognitive skills when modelling treatments and outcomes in separate equations. The main reason for employing IPWRA here is that it allows for multiple treatments. This allows, for example, elite university degrees and those from non-elite institutions to be treated as two different treatments, relative to the no-degree control individuals. The different majors are treated as three treatments (STEM, Social Sciences, Arts & Humanities). Combining these treatments allows us to estimate the effects of the six interactions between the two treatment types (Elite and STEM, for example). We estimate IPWRA using the Stata code *teffects ipwra*.

2.4.2 Sensitivity to selection bias

One of the aims of this study is to analyze whether previous estimates of returns to higher education are reliable, despite not being able to observe non-cognitive skills. So we compare estimates that control for these with those that do not. Nonetheless, we also want to formally test whether controlling for non-cognitive skills makes specifications less sensitive to selection bias. OLS and IPWRA both depend on no selection on unobservables, and we follow Oster, 2019 who, building on Altonji, Elder, and Taber, 2005, has developed a novel method for assessing bias arising from unobservables. Oster's approach extends the methodology for evaluating robustness to omitted variable bias by providing a) a method for estimating an unbiased treatment effect (using information from coefficient movements and movement in R-squared when adding further controls to the specification) and b) the proportional degree of selection between observables and unobservables (delta) which would be required to confound the observed treatment effects - that is, drive the effects

the results obtained with IPWRA below, but they provide less detail than here.

to zero (to evaluate robustness of results). In other words, the method aims to calculate the lower bound of the treatment effect using information from coefficient movements *and* movements in R-squared when adding further controls to the specification. It allows us to not only explore the lower bound of the estimates, assuming that there are still unobserved (non-cognitive) factors which may affect the outcome variables, but also allows us to compare these lower bounds before and after the inclusion of non-cognitive controls. The method also calculates the proportional degree of selection between observables and unobservables which would be required to confound the observed treatment effects - that is, drive their effects to zero. This latter provides a sense check on the reasonableness of the no selection on unobservables assumption.

Due to data limitations we are not able to control for pre-treatment ability to appropriately estimate the degree effect for similarly attaining 18-year olds, so estimates are presented as the difference in conditional wage/earnings outcomes for those who gain a degree compared to those who do not - including the effect of the higher average prior attainment that opens the door to HE. Since pre-treatment ability cannot be included here as a covariate, prior attainment is effectively an unobserved characteristic affecting selection. We argue that the use of IPWRA as a selection bias reducing method and the use of sensitivity to selection analysis using Oster bounds provides an appropriate examination of whether estimates are comparable to the literature that does control for prior attainment. As will be seen in Section 2.5 the Oster bound analysis/bias-adjusted estimates suggest that the exclusion of prior attainment does not affect the estimates very much (they only fall a few percentage points). As a final robustness check we also adjust the control group by excluding from the sample those with less than 2+ A Levels (a qualifying academic achievement to enter university). Table A.4 and A.5 show that using this alternative control group the estimates again do not differ significantly from the results presented below.

2.5 Results

The following section presents the estimation results for the returns to higher education, with and without including non-cognitive controls. We present the results for hourly wages first, followed by the results for weekly earnings; we then provide robustness checks using alternative non-cognitive skill definitions. Finally, we include the returns to different degree classifications.

2.5.1 Wages

We present wage results for pooled males and females, as well as wages by males and females separately. These are obtained by OLS in Table 2.5 (pooled male and female), Table 2.6 (male), and Table 2.7 (female). We present the average returns to a degree, as well as returns by institution (the elite Russell Group universities vs other HEI), subject (STEM, Social Sciences, Arts and Humanities). We also estimate returns by subject type AND institution type. The results of our four specifications are presented in four blocks, each with two columns: column (1) refers to the baseline regression without non-cognitive skills and column (2) controls for non-cognitive skills.

In Table 2.5 we see that the average return to a degree is 11.3% in the baseline regression. Controlling for locus of control, work ethic and self-esteem the returns reduce to 10.6% - a statistically insignificant difference of less than one percentage point. The F-test of joint insignificance for the included NC skills is rejected, but only locus of control is individually statistically significant. A one standard deviation change in locus of control increases an individual's wages by 3.3%. The female differential varies from between -6 .4 and -7.7 % across specifications in Table 2.5.

The return to a Russell Group degree, relative to none, is 20% which is more than three times as large as the wage premium for graduates of non-elite HE institutions, at 5.6%, in both cases taking account of NC skills. The difference in estimates controlling for NC skills and not is again statistically insignificant and relatively modest at close to 1%.

We further decompose average degree returns by subject areas such as STEM, Social Science, and Arts and Humanities, in the third block, and lastly look at the returns to studying these subjects at either Russell or other HE institutions in the final block. The average returns to STEM and Social Science subjects seem to be the same when we do not control for NC skills at 14.4%. They fall to 13.5% after accounting for NC skills. The estimates for an Arts and Humanities degree are only 2% , and 1.1% without NC skills, and they are not statistically significantly different from non-graduate controls. The returns to obtaining a degree from an elite university are unsurprisingly larger regardless of subject studied. Controlling for non-cognitive skills, a STEM subject at an elite university has a return of 24.4%; the Social Science return is 21.1%; and the Arts and Humanities return is 12.8%. Again the difference between these estimates and those estimates that do not take NC skills into account are modest at 1-2 percentage points. The biggest effect of institution type is for Arts and Humanities where the return in an elite institution is close to 13% compared to -3% for the non-elite case. Locus of control is the only

NC skill that is statistically significant and its effect remains around 3% irrespective of specification.

Our headline estimate of the average wage premium to a university degree is around 10%. This is lower than typical estimates obtained from data containing individuals from across the life-cycle - reflecting the very early stage of the life-cycle of LSYPE. Recent UK estimates obtained from administrative data at a similar age are in the same ballpark as here(Belfield et al., 2018b). Indeed, the extent of heterogeneity in returns by subject *and* institution that are the dominant feature of Belfield et al., 2018a and Belfield et al., 2018b are also reflected here, to the extent that LSYPE allows.

Table 2.6 and Table 2.7 present results for the same specifications as Table 2.5 but now allows for differences in wage premia between males and females. Overall, there is very little difference between any estimate in Column (1) and corresponding estimates in Column (2) - the effect of NC skills is broadly similar for males and females. Controlling for non-cognitive skills reduces the estimate to the returns to a degree only modestly by 1-2 percentage points. The headline estimates for wage premia, in the first block of estimates, are uniformly higher for females, although the differential is never statistically significant. For example, the estimated graduate wage premium is close to 10% for males and 13% for females. In the second block of estimates we explore institutional type differences. The elite HEI differential is close to 20% for men, and 22% for women. The graduate wage premia associated with a non-elite HEI degree is, however, much smaller for men at around 3%, compared to close to 10% for women.

In the third blocks of Tables 2.6 and Table 2.7, the wage premium for a STEM subject are twice as large for females than for males - at 20% for women and 9% for men. We also note bigger differences in returns between male and female STEM graduates from elite universities as compared to the non-elite institutions. While there are some important gender differences in graduate wage premia, the gender differences in returns to NC skills are small. Locus of control remains to be the only statistically significant NC skill for both genders, with the exception of work ethic for females when we look at the specification by institution and subjects respectively. A one standard deviation change in locus of control (more internal locus of control) has a return of around 3% on top of the returns to a degree for both males and females. For females a one standard deviation change in work ethic importance increases wages by around 2%.

Since gender is not our focus here, and since the differences in results are small relative to what they have in common, we continue to present results using the pooled data only. Table 2.8 presents results for the Oster sensitivity to selection

Table 2.5: Wage returns to a degree (OLS - pooled male and female)

	Overall		by Institution		by Subject		by Subject x Institution	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Degree	0.113***	0.106***						
	(0.016)	(0.017)						
Russell Group			0.212***	0.200***				
			(0.026)	(0.026)				
Other HEI			0.062***	0.056**				
			(0.019)	(0.019)				
STEM					0.144***	0.135***		
					(0.022)	(0.022)		
Social Sciences					0.144***	0.136***		
					(0.026)	(0.026)		
Arts&Humanities					0.020	0.011		
					(0.024)	(0.024)		
STEM*Russell							0.254***	0.244***
							(0.038)	(0.038)
STEM*Other							0.103***	0.095***
							(0.024)	(0.025)
SocSc*Russell							0.228***	0.211***
							(0.044)	(0.044)
SocSc*Other							0.110***	0.107***
							(0.030)	(0.030)
A&H*Russell							0.141***	0.128**
							(0.042)	(0.042)
A&H*Other							-0.027	-0.032
							(0.026)	(0.027)
Female	-0.077***	-0.075***	-0.068***	-0.068***	-0.066***	-0.066***	-0.064***	-0.064***
	(0.014)	(0.015)	(0.015)	(0.016)	(0.016)	(0.016)	(0.015)	(0.016)
Locus of control		0.033***		0.030***		0.030***		0.029***
		(0.008)		(0.008)		(0.008)		(0.008)
Work ethic		0.013		0.014		0.017		0.014
		(0.008)		(0.009)		(0.009)		(0.009)
Self-esteem		-0.004		-0.006		-0.007		-0.007
		(0.011)		(0.012)		(0.012)		(0.012)
F-test of NC coeffs		F(3, 4064)=8.29		F(3, 3515)=6.30		F(3, 3516)=7.02		F(3, 3504)=6.17
		p <.001		p <.001		p <.001		p <.001
R-sqr	0.073	0.082	0.074	0.082	0.072	0.081	0.079	0.088
N	4077	4077	3529	3529	3531	3531	3522	3522

Note: The dependent variable is log of gross hourly wage. Specification (1) does not control for non-cognitive skills, while specification (2) does. All specifications include the following additional controls: gender, ethnicity as well as regional dummies. All observations are weighted by the most recent LSYPE sample weights.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 2.6: Wage returns to a degree (OLS - male)

	Overall		by Institution		by Subject		by Subject x Institution	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Degree	0.101***	0.094***						
	(0.024)	(0.025)						
Russell Group			0.200***	0.187***				
			(0.038)	(0.038)				
Other HEI			0.030	0.025				
			(0.028)	(0.028)				
STEM					0.094**	0.083*		
					(0.034)	(0.034)		
Social Sciences					0.141***	0.131***		
					(0.038)	(0.038)		
Arts&Humanities					-0.010	-0.013		
					(0.038)	(0.040)		
STEM*Russell							0.198**	0.188**
							(0.061)	(0.062)
STEM*Other							0.059	0.049
							(0.037)	(0.037)
SocSc*Russell							0.223***	0.203***
							(0.057)	(0.054)
SocSc*Other							0.095*	0.093*
							(0.046)	(0.046)
A&H*Russell							0.160*	0.153*
							(0.068)	(0.069)
A&H*Other							-0.098*	-0.096*
							(0.041)	(0.044)
Locus of control		0.034**		0.033**		0.033**		0.032**
		(0.012)		(0.012)		(0.012)		(0.012)
Work ethic		0.006		0.007		0.011		0.007
		(0.013)		(0.014)		(0.014)		(0.014)
Self-esteem		0.001		-0.004		-0.004		-0.004
		(0.022)		(0.024)		(0.024)		(0.024)
F-test of NC coeffs		F(3, 1837)=4.18		F(3, 1588)=3.46		F(3, 1588)=3.64		F(3, 1582)=3.26
		p <.01		p <.05		p <.0 . 5		p <.05
R-sqr	0.071	0.081	0.072	0.083	0.068	0.080	0.078	0.088
N	1849	1849	1601	1601	1602	1602	1599	1599

Note: The dependent variable is log of gross hourly wage. Specification (1) does not control for non-cognitive skills, while specification (2) does. All specifications include the following additional controls: gender, ethnicity as well as regional dummies. Further control for missing values in the sample for degree-observations as well as non-cognitive skill observation are also included (see Section 4). All observations are weighted by the most recent LSYPE sample weights.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

bias test (Oster, 2019) using the pooled data and the log wage rate as the dependent variable. Columns (1) and (4) are drawn from the first block of Table 2.5 to remind ourselves that controlling for NC skills barely reduces the wage premium. Comparing columns (3) and (6) we see that controlling for NC skills increases the selection on unobservables which would confound the observed treatment effect only fractionally. It follows that the bias in the estimates for the wage premium is not greatly affected by controlling for non-cognitive skills. We conclude that controlling for non-cognitive skills does not significantly decrease selection, thus the omission of these skills in other studies looking at wages as the outcome does not appear to be a cause for concern.

However, there is a case for thinking that IPWRA estimates are more robust to selection than OLS. Table 2.9 presents the IPWRA results for the pooled sample, comparable with the OLS estimates in Table 2.5. The headline estimates from Table 2.9 are, indeed, smaller than corresponding OLS results (by about 4%) but the pattern of results from the IPWRA analysis is very similar to before. The difference in estimates between specifications which control for NC skills and not remains modest at around 1 percentage point. The estimated wage premia fall across the board - driving the Arts & Humanities treatment effect to become insignificantly different from zero, when it had been about 6% and significant. The same is true for the Arts & Humanities estimate for the non-elite graduates - it is significantly large and negative. While the treatment model (IPWRA) estimates on NC skills are statistically significant the outcome model estimates are not.

2.5.2 Earnings

All of the developing literature that uses administrative data provide estimates of earnings, not wage rate, premia. For some purposes, at least, we are interested in the wage rate premium. In Table 2.10 we tabulate the returns to a degree in terms of weekly earnings to complement the wage rate estimates in Table 2.5. As before, we look at overall returns, returns by institution type, by subject group, and by subject group AND type of institution. Overall the graduate earnings premium, without controlling for NC skills, is 18.2%, while controlling for NC skills this reduces to 16.4%. These estimated earnings premia are significantly higher than the wage premia of Table 2.4, reflecting a large (around 6%) positive impact on hours (of over 2 hours, on average). These effects are higher than was the case for wages, which leads us to conclude that graduates also work more hours in addition to receiving a

Table 2.7: Wage returns to a degree (OLS - female)

	Overall		by Institution		by Subject		by Subject x Institution	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Degree	0.130***	0.121***						
	(0.022)	(0.022)						
Russell			0.229***	0.213***				
			(0.036)	(0.036)				
Other HEI			0.098***	0.091***				
			(0.025)	(0.025)				
STEM					0.204***	0.193***		
					(0.027)	(0.027)		
Social Sciences					0.152***	0.146***		
					(0.036)	(0.036)		
Arts&Humanities					0.054	0.041		
					(0.031)	(0.032)		
STEM*Russell							0.315***	0.301***
							(0.044)	(0.044)
STEM*Other							0.161***	0.152***
							(0.029)	(0.029)
SocSc*Russell							0.226**	0.214**
							(0.071)	(0.072)
SocSc*Other							0.132***	0.128***
							(0.039)	(0.039)
A&H*Russell							0.135**	0.116*
							(0.052)	(0.052)
A&H*Other							0.029	0.019
							(0.034)	(0.034)
Locus of control		0.032***		0.027**		0.028**		0.027**
		(0.009)		(0.010)		(0.010)		(0.010)
Work ethic		0.020		0.022*		0.023*		0.021
		(0.010)		(0.011)		(0.011)		(0.011)
Self-esteem		-0.008		-0.008		-0.009		-0.009
		(0.010)		(0.011)		(0.011)		(0.011)
F-test of NC coeffs		F(3, 2216)=6.45		F(3, 1915)=4.88		F(3, 1915)=5.55		F(3, 1906)=4.95
		p <.001		p <.01		p <.001		p <.01
R-sqr	0.066	0.077	0.072	0.082	0.075	0.085	0.082	0.091
N	2228	2228	1928	1928	1929	1929	1923	1923

Note: The dependent variable is log of gross hourly wage. Specification (1) does not control for non-cognitive skills, while specification (2) does. All specifications include the following additional controls: gender, ethnicity as well as regional dummies. Further control for missing values in the sample for degree-observations as well as non-cognitive skill observation are also included (see Section 4). All observations are weighted by the most recent LSYPE sample weights.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 2.8: Wage premium sensitivity to selection bias

	(1) OLS	(2) bias adj. β with δ=1	(3) δ^0 for β=0	(4) OLS with NC	(5) bias adj. β with δ=1	(6) δ^0 for β=0
Degree	0.113***	0.078*	1.787*	0.106***	0.073*	1.899
	(0.016)	(0.036)	(0.764)	(0.017)	(0.029)	(0.981)
R-sqr	0.073			0.082		
N	4,077			4,077		

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: The dependent variable is log gross hourly wage. Specifications (1) and (4) include gender, ethnicity, and regional dummies. All observations are weighted by LSYPE sample weights. (2) and (5) shows the bias adjusted β with δ fixed at 1 (obtained with Stata command *psacalc* provided by Oster (2019) to test the coefficient stability of specification (1) and (4). Columns (3) and (6) shows how much proportional selection in unobservables will fully confound the estimate for β, where we fix R_{max}=1.3$\tilde{R}$ for reasons outlined in Oster (2019).

higher wage than non-graduates [10]. The effect of a standard deviation change in locus of control is now larger at 4.7%, and contrary to the wage specifications work ethic is statistically significant too, with an effect of 4.5%. Graphing the distribution of weekly hours worked by work ethic supports the positive effect observed (see Appendix A).

Controlling for NC skills, a Russell graduate earns 33.7% more than a non-graduate, much higher than the corresponding wage effect of 20%, while a graduate from a non-elite HE institution earns just 9.3% more in weekly earnings, also higher than the wage premium of 5.6%. The corresponding estimates without NC skill controls are 37% and 10.6% respectively. The average returns to a STEM and Social Science degree are 24.1% and 21.8% respectively without NC skill control and controlling for them decreases these estimate by around 2%. Arts & Humanities provide an earnings premium of 6% and 8.1%, with and without NC skills, although the former is not significantly different from zero.

Earnings premia are once again higher for each subject group at Russell universities. Controlling for NC skills, STEM at an elite university has an earnings premium of 35.6%, while it is only 17.1% at non-elite institutions. These estimates are slightly

[10]There appears to be little research on how weeks worked per annum, or the entitlement to paid vacation days, vary by education. Bryan, 2006 appears to be the only study for the UK that bears on this. This uses the Labour Force Survey (similar to the US CPS) and estimated reduced form effects of degree premia of around 0.9 hours per week and of one additional day of annual vacation. Since these results also control for a wide range of bad controls it seems likely that they will be considerable underestimates.

Table 2.9: Wage returns to a degree (IPWRA - pooled)

	Overall		by Institution		by Subject		by Subject x Institution	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Degree	0.085***	0.075**						
	(0.024)	(0.023)						
Russell Group			0.162***	0.148***				
			(0.042)	(0.039)				
Other HEI			0.028	0.013				
			(0.035)	(0.032)				
STEM					0.106***	0.095***		
					(0.028)	(0.027)		
Social Sciences					0.102**	0.096**		
					(0.034)	(0.034)		
Arts&Humanities					-0.033	-0.045		
					(0.035)	(0.035)		
STEM*Russell							0.169***	0.159***
							(0.049)	(0.047)
STEM*Other							0.081*	0.071*
							(0.037)	(0.035)
SocSc*Russell							0.205**	0.178*
							(0.073)	(0.073)
SocSc*Other							0.058	0.0.039
							(0.047)	(0.048)
A&H*Russell							0.032	0.018
							(0.059)	(0.050)
A&H*Other							-0.095*	-0.096*
							(0.048)	(0.038)
N	2254	2254	1940	1940	1944	1944	1923	1923

Note: The dependent variable is log of gross hourly wage. Specification (1) does not control for non-cognitive skills, while specification (2) does. All specifications include the following additional controls: gender, ethnicity as well as regional dummies. All observations are weighted by the most recent LSYPE sample weights.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

higher when not controlling for NC skills, at 38.2% and 18.7% respectively. Social Sciences obtained from a Russell university show the highest earnings premium at 37.2% with NC skills and 41.1% without. It should also be noted that while Arts & Humanities at a non-elite institution, although not statistically significant, have a small negative return at -1.6% (controlling for NC skills) obtaining an Arts & Humanities degree, from an elite university, gives a relatively high premium of 27.8% in terms of weekly earnings, compared to the 13% wage premium.

Locus of control is statistically significant in all specifications and shows an effect of around 4.5% per standard deviation. Contrary to the wage specifications, work ethic is highly statistically significant in all earnings specifications, with a similar return. This is consistent with high work ethic graduates working longer hours.

Similarly to Table 2.8 in the case of wages, Table 2.11 presents results for the Oster sensitivity to selection bias test, here for the earnings estimates. Specifications with and without non-cognitive controls result in a lower bound of the earnings premium that is approx. 5 percentage points lower than the OLS estimate. Comparing columns (3) and (6), including more controls gives us a coefficient of proportionality between unobservables and observables that is smaller, meaning the relative degree of importance between unobservables and observables in explaining the outcome has reduced, compared to a specification that does not control for non-cognitive skills. It seems that in terms of earnings, the two statistically significant non-cognitive skills locus of control and work ethic do improve on the specification and reduce bias. It warrants caution that if earnings regressions are not able to control for NC skills, the bias may be more of an issue because of the effect of degree on hours worked and controlling for a form of work ethic would be more important.

We have also looked at the returns of higher education using other definitions of non-cognitive skills. We have applied principal component analysis to all the non-cognitive skill statements discussed in Section 3.2 (and originally used in the main analysis) and obtained 3 factors that can be broadly summarized into locus of control, work ethic, and self-esteem (only the latter is the same as the previous definition because the statement "How well you get on in this world is mostly a matter of luck" is now attributed to the second factor instead of locus of control). Table A.3 shows the specifications using these non-cognitive skills. It becomes apparent that only work ethic is statistically significant and of quantitative importance, with a return of 2.5%. The robustness of the estimate of the returns to a degree is similar to the previous specifications. The estimates are at most reduced by 2 percentage points.

Last but not least interacting NC skills with HE does not find any difference in impact of NC skills on outcomes and supports the conclusion that NC skills are

important for earnings but there is not any more of an effect for graduates compared to nongraduates.

2.5.3 Returns to Degree Classifications: Wages and Earnings

Figure 2.4 showed that the average (across males and females) percentage of graduates that obtained a First classification was 18%, while the percentage obtaining an Upper Second classification was 52%, and 30% received a lower degree classification. Most of this cohort will have graduated from university around 2012 and these figures are close to the national averages at the time (although there has been a great deal of "grade inflation" around this period).

Although undergraduate students are relatively homogeneous within courses (i.e a particular major at a particular institution), because courses select largely by prior test scores, the degree class outcomes vary greatly across individuals within a course. We surmise that the NC skills that students on a course have are the important unobservable, to the course admission authority, that drives academic success conditional on being admitted. LSYPE records the degree class of each individual graduate. We treat NC skills as exogenous, conditional on course, and estimate the wage and earnings premia to different degree classes, including NC skills in the specification and not.

Our prior is that employers of graduates at such an early age have had little opportunity to establish and reward NC skills so degree class acts as a signal to employers. Thus, we expect that NC skills conditional on degree class will not greatly affect wages and that degree class, at least in the short run, acts as a sufficient statistic for NC skills. Indeed, one role that a degree might play is to signal skills to the potential employers of newly minted graduates, and being able to credibly communicate NC skills through degree class might be a reliable way for good graduates to do so.

Table 2.12 shows the estimated degree class effects on wages and earnings [11]. Focusing on columns 1-4 for the OLS wage premia in Table 2.12 we see that NC skills no longer have significant effects. Previously, in Table 2.5, LoC had an effect of 3.3% compared to an insignificant effect of 1.3% in Table 2.12. Graduates with a first class degree earn 15.9% more than non-graduates, estimated by OLS, which is not significantly greater than the 13% premium for an upper second class degree. However, the return to a lower-second or third class degree is just 1% which is not significantly different from the counterfactual non-graduate wage. The suggestion

[11] Tables 2.5 and 2.10 include NC skills, but estimation that does not control for NC-skills results in estimates that are on average 1% higher (in line with earlier results).

Table 2.10: Earnings returns to a degree (OLS - pooled)

	Overall		by Institution		by Subject		by Subject x Institution	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Degree	0.182***	0.164***						
	(0.022)	(0.022)						
Russell Group			0.370***	0.337***				
			(0.033)	(0.033)				
Other HEI			0.106***	0.093**				
			(0.026)	(0.026)				
STEM					0.241***	0.221***		
					(0.030)	(0.030)		
Social Sciences					0.218***	0.200***		
					(0.035)	(0.034)		
Arts&Humanities					0.081*	0.060		
					(0.033)	(0.033)		
STEM*Russell							0.382***	0.356***
							(0.055)	(0.056)
STEM*Other							0.187***	0.171***
							(0.032)	(0.032)
SocSc*Russell							0.411***	0.372***
							(0.049)	(0.049)
SocSc*Other							0.140***	0.133***
							(0.040)	(0.040)
A&H*Russell							0.309***	0.278***
							(0.045)	(0.045)
A&H*Other							-0.003	-0.016
							(0.038)	(0.038)
Female	-0.237***	-0.231***	-0.237***	-0.233***	-0.233***	-0.230***	-0.229***	-0.226***
	(0.019)	(0.019)	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)
Locus of control		0.047***		0.044***		0.046***		0.044***
		(0.010)		(0.011)		(0.011)		(0.011)
Work ethic		0.045***		0.045***		0.047***		0.042***
		(0.012)		(0.013)		(0.012)		(0.012)
Self-esteem		0.010		0.010		0.008		0.008
		(0.010)		(0.011)		(0.011)		(0.011)
F-test of NC coeffs		F(3, 4160)=16.25		F(3, 3602)=13.59		F(3, 3603)=14.97		F(3, 3591)=13.12
		p <.001		p <.001		p <.001		p <.001
R-sqr	0.125	0.143	0.134	0.152	0.127	0.146	0.139	0.156
N	4173	4173	3616	3616	3618	3618	3609	3609

Note: The dependent variable is log of gross weekly earnings. Specification (1) does not control for non-cognitive skills, while specification (2) does. All specifications include the following additional controls: gender, ethnicity as well as regional dummies. Further control for missing values in the sample for degree-observations as well as non-cognitive skill observation are also included (see Section 4). All observations are weighted by the most recent LSYPE sample weights.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 2.11: Earnings premium sensitivity to selection bias

	(1) OLS	(2) bias adj. β with δ=1	(3) δ^0 for β=0	(4) OLS with NC	(5) bias adj. β with δ=1	(6) δ^0 for β=0
Degree	0.182***	0.135***	2.028**	0.164***	0.106**	1.863**
	(0.022)	(0.039)	(0.645)	(0.022)	(0.035)	(0.651)
R-sqr	0.125			0.143		
N	4,173			4,173		

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: The dependent variable is the log of gross weekly earnings. Specifications (1) and (4) include gender, ethnicity, and regional dummies. All observations are weighted by LSYPE sample weights. (2) and (5) shows the bias adjusted β with δ fixed at 1 (obtained with Stata command *psacalc* provided by Oster (2019) to test the coefficient stability of specification (1) and (4). Columns (3) and (6) shows how much proportional selection in unobservables will fully confound the estimate for β, where we fix R_{max}=1.3$\tilde{R}$ for reasons outlined in Oster (2019).

is that around *one third* of students experience no significant financial gain from university. When we contrasted Table 2.5 OLS estimates with Table 2.9 we found lower wage premia across comparable specifications. Similarly, here, in Table 2.12 we also find lower degree class estimates using IPWRA compared to OLS and the effects of lower second and third class are now negative, albeit insignificantly so. The NC skills remain individually insignificant.

Looking at degree class earnings premia, in Table 2.12 columns 5-8, we find IPWRA generate lower estimates of degree class earnings premia, as before for wages. Work ethic remains significant in the OLS specification and suggests a one SD rise would raise hours by approximately 4. LoC remains significant in the IPWRA specification for first class but not otherwise.

2.6 Discussion and Conclusion

The aim of the study has been to explore the robustness of estimates of the financial return to Higher Education to the inclusion of non-cognitive skills such as locus of control, conscientiousness (here proxied by adolescent work ethic) and self-esteem. We use OLS and Inverse Probability Weighted Regression Adjustment - both of which rely on no selection on unobservables, and apply 'Oster bounds' (following Oster, 2019) to assess bias arising from all potential unobservables (including NC skills). We exploit the most recent large-scale cohort study in the UK, the

Table 2.12: Wage and Earnings returns to degree classification

	Wage returns				Earnings returns			
	OLS		IPWRA		OLS		IPWRA	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1st	0.159***	0.122***			0.238***	0.200***		
	(0.031)	(0.034)			(0.043)	(0.046)		
2.1	0.130***		0.093***		0.199***		0.131***	
	(0.021)		(0.028)		(0.027)		(0.034)	
≤ 2.2	0.010			-0.017	0.048			-0.020
	(0.025)			(0.031)	(0.036)			(0.046)
Female	-0.089***	0.018	-0.085*	-0.106*	-0.233***	-0.061	-0.127*	-0.102
	(0.018)	(0.060)	(0.040)	(0.052)	(0.025)	(0.091)	(0.051)	(0.080)
Locus of control	0.013	0.037	0.022	-0.040	0.024	0.066*	0.047	-0.046
	(0.009)	(0.030)	(0.022)	(0.027)	(0.014)	(0.038)	(0.029)	(0.042)
Work Ethic	0.016	-0.011	-0.001	0.025	0.056**	0.027	0.026	-0.011
	(0.012)	(0.038)	(0.031)	(0.030)	(0.018)	(0.043)	(0.031)	(0.050)
Self Esteem	0.015	0.026	0.025	0.005	0.021	-0.026	0.029	0.045
	(0.010)	(0.026)	(0.020)	(0.023)	(0.015)	(0.038)	(0.029)	(0.034)
R-sqr	0.085	-	-	-	0.136	-	-	-
N	2173	1408	1408	1408	2225	1438	1438	1438

Note: The dependent variable is log of gross hourly wage. All specifications include the following additional controls: gender, ethnicity as well as regional dummies. OLS specifications further control for missing values in the sample for degree-observations as well as non-cognitive skill observation (see Section 4). IPWRA estimates the average treatment effect on treated under the assumption of no selection on unobservables. All observations are weighted by the most recent LSYPE sample weights.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Longitudinal Study of Young People (LSYPE), which follows the lives of individuals since 2004 (aged 13-14) until the most recent wave (8) at age 25. This wave contains not only updated information on the individual's life but also includes, for the first time, labor market outcomes such as wages, earnings, hours, and employment status.

We estimate both the wage rate premium as well as the earnings premium. Across both, OLS and IPWRA, estimation methods used, the results do not suggest that previously estimated graduate premia have been significantly overestimated because of the omission of NC skills. Indeed, controlling for non-cognitive skills changed the estimates relatively modestly for both outcomes (wages & earnings).

The wage returns to higher education, estimated for people observed at this age, are in line with the previous literature - averaging around 10%. This is lower than typical estimates obtained from data containing individuals from across the life-cycle - reflecting the very early stage of the life-cycle of LSYPE. IPWRA estimates are generally consistently slightly lower than OLS estimates. In fact, our IPWRA estimates are close to the Oster bounds, which might suggest that this weighting method does contribute to reducing ability bias. Non-cognitive skills reduce the estimate for the graduate premia by 2% on average. The non-cognitive skill that stands out as being the only statistically significant one, for almost all specifications, was locus of control in the case of wages, and work ethic in the case of earnings. These appear to be quantitatively important since a 1 standard deviation change in each of the two NC skills could have approximately the same effect on earnings as a third of the effect that a degree has.

While we have shown, surprisingly, that controlling for non-cognitive skills makes largely no significant difference to our estimates of the return to a degree there is some evidence for caution in the case of earnings. In the case of the wage rate premium the bias in the estimates is not greatly affected by controlling for non-cognitive skills and after a selection sensitivity analysis (Oster, 2019) we conclude that controlling for non-cognitive skills does not significantly decrease selection. Thus the omission of these skills in other studies looking at wages as the outcome does not appear to be a cause for concern.

Contrary to the wage specifications, where only locus of control stands out as a statistically significant NC skill, work ethic is highly statistically significant in all earnings specifications, with a similar return (as locus of control). This is consistent with high work ethic graduates working longer hours. Furthermore, it seems that in terms of earnings, the two statistically significant non-cognitive skills locus of control and work ethic do improve on the specification and reduce bias. It warrants caution that if earnings regressions are not able to control for NC skills, the bias may

be more of an issue because of the effect of degree on hours worked. Controlling for a form of work ethic would be more important.

In general controlling for non-cognitive skills makes no significant difference to wage and earnings estimates of a degree and this remains true when we disaggregate degree by subject groups, by elite vs non-elite HEIs, and by both. Overall, we find much larger graduate earnings premia than graduate wage premia - this is consistent with the idea that graduates have greater human capital and may wish to use it more intensively. This is also reflected in work ethic being a more important determinant of earnings than of wages.

We also explored the premia associated with the different degree classifications with the assumption/hypothesis that the NC skills that students on a course have are the important unobservable, to the course admission authority, that drives academic success conditional on being admitted. We show that NC skills conditional on degree class will not greatly affect wages (remain insignificant) and that degree class, at least in the short run, acts as a sufficient statistic for NC skills. We draw the conclusion that one role that a degree might play is to signal skills to the potential employers of newly minted graduates, and being able to credibly communicate NC skills through degree class might be a reliable way for good graduates to do so. It also follows that if NC skills are missing in the dataset, degree class may be a suitable proxy for it. We also show that around *one third* of students experience no significant financial gain from university if looking at degree class as an outcome.

It does not appear, however, that the effect of NC skills on premia is significantly different between graduates and non-graduates. Thus, it appears that failing to control for locus of control does not affect the returns to a degree. Furthermore, allowing for differentials associated with degree class results in a loss in the significance of NC skills. It seems that degree class captures, to a large extent, the effects of the relevant NC skills.

There are many extensions that would be interesting to explore, including more comprehensive analyses by gender. While it is not unusual to exploit outcomes at age 25, one should bear in mind that these individuals are still relatively early in their career path so graduates will have much less work experience relative to those that some have just finished university while those who did not pursue Higher Education would have acquired more work experience. In particular, it is possible that the effects of NC skills may only become apparent later, after more work experience has been accumulated. So far we show that the effects of these NC skills are important, but its not yet clear whether or not they fade in later life. Thus, it would be interesting to study this further with the next wave of LSYPE at age 32.

If a larger sample were available, it would be useful to apply the Heckman, Stixrud, and Urzua, 2006 methodology and estimate a latent factor model on this data. In future research, beyond the scope of this paper, one could also look at outcome variables beyond labor market outcomes. For example, LSYPE hass information on criminal behavior and health measures.

Chapter 3

The Non-Pecuniary Returns to being a Graduate: Evidence from a Large English Cohort Study

3.1 Introduction

There are very few studies that explore the wider effects of **Higher** Education despite the importance attached to potential social returns to Higher Education - that would support a case for government tuition subsidies. Much of the existing work is confined to education in general, often measured by years, and often assuming linear marginal effects. Our first contribution is to model the correlation between graduate status and a wide variety of non-pecuniary outcomes. How one decides which of these outcomes are private and which are social is a difficult call - indeed, these will vary by context and what applies in the UK, with its extensive health service and a relatively generous welfare system, will not necessarily apply in the US. However, this definitional point is largely moot because the pattern of effects are broadly commensurate across many outcomes.

Our second contribution is that we model heterogeneity in the effects across types of graduate. We are motivated by the heterogeneity research that has been a feature of recent work on financial returns. The extent to which non-pecuniary effects are correlated with pecuniary ones across this heterogeneity is also important - there may be a case for thinking that subjects and/or institutions with high social returns merit greater subsidies. We have not been able to identify studies that explore such heterogeneity of effects. However, we find, broadly speaking, that there are rather

few outcomes where there are large significant differences. This applies across institution types, comparing the elite institutions with the rest; and it also applies across subject types, comparing STEM with Social Sciences and with the Arts & Humanities. This relative uniformity suggests that there is little correlation between the pecuniary returns, which were found to be large in STEM and Social Sciences but insignificantly different from zero for Arts & Humanities in Buchmueller and Walker, 2020, and the non -pecuniary returns found here using the same data. We find no evidence that pecuniary and non-pecuniary returns are negatively correlated - that might be suggested if these were compensating differentials.

The chapter proceeds as follows. Section 3.2 reviews the relevant literature. Section 3.3 describes the data and (outcome) variables; Section 3.4 outlines the method; and Section 3.5 presents and explains the results. Section 3.6 concludes.

3.2 Related Literature

The financial returns to education have been studied extensively in the literature but graduates are likely to take away much more than the higher pay that is associated with being a graduate. This pecuniary benefit is largely a private one. The literature, without exception, looks at gross income - which may exaggerate the net private returns to the extent that taxes on earnings are progressive. Several studies suggest that the tax revenue (and reduced welfare payments) associated with higher education should be counted as a social benefit (Department for Business and Skills, 2013).

While there has been increased interest on the wider benefits of education, especially when focusing on higher level education, studies of the financial returns (see Oreopoulos and Petronijevic, 2013) still far outweigh those on non-pecuniary outcomes, whether private or social. The framework adopted, if only implicitly, is one of educational production whereby better skills makes for better decisions regarding life outcomes, either by achieving more with the same resources (productive efficiency) or by choosing a more favourable 'input mix' (allocative efficiency) (Grossman, 2006).

There are a large number of outcomes in the literature that have been associated with increased levels of education - apart from the private pecuniary returns: health-related behaviours and outcomes; choosing ones partner, the stability of partnership (Becker, 1973, Lafortune, 2013), parenting skills (Kalil, Ryan, and Corey, 2012), and the timing/number of children (Brand and Davis, 2011, Rindfuss, Bumpass, and St. John, 1980); behaviours that are associated with increased trust (Helliwell and Putnam, 1999, Oreopoulos and Salvanes, 2011), and tolerance (Borgonovi,

2012, Kingston et al., 2003); higher civic engagement, which includes political participation and time spent on volunteering activities and (perhaps) reduced criminal activity (see Machin, Marie, and Vujić, 2011; Oreopoulos and Salvanes, 2011; Hout, 2012).

Beyond this, there are studies that explore spillovers/externalities. For example, there are a few studies on productivity spillovers within firms or within localities - such as Acemoglu and Angrist, 2000, Moretti, 2004, and Martins and Yip (2010). Even when there are no such indirect spillovers there may be effects that are mediated by the labour market. For example, if high- and low-skill workers are imperfect substitutes, then an increase in the supply of the former will affect the wage rates of both types of workers (Ciccone and Peri, 2006). While this is a form of general equilibrium effect rather than a spillover, it would feel the same as a spillover to the workers concerned. Technological spillovers that arise from the effects of firm R&D on other firms is more distantly related to conventional productivity spillovers - but since R&D spending is largely driven by the costs of highly skilled workers an increase in R&D spending by one firm affects other firms - for example, one transmission mechanism is through the mobility of skilled workers (see Stoyanov and Zubanov, 2012).

Brennan, Durazzi, and Séné, 2013 and Department for Business and Skills, 2013 summarise a wide variety of literature concerned with higher education impacts which are categorised along two dimensions: private vs market effects, and individual vs social effects. In reviewing further studies we focus on outcomes that fall under individual and social non-market benefits.

We consider start with causal links established in the literature through the popular use of changes to legal school leaving ages (US; *Raising of the School Leaving Age* in UK) for identification strategy and why inference cannot be made for impacts of Higher Education; as well as other studies with quasi-experimental methods. Thus, much of the literature does not distinguish between variation in education associated with schooling from variation in education associated with college. There are only two examples of causal identification in the context of college degrees. We then move on to examples that do not attempt to provide causal effects and summarise some of the more salient studies.

In the context of health outcomes this framework is behind the transmission in the longstanding Grossman model (see Grossman, 2006). Galama, Lleras-Muney, and Van Kippersluis, 2018 summarises the most important causal studies of this kind in an extensive review of experimental and quasi-experimental evidence on the effects of education on mortality, obesity and smoking. The review concludes that there are moderate effects on mortality, although these seem to be sensitive to settings

(outcome studied, country, time period), and there is no conclusive support on the effects on obesity and the effect on smoking, which is thought to be driven by peer effects rather than education *per se*. Some of the most salient studies are further highlighted below.

Lleras-Muney, 2005 finds education lowers the risk of premature death. A further example is Glied and Lleras-Muney, 2008 who find higher educated individuals take better advantage of technological advances to lower mortality, and improving other dimensions of health such as cardiovascular outcomes and weight outcomes (Fletcher, 2015). Cutler and Lleras-Muney, 2010 look at the education gradient for a variety of different health outcomes and health behaviours using US and UK datasets. They find large positive associations between education and healthier behaviours as more educated individuals are "less likely to smoke, less likely to be obese, less likely to be heavy drinkers, more likely to drive safely and live in a safe house, and more likely to use preventive care."

Whatever the outcome analysed, the majority of this evidence does not specifically distinguish between higher education and the rest of the education distribution, or does not explicitly consider the effect of higher education, relative to education as a whole. Exploiting changes made to compulsory schooling laws as an identification strategy to uncover causal effect is common, but the weakness of an effect of such "RoSLA" reforms on levels of education above the (new) minimum (see Chevalier et al., 2004) in the UK and Lang and Kropp, 1986 in the US) suggests that this could not be a strategy that would work for exploring the causal effect of higher education *per se*.

Devaux et al., 2011 explores the link between education and obesity in England as well as in Australia, Canada, and Korea and England. In the case of England this study uses the Health Survey for England (1991-2005). The authors show that the marginal effect of successive years of education does fall dramatically across years of education. While the multi-level modelling approach taken in this work does allow for mediation (via the behavior of other household members) the work cannot be thought of as causal since it is ultimately a random effects approach.

Sabates and Feinstein, 2004 use the British Household Panel Survey and 'highest qualification completed' converted to NVQ (National Vocational Qualifications, the top one of which indicated graduate status) to assess differences by education levels in the uptake of screening for cervical cancer - an example of takeup of preventative health services. They find a positive correlation with having NVQ2 (passing grades in GCSE and equivalent) qualifications corresponding to age 16, but also statistically insignificant.

There are, however, a few attempts at causal estimation in the higher education context, outside of the UK, that provide some support for the idea that it may have a causal effect on health and health behaviours. For example, De Walque, 2007 provides causal evidence on the effect of education in lowering the likelihood of smoking, where the identification strategy exploits the fact that during Vietnam War college attendance provided an opportunity to avoid the draft. In addition to a lower probability of smoking for educated individuals, he also found that those who smoked experiences an increased probability of cessation. Buckles et al., 2016 uses the same identification strategy and finds negative effects on mortality, but only in middle age. Fletcher and Frisvold, 2009 use sibling fixed effects, augmented by matching, to explore the impact of education on preventive care. They use a large cohort of Wisconsin high school graduates, and find that attending college is associated with a sizeable increase in the use of several forms of preventive care. Bratti and Miranda, 2010 establish a negative link between HE in the UK and the intensity/frequency of smoking, but it is based on the implausible restriction that parental education does not affect smoking conditional on educational attainment.

Beyond health outcomes there is limited evidence on Higher Education impact on wider outcomes in UK data. Ogg, 2006 uses a single cross-section from a small UK survey and presents only correlations between education levels and a variety of outcomes (e.g. political involvement, attitudes towards immigration). Borgonovi, Miyamoto, et al., 2010 summarise existing evidence that sheds little light on the role of higher education in promoting civic engagement, interpersonal trust and tolerance, with stronger effects found in the US than in the UK/Europe.

Results vary largely across studies. Various outcomes have been studied under different contexts (countries, educational attainment levels, etc) as well as on different samples. This chapter looks at a large number of outcomes for a given sample, allowing to compare between outcomes and explores heterogeneity across institution type and degree subjects.

3.3 Data & Descriptives

The data used comes from the Longitudinal Study of Young People in England (LSYPE) . This is a large-scale cohort study that follows the lives of around 16,000 people born in 1989-90 in England. Cohort members were aged 13-14 when the study began in 2004 and were interviewed every year until 2010, aged 19-20. The sampling was stratified with secondary schools being selected at random and from all schools, and pupils within each school selected at random. LSYPE selected observations to be representative of the English school population, but

specific groups were oversampled - in particular, youths from low socioeconomic backgrounds and minorities (see Department for Education, 2010). More details can be found in Centre for Longitudinal Studies, 2018 and Anders, 2012. The LSYPE pupils were revisited in 2016, aged 25, to provide some insights into their lives as young adults.

Treating the data as a cross-section provides information on the educational and labour market experiences, economic circumstances, family life, physical health and emotional wellbeing/indicators of mental health, social participation, attitudes and adult identities, and non-cognitive skills - and as such provides the necessary insight into a multitude of non-pecuniary outcomes at age 25.

LSYPE achieved cross-sectional responses rates ranging from 48% (in Wave 8), to 84% (in Wave 2). For waves 1 to 7, the sample issued (response rate denominator) at each wave comprised respondents from the immediately preceding wave who agreed to be re-contacted. Despite reasonably good cross-sectional response rates, the sample size was reduced to 7,707 by Wave 8 from an initial 15,774 responses at Wave 1. The fact that many of the participants in Wave 8 had not participated in each wave, due to the sequential sampling method, means that out of the 7,707 Wave 8 participants, many do not have a complete history from participation in all waves. This type of attrition could pose a problem for our study if, conditional on observed covariates, survey attrition is related to higher education and further outcomes.

3.3.1 Outcome Variables Overview

The outcomes explored in this study range from various indicators of self-reported physical and mental health, overall life satisfaction, family life, and fertility, to trust, risk and patience profiles, adult identities, and social engagement and participation.

To assess health outcomes at age 25 we look at: self-assessed general health, Body Mass Index, amount of weekly exercise, average hours of sleep, and an indicator for Alcohol Use Disorders. We look at the 'General Health Questionnaire (GHQ12) score Goldberg, Williams, and London, 1988 as a mental health indicator, and at overall life satisfaction as an indicator of wellbeing. Family life and fertility outcomes are: legal marital status, and the number of children aged 0-4, and the number of children aged 5-11. Further outcomes are the trust, risk and patience profiles, adult identities such as 'Whether you consider yourself to be an adult' and 'Whether you feel you have matured fully', and societal engagement such as frequency of voluntary/unpaid work, frequency of donating money to charities, frequency of participating in public meetings/demonstration, and lastly interest in

politics.

Table 3.1 shows the raw statistics on all outcomes by gender and Table 3.2 by degree status.

All individual outcome variables and their differences between graduates and non-graduates are explained in more detail below.

Table 3.1: Raw Statistics for Outcomes by gender

	Male		Female		Total			
Outcome variable	mean	sd	mean	sd	mean	sd	min	max
Self-assessed general health	3.849	0.978	3.802	0.950	3.827	0.965	1	5
DV: Body mass index	25.399	4.815	25.295	6.309	25.351	5.560	4.49	91.13
DV: General Health Questionnaire (GHQ12) score (Goldberg&Williams1998)	2.120	3.0329	2.427	3.133	2.263	3.083	0	12
Number of days per week do exercise for 30min or more	3.427	2.202	2.765	2.0430	3.119	2.155	0	7
Hours slept per night (last 4 weeks)	7.00325	1.190	7.0735	1.248	7.036	1.218	0	15
DV: Alcohol Use Disorders Identification Test Consumption (AUDIT-C) scale	4.0837	2.560	3.326	2.270	3.731	2.458	0	12
Overall Life satisfaction	3.845	0.928	3.943	0.901	3.891	0.917	1	5
DV: Legal Marital Status	1.102	0.305	1.170	0.399	1.133	0.354	1	3
DV: Number of own children between 0 and 4	0.165	0.477	0.250	0.548	0.204	0.513	0	3
DV: Number of own children between 5 and 11	0.0499	0.256	0.100	0.350	0.0734	0.304	0	3
Trust scale	6.469	2.273	6.619	2.152	6.539	2.218	0	10
Risk scale	6.573	2.138	5.782	2.042	6.205	2.130	0	10
Patience scale	6.0724	2.568	6.205	2.386	6.134	2.486	0	10
Whether reached adulthood: You consider yourself to be an adult	3.448	0.739	3.421	0.761	3.436	0.749	1	4
Whether reached adulthood: You feel you have matured fully	2.885	0.887	3.001	0.891	2.939	0.891	1	4
How often do activity: Unpaid voluntary work unpaid help to other people	1.609	0.868	1.620	0.888	1.614	0.877	1	4
How often do activity: Money to charity fundraising event	1.995	0.821	2.0919	0.772	2.040	0.800	1	4
How often do activity: Public meeting/rally; public demonstration/protest	1.166	0.445	1.150	0.393	1.158	0.422	1	4
Interest in politics	2.476	0.982	2.180	0.883	2.339	0.949	1	4
N	1926	1926	2163	2163	4089	4089		

Table 3.2: Raw Statistics for Outcomes & by degree status

	Higher Education Status							
	No Degree		Degree		Not Applicable		Total	
	mean	sd	mean	sd	mean	sd	mean	sd
Outcome variables								
Self-assessed general health	3.776	0.949	3.970	0.896	3.787	0.966	3.860	0.938
DV: Body mass index	25.870	5.567	24.323	4.775	25.278	6.078	25.026	5.481
BMI (healthy/unhealthy weight)	0.496	0.500	0.610	0.488	0.528	0.499	0.554	0.497
DV: General Health Questionnaire (GHQ12) score (Goldberg & Williams1988)	2.147	2.925	2.142	2.860	2.223	3.170	2.171	2.985
Number of days per week do exercise for 30 mins or more	3.211	2.143	2.940	1.942	2.974	2.163	3.017	2.072
Hours slept per night (last 4 weeks)	7.012	1.272	7.108	1.002	7.028	1.268	7.057	1.167
DV: Alcohol Use Disorders Identification Test Consumption (AUDIT-C) scale	3.565	2.467	3.383	2.378	3.240	2.567	3.378	2.468
Overall life satisfaction	3.918	0.903	3.969	0.839	3.813	0.960	3.903	0.900
DV: Legal marital status	1.157	0.378	1.105	0.309	1.162	0.382	1.137	0.353
DV: Number of own children between 0 and 4	0.224	0.513	0.048	0.250	0.230	0.543	0.154	0.446
DV: Number of own children between 5 and 11	0.073	0.296	0.010	0.111	0.074	0.307	0.047	0.245
Trust scale	6.590	2.113	6.537	2.049	6.548	2.314	6.554	2.158
Risk scale	6.263	2.075	6.099	1.884	6.119	2.208	6.146	2.048
Patience scale	6.226	2.442	6.485	2.265	6.070	2.550	6.279	2.415
Whether reached adulthood: You consider yourself to be an adult	3.473	0.715	3.378	0.751	3.440	0.758	3.423	0.746
Whether reached adulthood: You feel you have matured fully	2.984	0.873	2.804	0.884	3.011	0.895	2.919	0.890
How often do activity: Unpaid voluntary work unpaid help to other people	1.633	0.897	1.725	0.901	1.553	0.854	1.643	0.887
How often do activity: Money to a charity fundraising event	2.094	0.803	2.233	0.778	2.017	0.827	2.125	0.807
How often do activity: Public meeting/rally; public demonstration/protest	1.136	0.382	1.214	0.473	1.156	0.431	1.175	0.439
Interest in politics	2.233	0.912	2.685	0.850	2.172	0.920	2.399	0.922
Observations	988	988	1691	1691	1410	1410	4089	4089

3.3.1.1 General Health

The general health outcome describes the individuals self-assessed general health at age 25 - 'How would you describe your health generally?'. The individual is asked to rate his/her health from poor to excellent on a 5-point Likert scale.

Figure 3.1: General Health

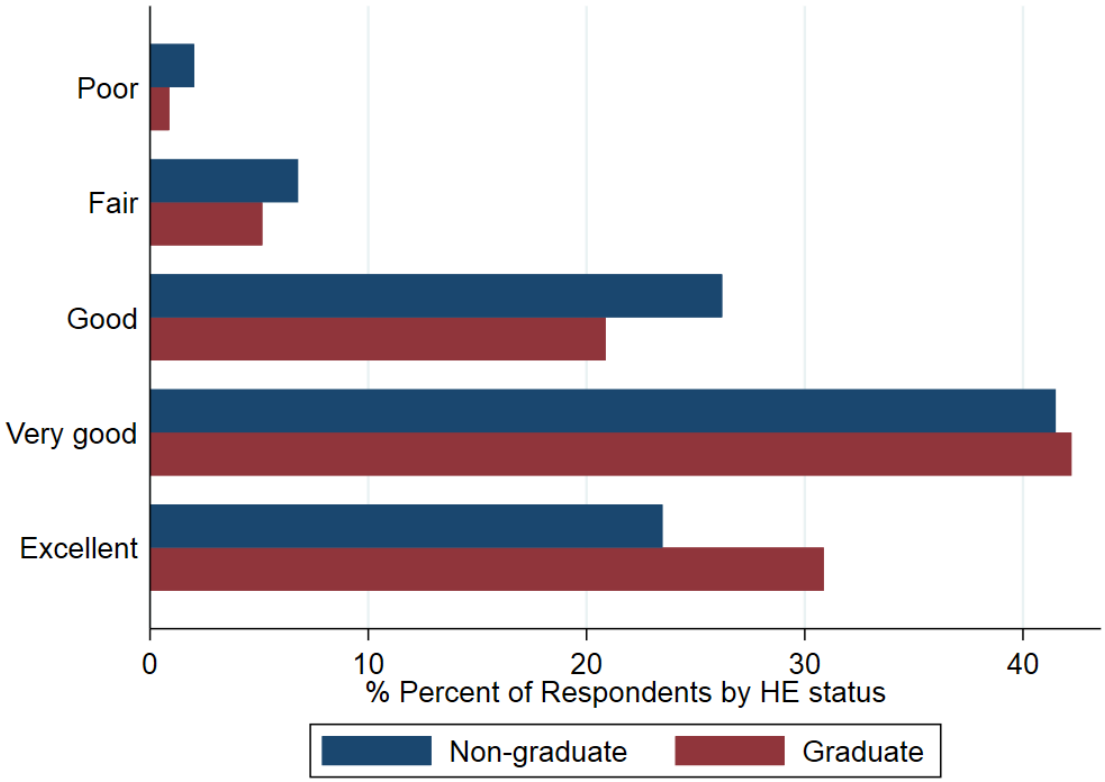


Figure 3.1 visualises the distribution of 'General Health' by degree-status. The majority of graduates (over 70%) report either 'Excellent' or 'Very Good' general health as well as showing a higher representation in each of these categories relative to non-graduates. Contrary, a higher percentage of non-graduates (compared to graduates) reports 'Good', 'Fair', or 'Poor' general health.

3.3.1.2 Body Mass Index (BMI)

BMI is the individual's Body Mass Index at age 25. It is a derived variable calculated from the person's given height and weight. The minimum recorded BMI is 4.49 and

the maximum (in the sample used) is 91.13. For simplicity and overview I use a 'Body mass index category' variable, which categorises the individual's calculated BMI according to whether they are underweight, healthy weight, overweight, or obese, according to World Health Organization (WHO) BMI thresholds. The categories are (1) Underweight, (2) Healthy weight, (3) Overweight, (4) Obese.

Figure 3.2: BMI Categories

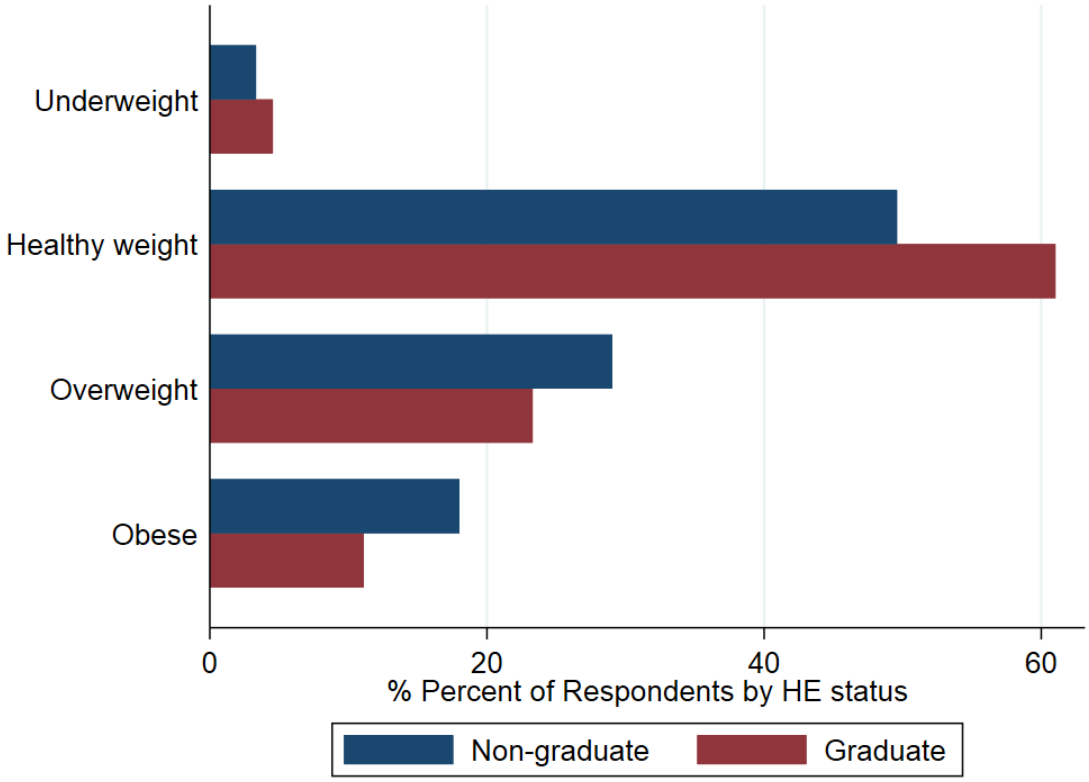


Figure 3.2 shows that relative to non-graduates, graduates have a lower weight on average, as there is a higher proportion of non-graduates being either 'Overweight' or 'Obese'. There are at least 10% more graduates that are categorised by a 'Healthy Weight', while there are between 5-10% more non-graduates categorised with either being 'Overweight' or 'Obese'.

3.3.1.3 GHQ12 (Mental Health)

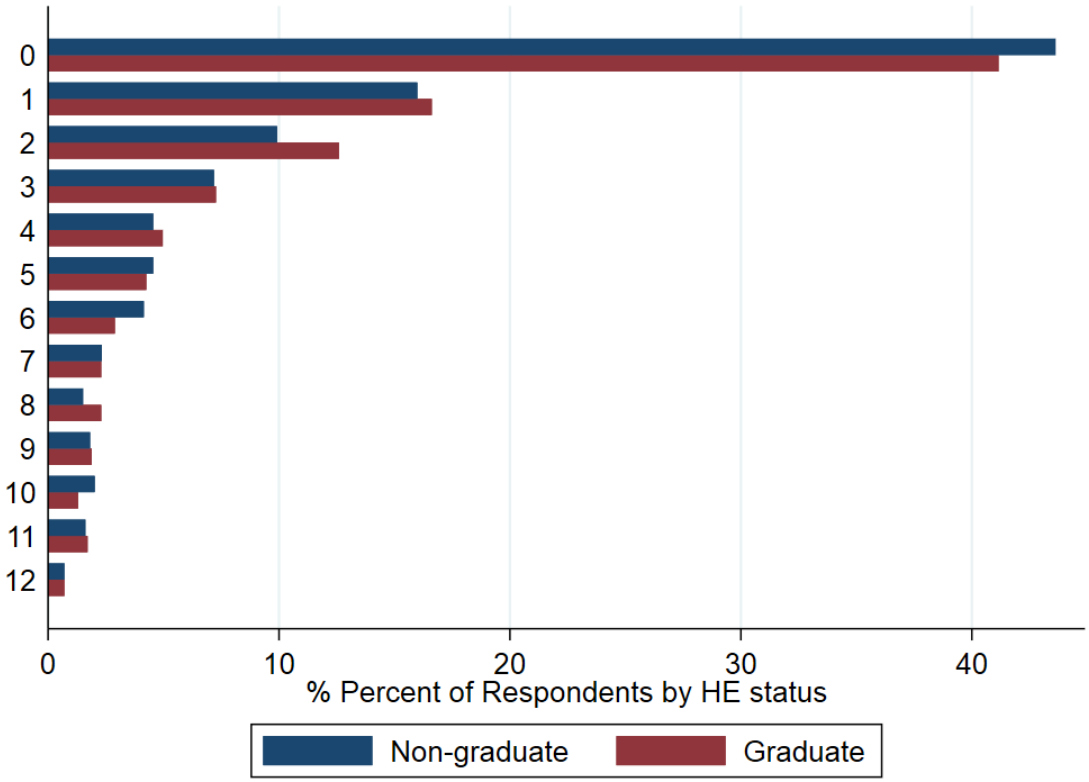
The outcome GHQ12 describes the cohort member's score on the General Health Questionnaire 12 point scale (Goldberg, Williams, and London, 1988), with 0

feeling least distressed and 12 most distressed.

The score was derived by summing responses to the twelve GHQ12 questions outlined below and was scored according to the 0-0-1-1 method, in which the first two possible responses to each question were assigned a value of 0 and the third and fourth responses with a value of 1, resulting in a maximum possible score of 12 for this variable. A higher score on this scale indicates a greater likelihood of mental ill-health. GHQ12 questions:

1. Have you recently been able to concentrate on what you're doing? (Better than usual, same, less, much less)
2. Have you recently lost much sleep over worry?
3. Have you recently felt that you are playing a useful part in things?
4. Have you recently felt capable of making decisions about things?
5. Have you recently felt constantly under strain?
6. Have you recently felt you couldn't overcome your difficulties?
7. Have you recently been able to enjoy your normal day to day activities?
8. Have you recently been able to face up to your problems?
9. Have you recently been feeling unhappy or depressed?
10. Have you recently been losing confidence in yourself?
11. Have you recently been thinking of yourself as a worthless person?
12. Have you recently been feeling reasonably happy, all things considered?

Figure 3.3: GHQ12 (Mental Health)



The distribution in Figure 3.3 does not show a clear pattern. On average, graduates and non-graduates do not seem to differ much in terms of the state of their mental health.

3.3.1.4 Exercise

The outcome 'exercise' describes the cohort member's frequency of exercising 30min or more in a typical week - 'On how many days in a typical week do you do 30min or more of exercise where you are working hard enough to raise your heart rate and break into a sweat?'.

Figure 3.4: Days of weekly exercise

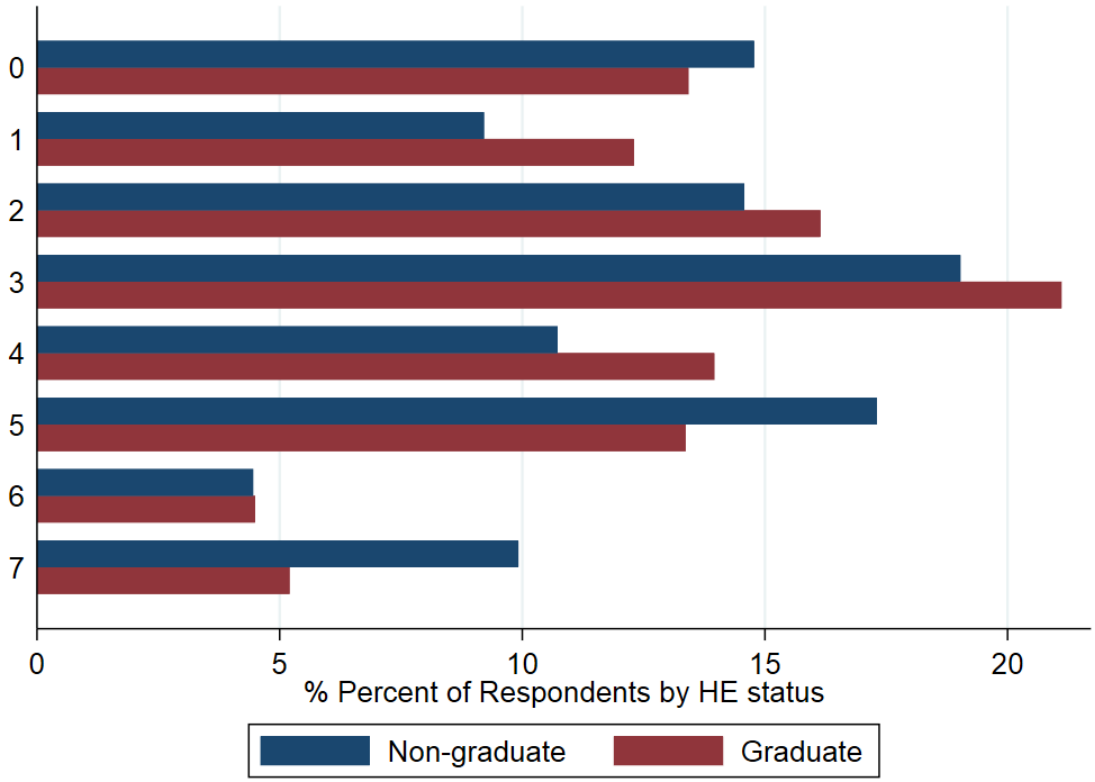


Figure 3.4 shows that the majority of graduates work out 3 days or less per week while just over a third of non-graduates exercise more than 5 days per week. Overall there does not seem to be a definite pattern in distribution, but from Table 3.2 we see that on average non-graduates exercise slightly more (3.21 vs 2.94).

3.3.1.5 Sleep

The outcome 'sleep' regards the number of hours the individual sleeps each night on average - 'During the last four weeks, how many hours did you sleep each night on average? Answer to the nearest hour.' Answers range from 0 hours to 14 hours.

Figure 3.5: Hours slept on average

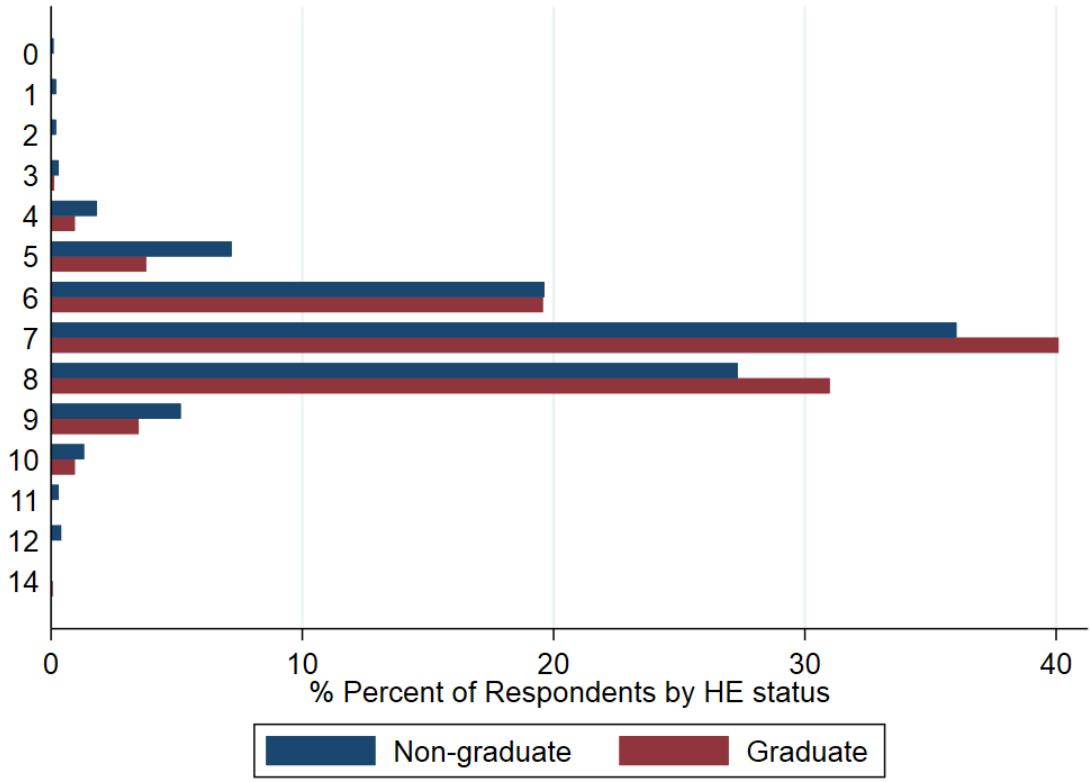


Figure 3.5 shows that a higher proportion of graduates sleep 7 and 8 hours on average compared to non-graduates. While a higher proportion of non-graduates sleep 5 hours or less per night relative to graduates, a higher percentage of non-graduates also sleeps 9 hours or more relative to graduates. According to Table 3.2 graduates sleep 7.11 hours vs 7.01 for non-graduates.

3.3.1.6 Alcohol Consumption

'Audit' is a variable representing the Alcohol Use Disfunction Test Score (Organization et al., 2001). It is a sum of the scores attributed to the following questions:

- How often do you have a drink containing alcohol?
    1. Never
    2. Monthly or less
    3. 2-4 times a month

4. 2-3 times a week
5. 4 or more times a week

- How many drinks containing alcohol do you drink on a typical day?
  1. 1-2 drinks
  2. 3-4 drinks
  3. 5-6 drinks
  4. 7-9 drinks
  5. 10 plus drinks
- How often have you had six or more drinks on one occasion in the past year?
  1. Never
  2. Less than monthly
  3. Monthly
  4. Weekly
  5. Daily, or almost daily

The responses to the questions above were scored as follows (1=0) (2=1) (3=2) (4=3) (5=4). The derived variable is the sum of these scores. While a score of 1 to 7 suggests low-risk consumption according to World Health Organization (WHO) guidelines (Organization et al., 2001), more conservatively, a score of 4 or more for males, or 3 or more for females indicates higher risk drinking according to the 'Next Steps' survey guidelines (Centre for Longitudinal Studies, 2018. Scores from 8 to 14 suggest hazardous or harmful alcohol consumption and a score of 15 or more indicates the likelihood of alcohol dependence (moderate-severe alcohol use disorder).

Figure 3.6: Alcohol Use Disfunction Test Score

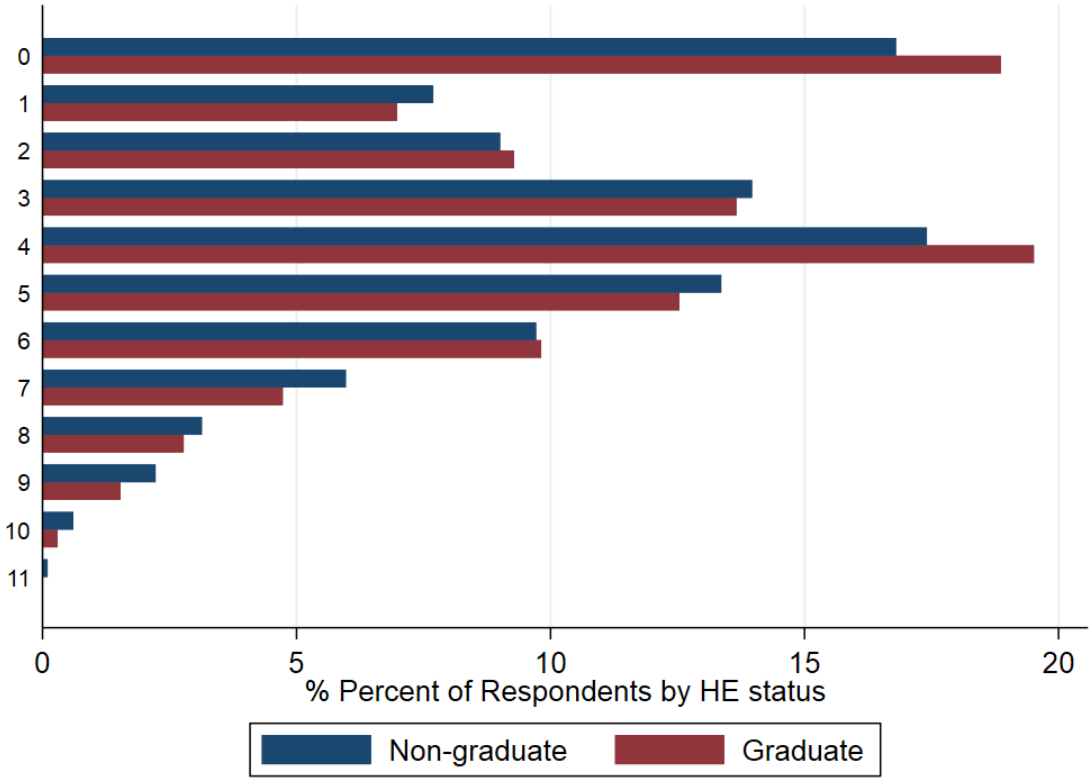
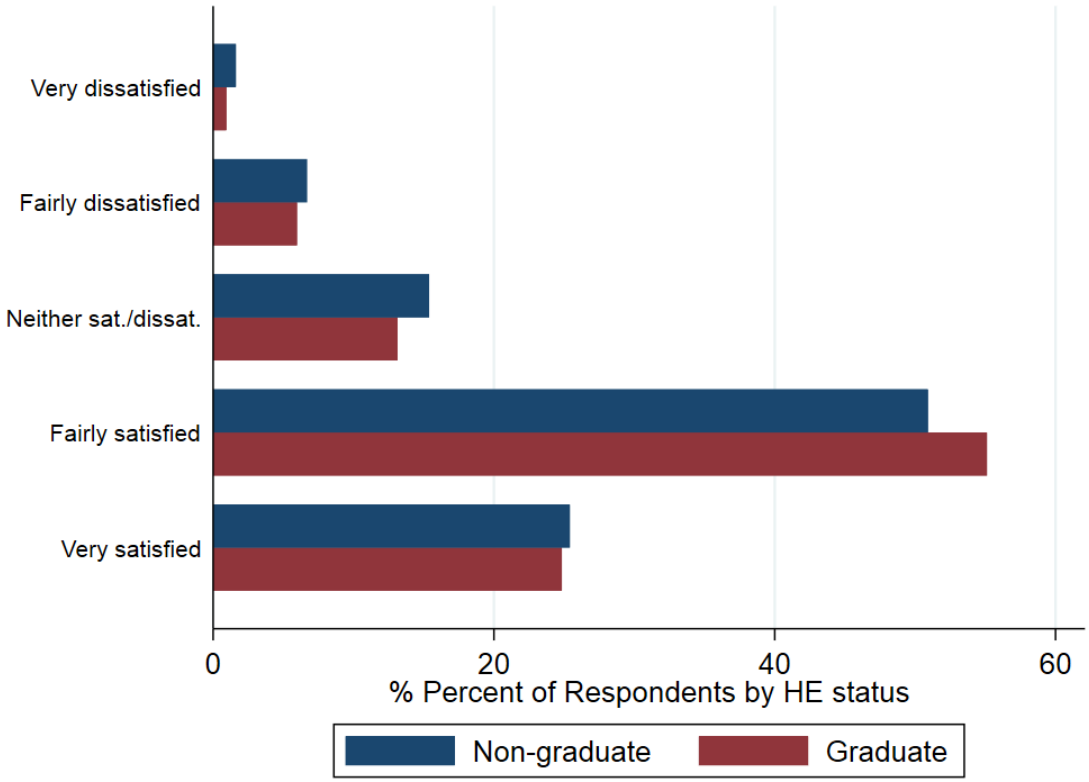


Figure 3.6 shows the distribution of scores for graduates and non-graduates. From Table 3.2 the overall average score for graduates at 3.38 is slightly below the average non-graduate score 3.57.

3.3.1.7 Life Satisfaction

This outcome reflects overall life satisfaction of the participant, by answering the question how dissatisfied or satisfied they are about the way their life has turned out so far on a 5-step Likert scale (very satisfied, fairly satisfied, neither satisfied nor dissatisfied, fairly dissatisfied, very dissatisfied). The scores are recoded so that the higher the score the more satisfied the individual is.

Figure 3.7: Life Satisfaction



In Figure 3.7 we see that non-graduates are slightly stronger represented in the categories 'Very dissatisfied', 'Fairly dissatisfied' and 'Neither sat./dissat.'. A slightly higher proportion of graduates are 'fairly satisfied'. And graduates and non-graduates are approximately in equal relative proportions 'Very satisfied' with their overall life.

3.3.1.8 No. of Children age 0-4

This outcome shows the number of cohort member's own children aged between 0 and 4, from a population of cohort members with children who are living in the household (all or some of the time).

Figure 3.8: No. of Children age 0-4

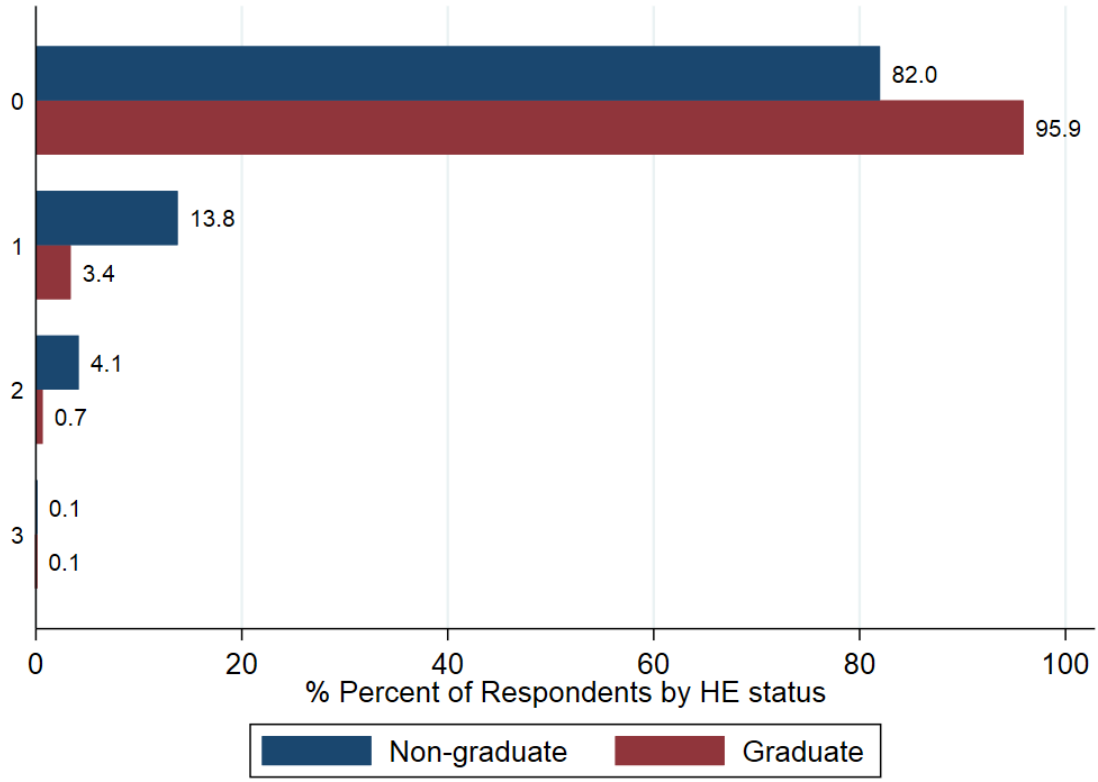
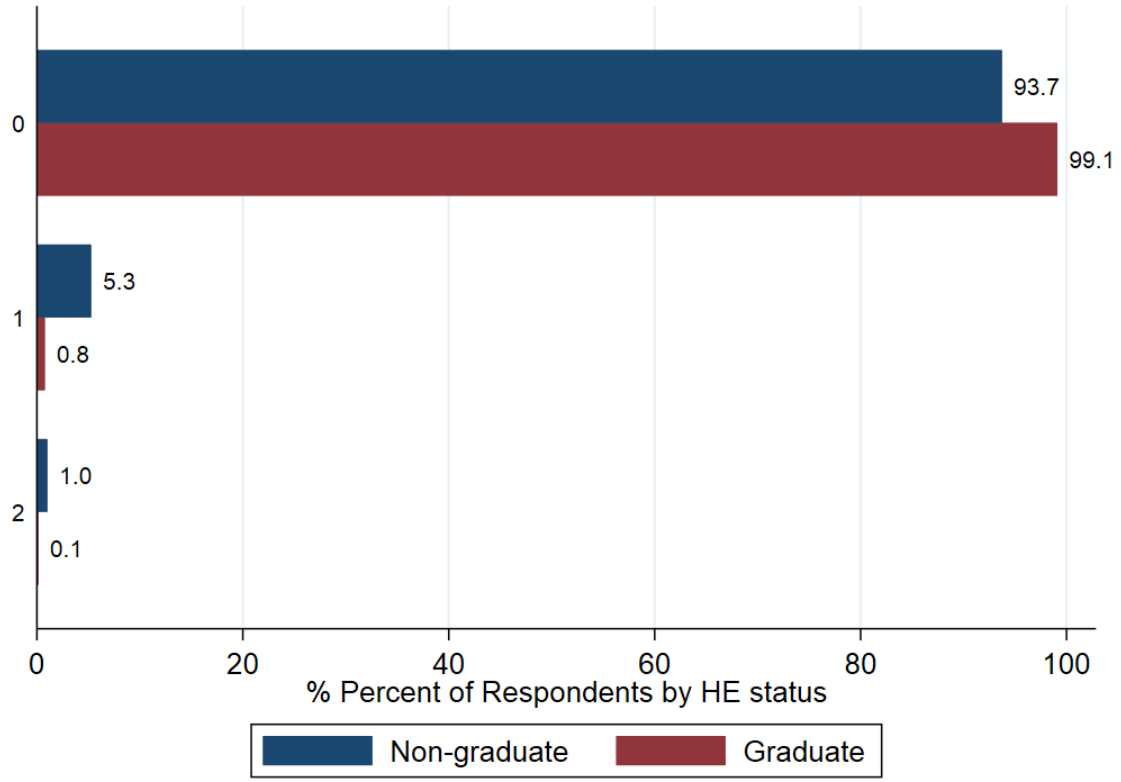


Figure 3.8 shows a significant difference between graduates and non-graduates. 13.8% of non-graduates have one child age 0-4 compared to only 3.4% graduates, and 4.1% of non-graduates have 2 children age 0-4 compared to 0.7% graduates.

3.3.1.9 No. of Children age 5-11

The outcome shows the number of cohort member's own children aged between 5 and 11, from a population of cohort members with children who are living in the household (all or some of the time).

Figure 3.9: No. of Children age 5-11



Similarly to Figure 3.8 Figure 3.9 demonstrates a higher percentage of non-graduates having 1 (5.3% vs. 0.8%) or 2 children (1% vs. 0.1%) between the ages 5-11.

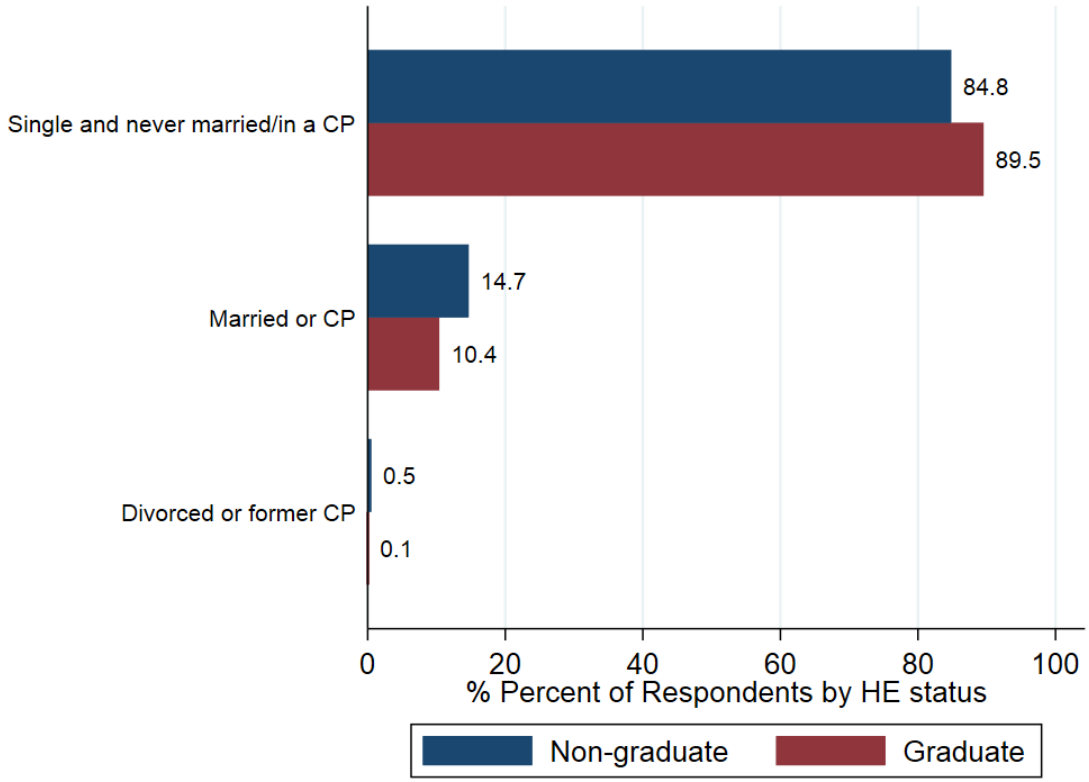
3.3.1.10 Marital Status

This outcome variable states the legal marital status of the cohort member as

- Single and never married/in a Civil Partnership
- Married or in a Civil Partnership
- Divorced or former Civil Partnership.

Figure 3.10 shows that 14.7% of non-graduates are married/in a civil partnership versus only 10.4% and 0.5% of non-graduates are divorced/former civil partnership versus 0.1% of graduates.

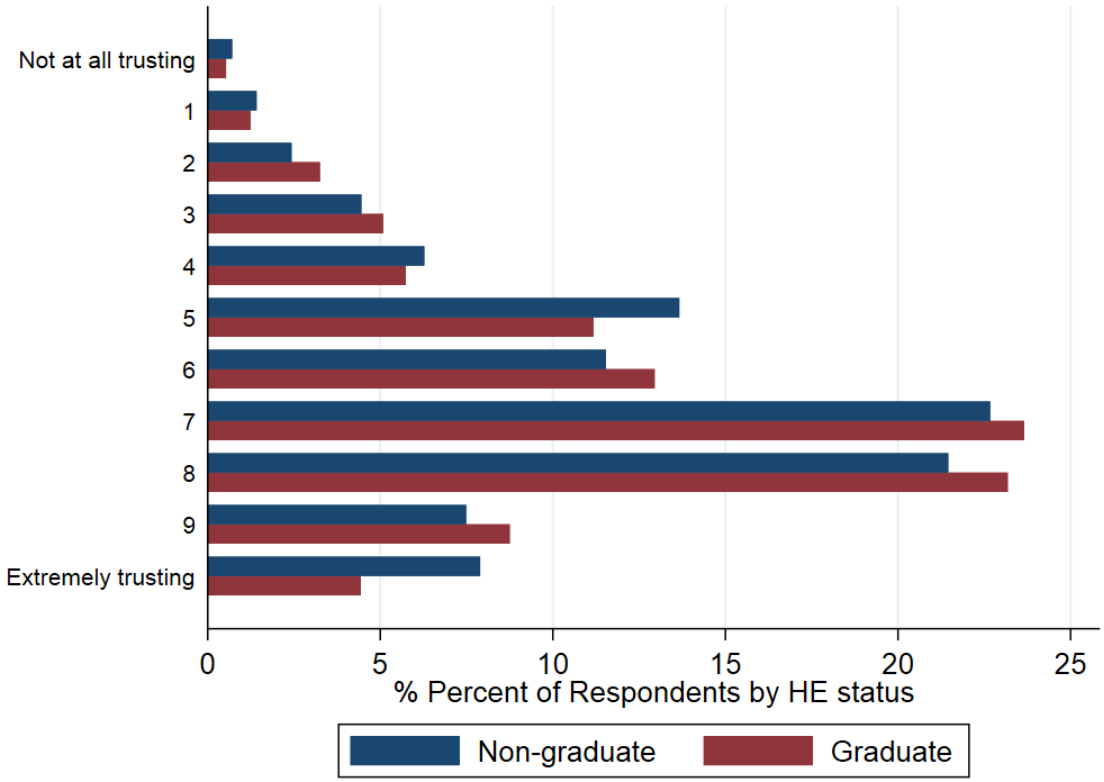
Figure 3.10: Legal Marital Status



3.3.1.11 Trust

To assess the individuals trust profile respondents/cohort members were asked to indicate how trusting they are of other people on a scale from 0-10, 0 meaning not trusting at all, and 10 meaning extremely trusting. Figure 3.11 shows the distribution of scores among graduates and non-graduates. Table 3.2 shows that non-graduates average overall at 6.47 and graduates at 6.62.

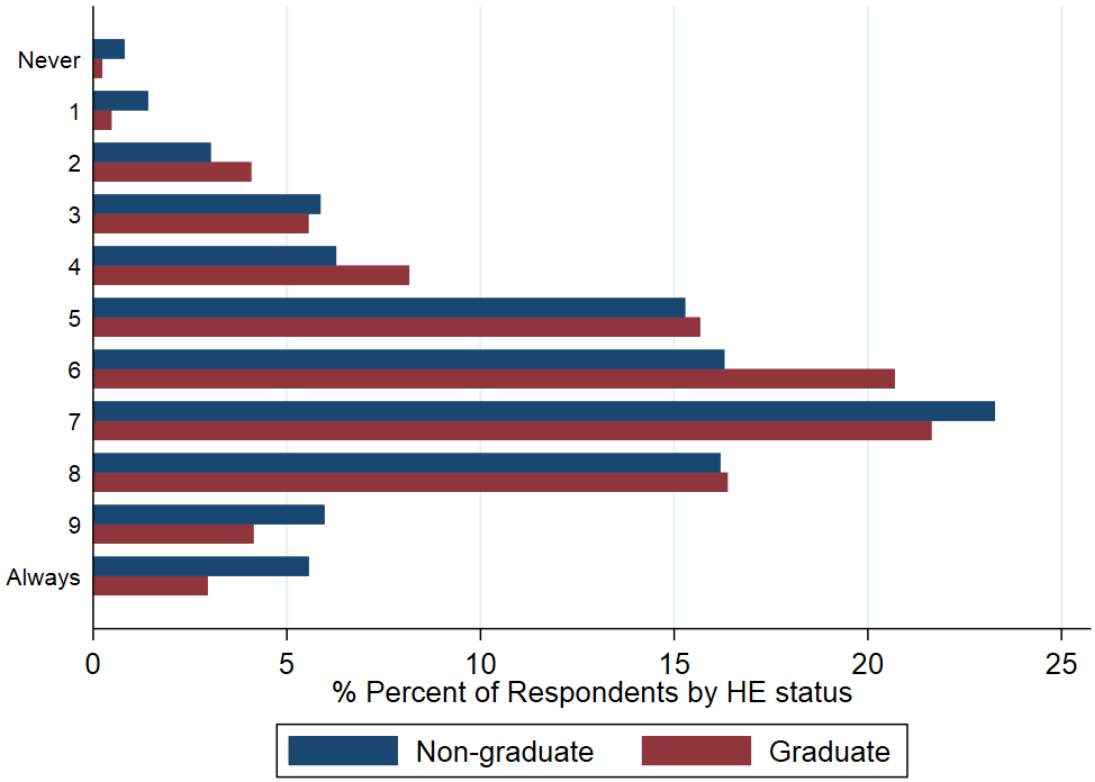
Figure 3.11: Trust



3.3.1.12 Risk

'Risk' indicates how willing to take risks the cohort member is on a scale of 0-10 (0 never, 10 always). Figure 3.12 presents the distribution of scores among graduates and non-graduates and shows large differences between the two. Table 3.2 shows that non-graduates average overall at 6.26 and graduates at 6.10.

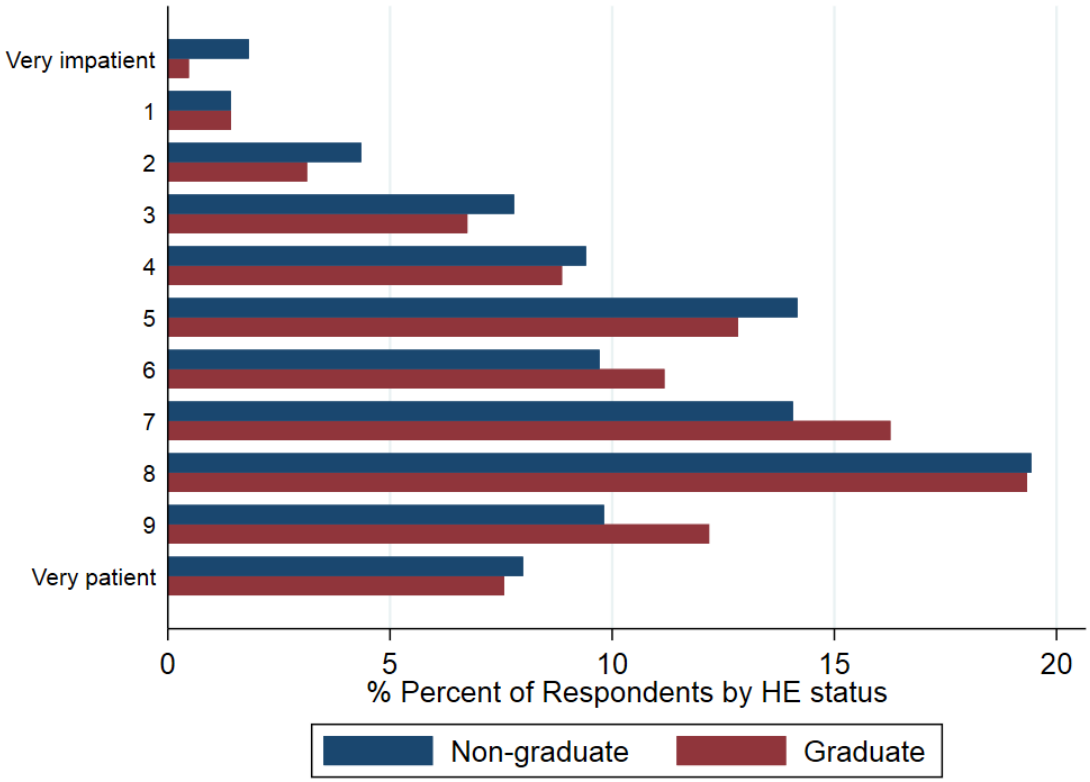
Figure 3.12: Risk



3.3.1.13 Patience

'Patience' indicates the individuals patience profile, i.e. how patient the cohort member says they are on a scale of 0-10, 0 being very impatient, and 10 being very patient. Figure 3.13 shows the distribution of scores among graduates and non-graduates. Table 3.2 shows that non-graduates average overall at 6.23 and graduates at 6.49.

Figure 3.13: Patience



3.3.1.14 Consider yourself an adult

The first outcome with regards to adult identity reflects the individuals belief about 'considering themselves to be an adult'. (The questions that is being answered is: "You consider yourself to be an adult".) The answer options on the 4-step Likert scale were as follows: Not at all true (1), Somewhat true (2), Mostly true (3), Entirely true (4).

Figure 3.14: You consider yourself to be an adult

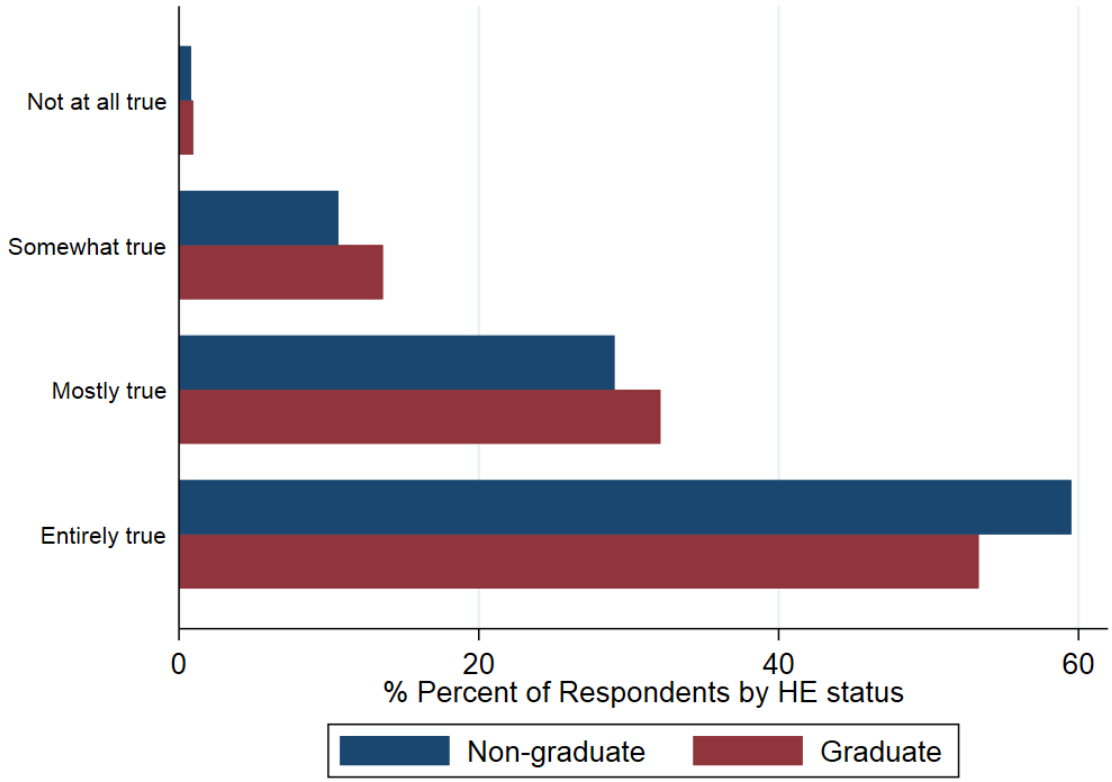
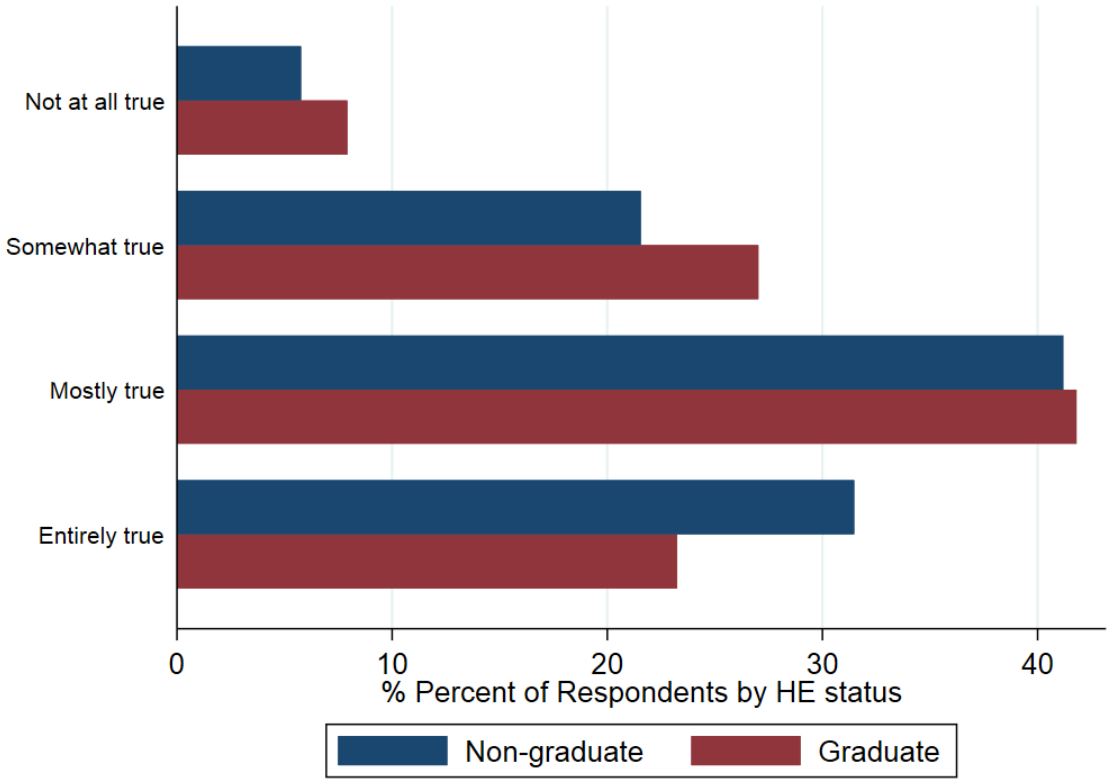


Figure 3.14 shows a higher proportion of graduates scoring 'mostly true' and below while a higher proportion of non-graduates relative to the proportion of graduates confidently think of themselves as adults.

3.3.1.15 You feel you have matured fully

The second outcome with regards to adult identity reflects the individual's belief about feeling that 'you have matured fully'. (The questions that is being answered is: "You feel you have matured fully".) Figure 3.15 shows a similar pattern as Figure 3.14 with a higher proportion of graduates scoring 'mostly true' and below while a higher proportion of non-graduates relative to graduates feel that they have matured fully (just over a third of non-graduates vs just under a fourth of graduates).

Figure 3.15: You feel you have matured fully



3.3.1.16 Volunteering, Donating, and Public Meetings/Demonstrations/Protests

For these outcomes on societal engagement, the cohort member was asked to answer the following questions: "Please say how often you do the following activities:

1. Attend meetings for local groups/voluntary organisations
2. Unpaid voluntary work, give unpaid help to other people eg. Friend, neighbour, or someone else (but not relative)
3. Give money to a charity/Take part in a fundraising event
4. Take part in a public meeting or rally/Take part in a public demonstration or protest

Answers were given as follows: At least once a week, At least once a month, Less often, Never. The scale was recoded for the purpose of having a higher score correlate to a higher frequency of carrying out the respective activity.

Figure 3.16: Unpaid Voluntary Work

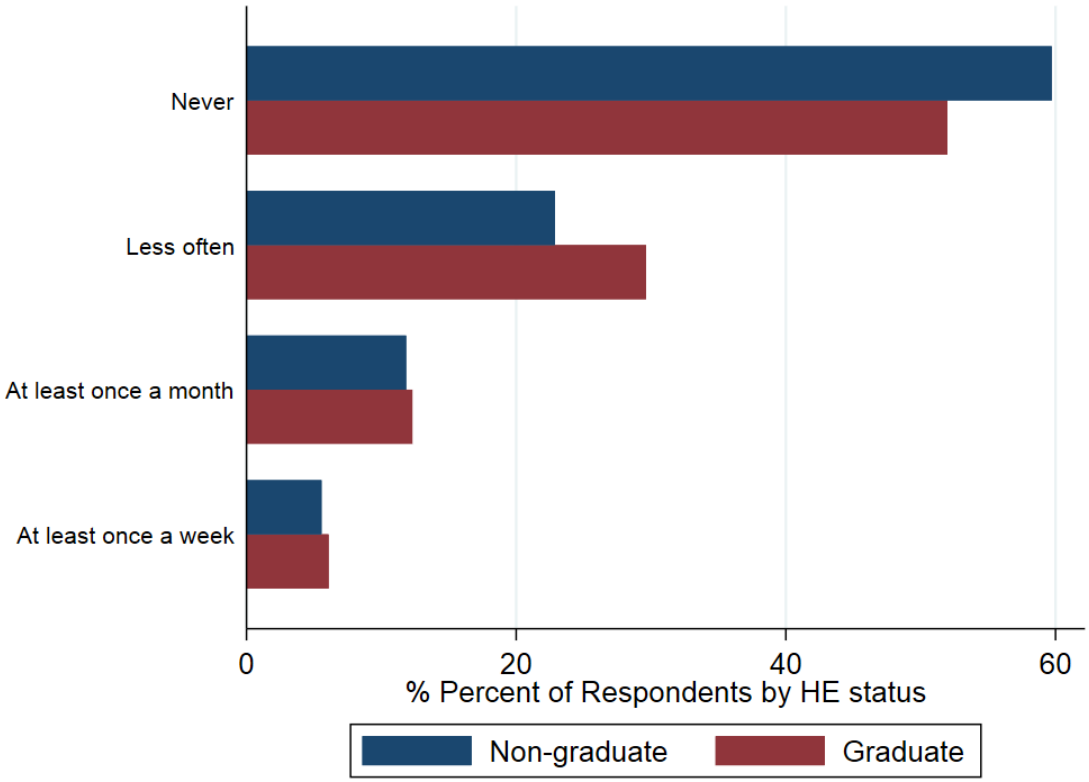


Figure 3.16 shows the distribution of graduates and non-graduates for 'Volunteering'. An equal respective percentage of graduates and non-graduates volunteer 'at least once a month' and 'at least once a week' while a bigger percentage of graduates volunteers 'less often' and a higher percentage of non-graduates volunteers 'never'.

Figure 3.17: Money to a Charity or Fundraising event

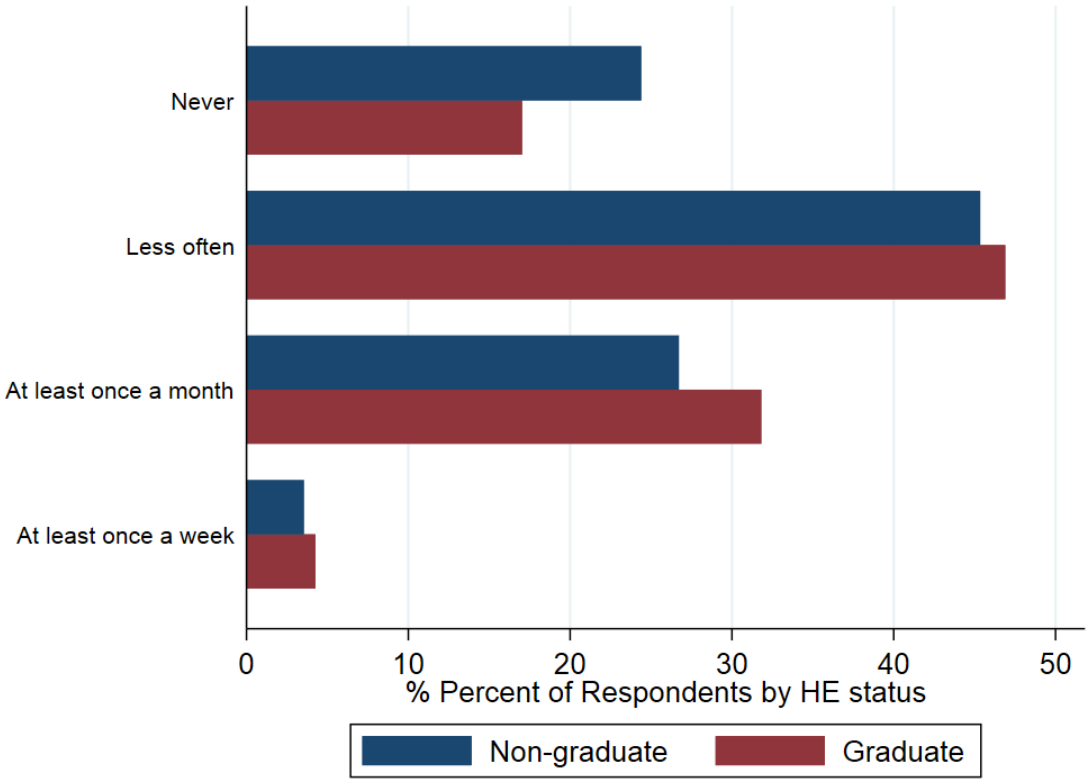


Figure 3.17 shows the distribution of graduates and non-graduates for 'Donating Money to a Charity or Fundraising event'. A very similar proportion of graduates and non-graduates donate 'at least once a week'. While a higher percentage of graduates relative to non-graduates donates 'at least once a month' and 'less often', a higher percentage of non-graduates 'never'.

Figure 3.18: Public meeting/rally/demonstration/protest

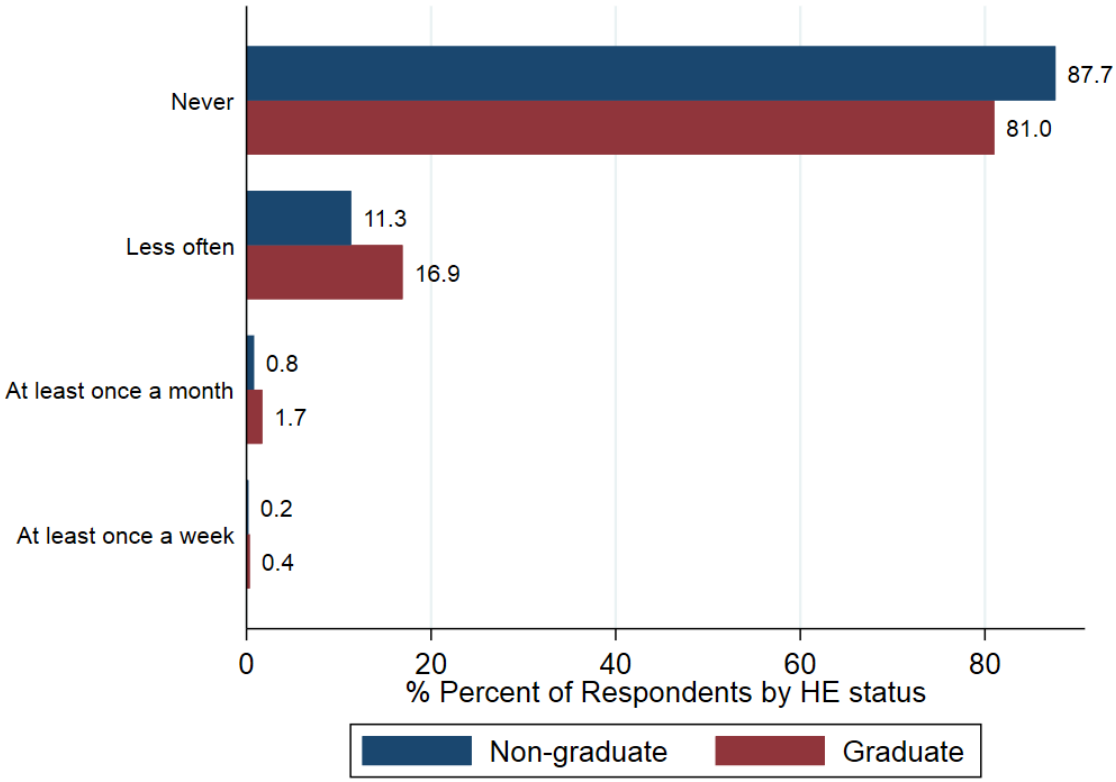


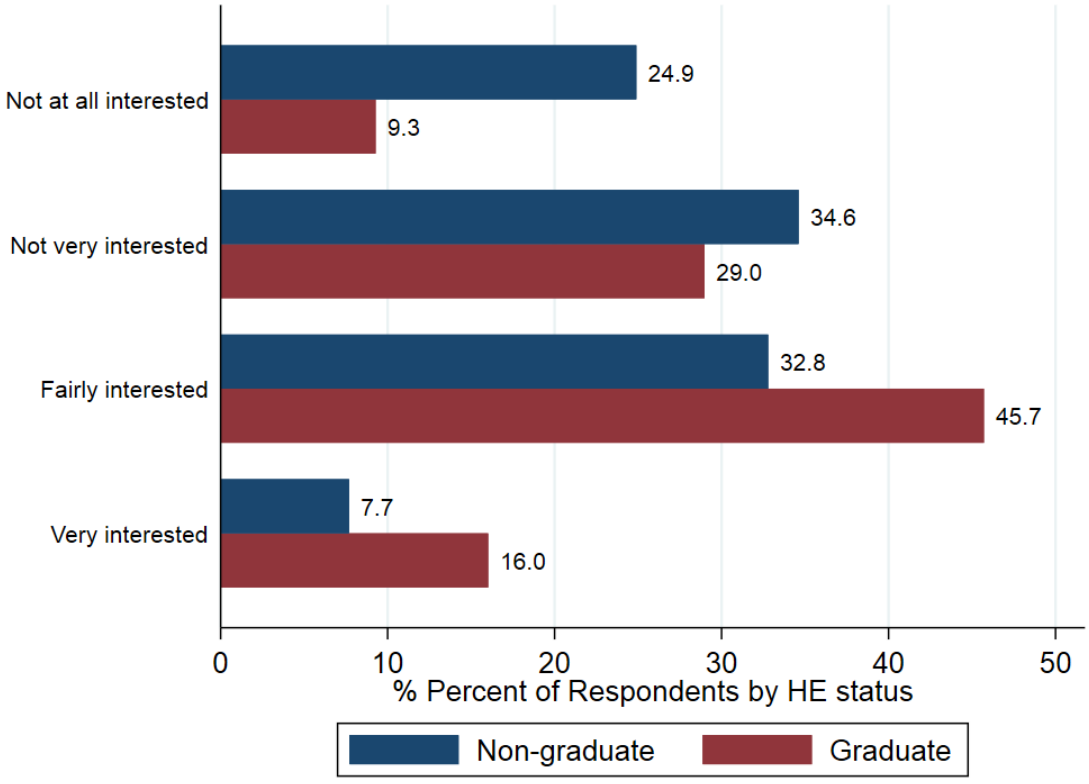
Figure 3.18 shows the distribution of graduates and non-graduates for 'Participation in public meetings/rallies, demonstrations/protests'. Graduates are more likely to protest 'at least once a week', 'at least once a month' and 'less often', while a higher proportion of non-graduates compared to graduates 'never' protest/participate in public meetings.

3.3.1.17 Interest in Politics

The outcome reflects the individual's interest in politics on a 4-level Likert scale ranging from not at all interested to very interested and the distribution for graduates and non-graduates can be seen in Figure 3.19. 16% of graduates are 'very interested' compared to only 7.7% non-graduates. Similarly 45.7% of graduates are 'fairly interested' compared to 32.8% non-graduates. Almost a quarter of all non-graduates scored 'not at all interest' in politics compared to only a tenth of graduates. Distributions indicate a negative skew for graduates and a positive skew

for non-graduates.

Figure 3.19: Interest in Politics



3.3.2 Degree Attainment

A graduate is defined as an individual who has (successfully) completed at least an undergraduate degree.[1] Conditional on having obtained a degree, LSYPE also reports whether the individual has been awarded a degree by an elite "Russell Group" university (that approximately 25% of students attend) or otherwise. LSYPE wave 8 at age 25 further specifies the subjects that individuals studied at university - which can be grouped into STEM, Social Sciences, Arts and Humanities, and other majors.[2]

[1] It also includes individuals having completed a postgraduate degree (e.g. MSc, PhD) but it does not condition on them in the analysis. That is, all estimates can be thought of as including the option value associated with the possibility of pursuing post-graduate qualifications.

[2] UK students typically specialise intensively in a single major throughout their three years of higher education, which typically occur straight from senior high school at age 18 or 19.

The data also records degree class obtained on course completion. Other explanatory variables used in the specifications are controls for gender (female=1), non-cognitive skills, regional controls (which are collapsed into North, South, omitted category Midlands), parental characteristics (education, income) and controls for individual ethnicity (which are collapsed into Non-white vs. White). The dataset does not unfortunately allow us to distinguish between nongraduates and dropouts (drop out rates are around 6%), so results presented in 3.5 are conditional on not dropping out by age 25 . While dropout earnings are close to those who never go to university Walker and Zhu, 2013 we do not know the potential differences for nonpecuniary outcomes.

3.4 Methodology

To assess the basic correlations between a degree and the various non-pecuniary outcomes I estimate the following regression:

$$Outcome_i = c + \beta D_i + X_i\delta + \epsilon_i$$

Where $Outcome_i$ is one of the individuals i's outcomes discussed in Section 3.3 (General Health$_i$,Banded BMI$_i$, GHQSC$_i$, Exercise$_i$, Sleep$_i$, Alcohol Use$_i$, Life Satisfaction$_i$, Risk$_i$, Patience$_i$, Trust$_i$, Marital Status$_i$, No.of children 0-4$_i$, No.of children5-11$_i$, Adult Identity$_i$, Maturity$_i$, Volunteering$_i$, Donating$_i$, Demonstrating$_i$, Political Interest$_i$); D_i is a dummy variable indicating the individuals i's degree status, X_i is a vector of individual characteristics that includes race, gender, region dummies, c is a constant term and ϵ_i is the error term. An additional specification further includes pre-treatment personal and parental characteristics such as parental income, non-cognitive skills, and intention of going to university. The coefficient on degree status, β, is the object of interest and measures effects of a degree on various private and social non-market outcome measures at age 25. All outcome measures are standardised for comparability.

A third specification also includes log hourly income to asses the extent to which degree effects are being mediated by income. Differences in effects between specification 2 and 3 are negligible - results are included in Appendix B.

3.5 Results

This section reports the coefficient plots of β of the base specification as well as the second specification (controlling for further personal and parental characteristics) for the entire sample, for males and females separately, by institution type, by

different subject groups and lastly by interaction between subject groups at different institution types. All effects are estimated with linear models using OLS.

We naturally worry about selection on unobservables because there are likely to be missing controls that are correlated with both the outcome and the treatment. Similarly to the previous chapter, for instance, we are not able to control for prior attainment and we acknowledge the strong assumption that this presents: that both graduates and non-graduates have similar expected non-HE outcomes. It is common in the literature to vary the control set to establish the robustness of estimates to selection on unobservables and to address our lack of prior attainment for example we also obtain estimates using a restricted sample of individuals with at least two A levels (the minimum entry requirement to a UK university) presented in Appendix B.

Oster, 2019 on the other hand demonstrates that this itself is not necessarily a robust procedure. Rather she proposes a test of robustness to selection bias that pays attention to the contribution of variables to the R2 of the model. In appendix B we further implement Oster's test for such sensitivity to selection bias. Here we focus simply on the differences between the treatment estimates between the two specifications. Primarily this an analysis is of descriptive nature on the graduate vs non graduate differences in non-pecuniary outcomes and its heterogeneity across institution type, subjects, and their interactions. We comment and draw conclusions on the robustness of the estimates of a degree as a treatment effect, in the respective sections below.

3.5.1 Overviews

3.5.1.1 Pooled Coefplot

Figure 3.20 gives an overview of degree effects on all non-pecuniary outcomes examined in this paper, on a pooled sample. The two specifications per outcome correspond to a base specification (model 1 in blue) which controls for exogenous characteristics such as sex, ethnicity and region, and a second specification (model 2 in red) that additionally includes parental income, pre-treatment non-cognitive skills and pre-treatment 'intention of going to university'.

The biggest positive correlations between an outcome at age 25 and at least a bachelors degree can be observed for physical health outcomes such as self-assessed General Health, and sleep, as well as patience, and socially beneficial activities such as donating money, demonstrating, and political interest (which relative to all other outcomes observes the highest degree effect). Controlling for additional personal and parental characteristics the degree effect on self-assessed general

health is reduced by half, while there is only a very small change in effect on sleeping habits. Degree effects on patience, donating money and participating in demonstrations, reduce as well with model 2, making the estimates statistically insignificant, particularly for donating money. The effect on political interest is almost halved as well, while remaining still statistically significant and one of the largest effects present.

No statistically significant degree effects are observed for the GHQ-score (indicator of mental health), life satisfaction, trust, and volunteering (regardless of specification).

Using the less parsimonious specification, there is no statistically significant association between a degree and Alcohol Use despite a small positive correlation in model 1.

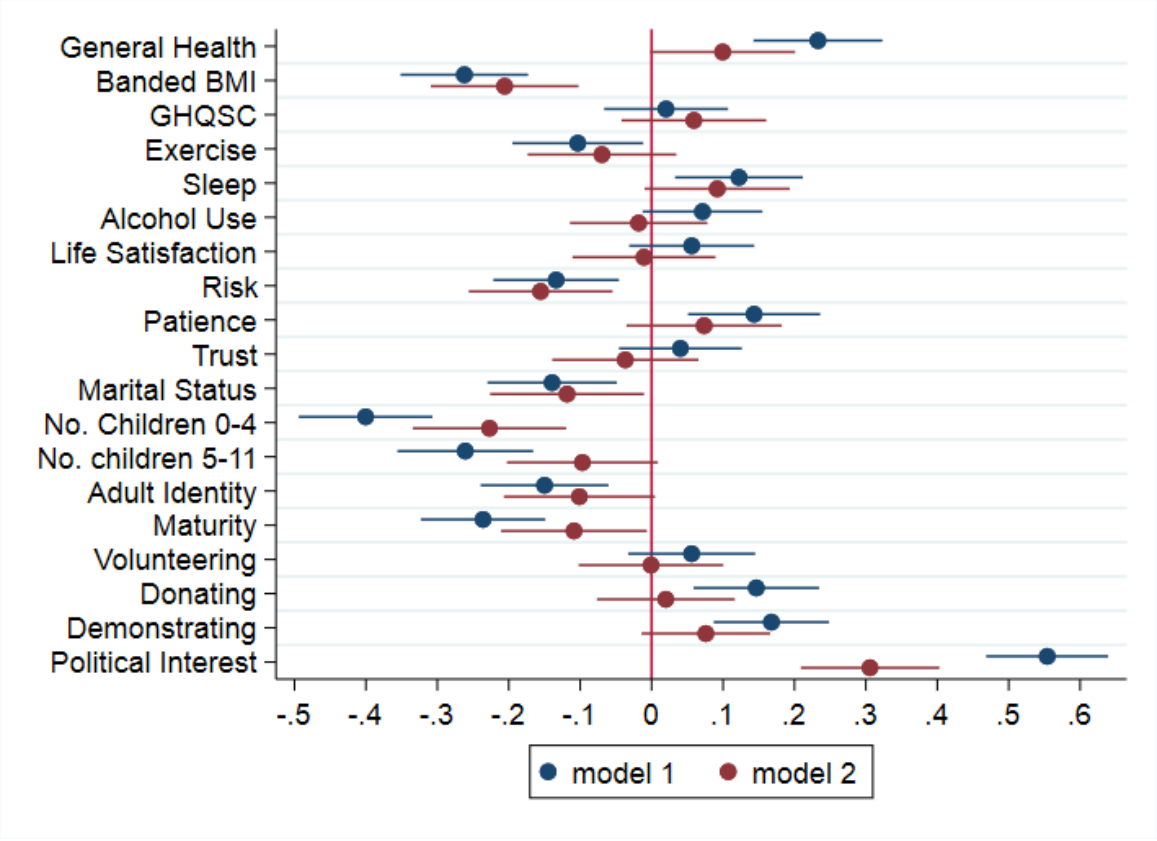
The largest negative degree effects can be seen for outcomes BMI, no. of children, risk and maturity. Other negative degree effects are also seen for exercise, marital status and adult identity. A degree is therefore associated with a healthier BMI, a lower number of children at age 25, lower risk preferences, but a decreased sense of own maturity, as well as less exercise throughout the week, lower probability to be married, and a decreased sense of maturity, and decreased sense of 'feeling like an adult'.

Figure B.10 shows the estimates on the restricted sample of individuals with 2+ A levels. Firstly it is noticeable that positive degree effects largely become statistically insignificant. While General Health was previously statistically significant in both models, it remains only significant in model 1 here and the effect reduces to zero in model 2. Previously positive and significant degree effects on sleep and patience have also become insignificant here. The effect on donating has surprisingly reduced to zero in both models, although demonstrating remains significant in model 1. Lastly the positive degree effects on political interest remain the largest relative effect and statistically significant.

Contrary, negative degree effects, are largely similar to the ones presented below. The largest negative degree effects can still be seen for outcomes BMI, no. of children, risk and feelings of maturity.

The sensitivity to selection bias analysis using Oster bounds underlines some of the findings above. Risk, no of children, maturity, and political interest show some degree of robustness towards bias from selection on unobservables.

Figure 3.20: Coefplot Pooled



Note: Model 1 includes ethnicity and region as control variables, model 2 additionally controls for the following pre-treatment personal and parental characteristics: parental income, non-cognitive skills, intention of going to university. The confidence interval is set at 95%.

3.5.1.2 By Gender Coefplot

Figure 3.21 decomposes degree effects for females and males. There are some differences that can be observed that are dependent on gender - both in terms of degree effect size as well as the extent of which this effect changes with specification in model 2.

In the case of general health, controlling for additional personal and parental characteristics drives the degree effect for females further to zero while for males that is true to a smaller extent. For both genders model 2 renders the effects statistically insignificant. The negative degree effects on BMI remain largely similar between men and women. Degree effects on mental health (GHQ-score) remain insignificant for both genders similar to 3.20.

The biggest differences based on gender can be observed for exercise (positive yet insignificant for females, while much larger negative and significant effect on males), sleep (no degree effect for females, while positive for males), risk (negative significant effect for females but only in model 1, while negative degree effect using both models for males), trust (negative insignificant effect for females in model 1 but significant when controlling for additional characteristics (model 2); while effect positive yet insignificant for males).

No difference is observed for alcohol use. There is no difference based on gender in terms of overall life satisfaction as well: the effect is tending towards zero (although for females the effect was statistically significant positive in specification 1).

For patience the different specification seem to play a bigger role for males. While there is no difference between model 1 and model 2 for females (positive yet insignificant effect), for males model 2 is rendering an initially significant positive effect insignificant. The degree effect on marital status is negative for females while negative but insignificant for males.

In terms of number of children aged 0-4 at age 25, obtaining a degree is similarly negatively correlated for both males and female (and using both specifications), although for the number of children aged 5-11 the effect is smaller for both genders and insignificant for females once controlled for personal and parental characteristics.

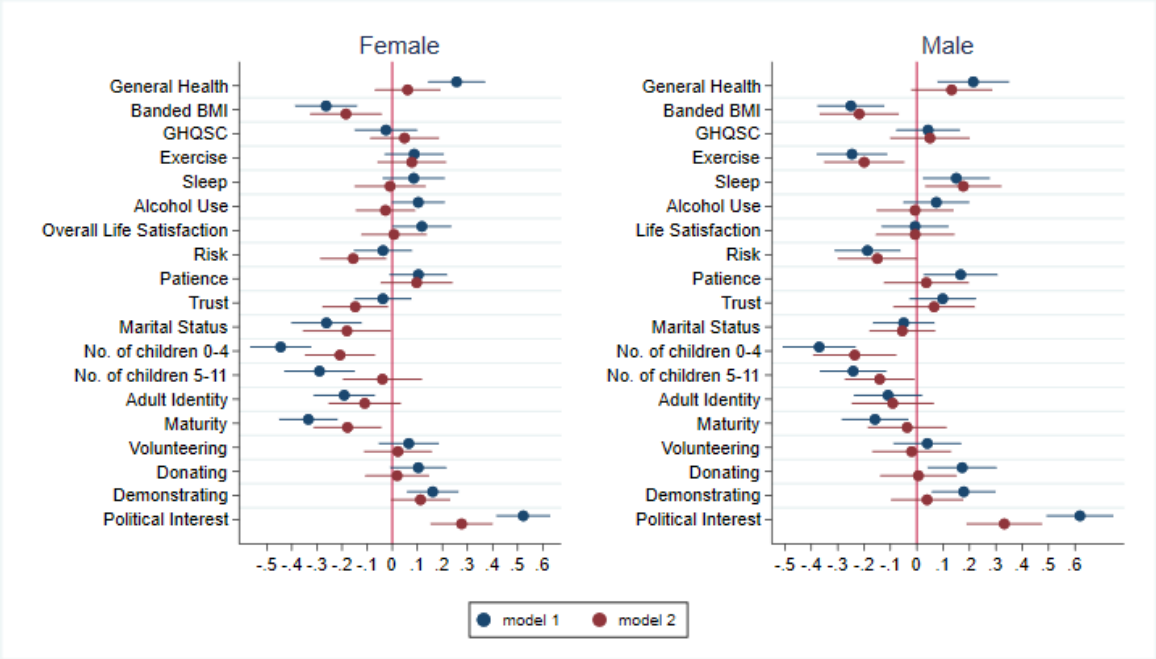
The negative correlation between obtaining a degree and ones sense of feeling like an adult is slightly larger for females, although (becomes) insignificant for both genders using model 2.

For sense of maturity, there seems to be a difference between females (negative significant correlation) and males (insignificant) controlling for additional characteristics (model 2).

There is virtually no difference in degree effect on volunteering based on gender. And while the degree effect for males on donating seems to be bigger the effect is insignificant in model 2. The degree effect for females on demonstrating remains positive even after controlling for additional characteristics, unlike for males, in which case the effect is significant at first but reduces to almost zero and becomes statistically insignificant.

The large degree effects on political interest are very similar across genders, the effect for males is slightly higher.

Figure 3.21: Coefplot by gender



Note: Model 1 includes ethnicity and region as control variables, model 2 additionally controls for the following pre-treatment personal and parental characteristics: parental income, non-cognitive skills, intention of going to university. The confidence interval is set at 95%.

3.5.1.3 by Institution type

Our motivation for looking across institution type is that there may be arguments to suggest that the more selective the institution one attends the greater the intensity of the treatment in which case we might expect that the treatment effect will be larger for the most selective institutions.

Figure 3.22 decomposes degree effects by Institution type: whether degree was obtained from a Russell group university or from other Higher Education Institutions.

Overall, degree effects seem to be more pronounced when obtained at Russell group universities, and tend to be smaller/ closer to zero from other HE institutions.

The biggest differences based on institution type can be seen for outcomes: general health, BMI, Risk, patience, feelings about sense of maturity, donating, demonstrating, and political interest.

For general health, a much bigger degree effect is observed for degrees obtained from a Russell group university. For other HEI the effect is positive in model 1 but controlling for additional characteristics the effect reduces to almost zero and becomes statistically insignificant.

For BMI we observe the same negative effect seen in 3.20 with the Russell degrees having a bigger effect.

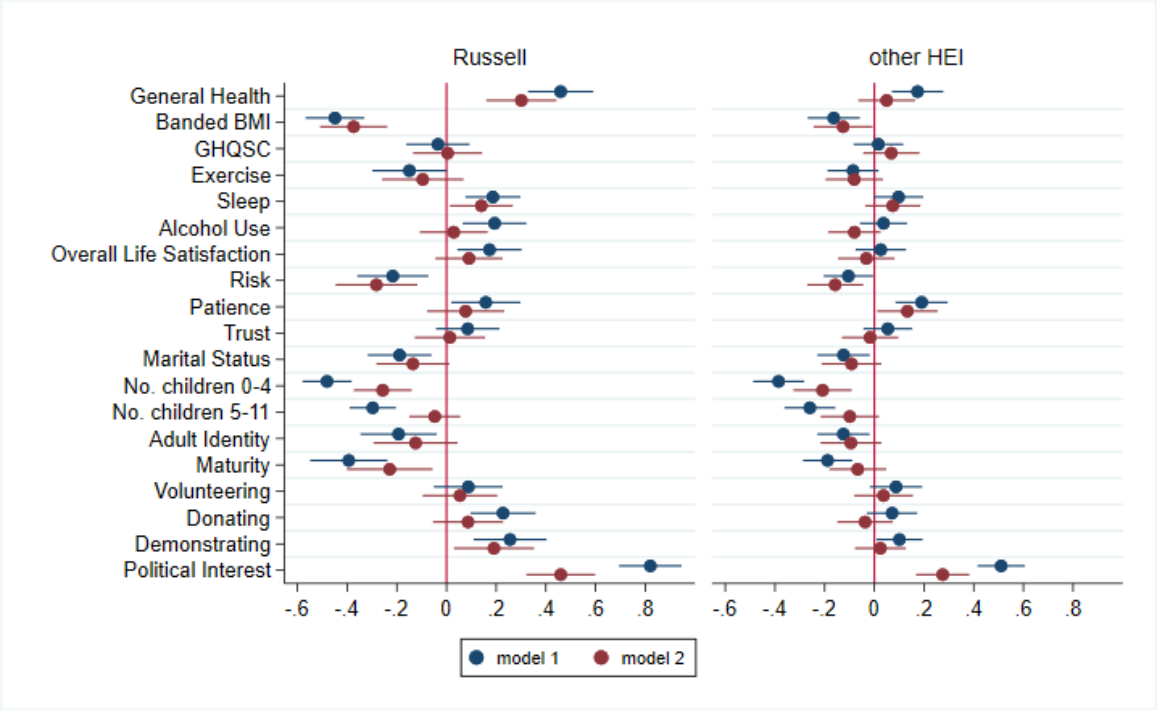
We also note that although a positive degree effect on average is seen in Figure 3.20 for alcohol use, the effect differs according to institution types in terms of changing signs. The effect is relatively large in the case of Russell groups in model 1 but reduces to almost zero in model 2. While for other HEI the effect is close to zero in model 1 but actually becomes negative in model 2.

While previously in Figure 3.20 there was no evident degree effect on patience, we observe that other HEI degree is statistically significant correlated with patience now.

Overall attending Russell group institutions seems to apply higher treatment effect across all outcomes, but their differences do not appear to be statistically different.

Estimates on the restricted sample of individuals with at least 2+ A levels (Appendix B - Figure B.11) decomposed by institution type leads us to the same conclusions as above.

Figure 3.22: Coefplot by Institution type



Note: Model 1 includes gender, ethnicity and region as control variables, model 2 additionally controls for the following pre-treatment personal and parental characteristics: parental income, non-cognitive skills, intention of going to university. The confidence interval is set at 95%.

3.5.1.4 by Degree Subject

Figure 3.23 decomposes average degree effects by degree subject groups: STEM, Social Sciences, Arts and Humanities and displays them for comparison per outcome. Figure 3.24 displays additional differences in effects from using different specifications: model 2 vs model 1.

Our expectation would be that treatment effects in the context of non pecuniary outcomes might follow the pattern for pecuniary effects estimated in Chapter 1, where we find that STEM and LEM have treatment effects on wages and earnings that exceed those for Arts. The Economics literature on the returns to higher education has focused largely on pecuniary effects, yet it is common across the social sciences to argue that money is not the only thing that matters. So here we decompose by subject type to explore whether or not non-pecuniary effect compensate for or reinforce pecuniary returns.

There is again likely to be a selection process into different majors which is related to prior attainment and other unobservables. While we are not able to account for differences in prior attainment, which arguably is more important for some subjects than others, we can adjust the control group to individuals with 2+ A levels. Estimate adjustments as seen in Appendix B (Figure B.12) should therefore be interpreted with caution.

Overall STEM has comparatively larger positive impacts on general health, BMI, sleep, alcohol use, life satisfaction (tied with social sciences) and patience (tied with arts & humanities). Using the restricted sample (2+ A levels) the effect on general health, alcohol use, and life satisfaction becomes statistically insignificant.

Social Sciences is often somewhere in between STEM and arts & humanities in terms of impact size on various outcomes. It stands out with the only subject group being significantly positively correlated with Alcohol use, tied with STEM in terms of effect size on life satisfaction, tied with arts & humanities in impact on volunteering, and comparatively largest effect sizes on donating to charity, and political interest. Using the restricted sample (2+ A levels) the effects on alcohol use and political interest are the only ones to remain significant as well.

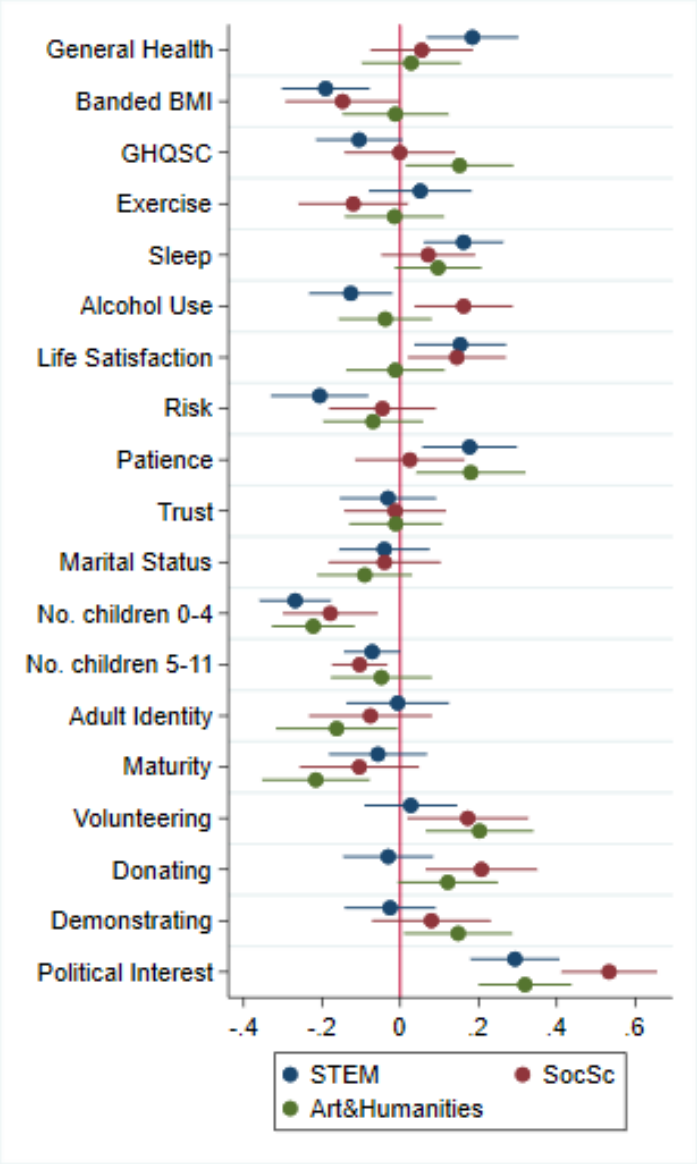
Arts and Humanities subjects have mixed impacts on various outcomes, often faring less favourably compared to the other subject groups or having no effect. It seems to do relatively better on the GHQ score, patience (tied with STEM), and shows largest (positive) impact on volunteering and demonstrating. It also stands out with significant negative effect on sense of maturity. The effects on patience, volunteering, and political interest as well as the comparatively large effects on sense of maturity stand out using the restricted sample as well.

There remains caution in interpreting these estimates as treatment effects. Especially with individual subject choice we are unable to control for 'previous interests', so that Social Science graduates for example may have a particularly high preference for current affairs and politics to begin with.

Overall though, subject type is fairly neutral on non-pecuniary effects - the effects are rarely statistically different from each other. Thus there does not seem to be a case for thinking that non-pecuniary effects compensate for the pecuniary differences across subjects.

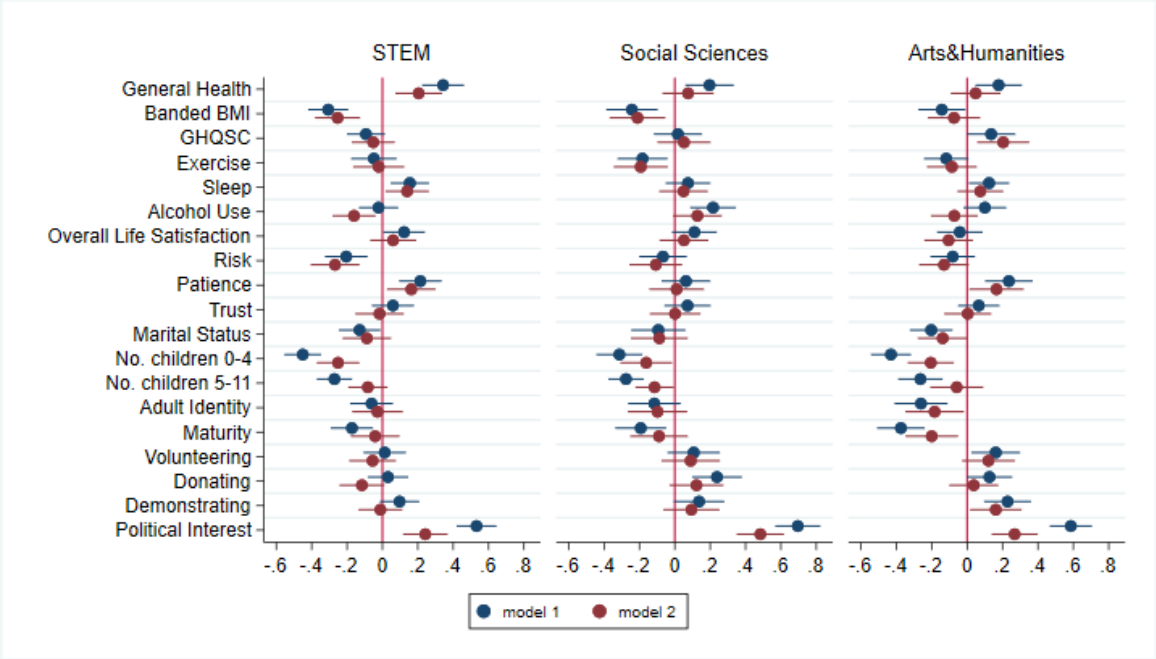
Figure 3.24 additionally displays differences between model 1 and model 2.

Figure 3.23: Coefplot by Degree Subject (in one plot)



Note: The specifications control for gender, ethnicity, region and the following pre-treatment personal and parental characteristics: parental income, non-cognitive skills, intention of going to university. The confidence interval is set at 95%.

Figure 3.24: Coefplot by Degree Subject



Note: Model 1 includes gender, ethnicity and region as control variables, model 2 additionally controls for the following pre-treatment personal and parental characteristics: parental income, non-cognitive skills, intention of going to university. The confidence interval is set at 95%.

3.5.1.5 by Institution x Subject

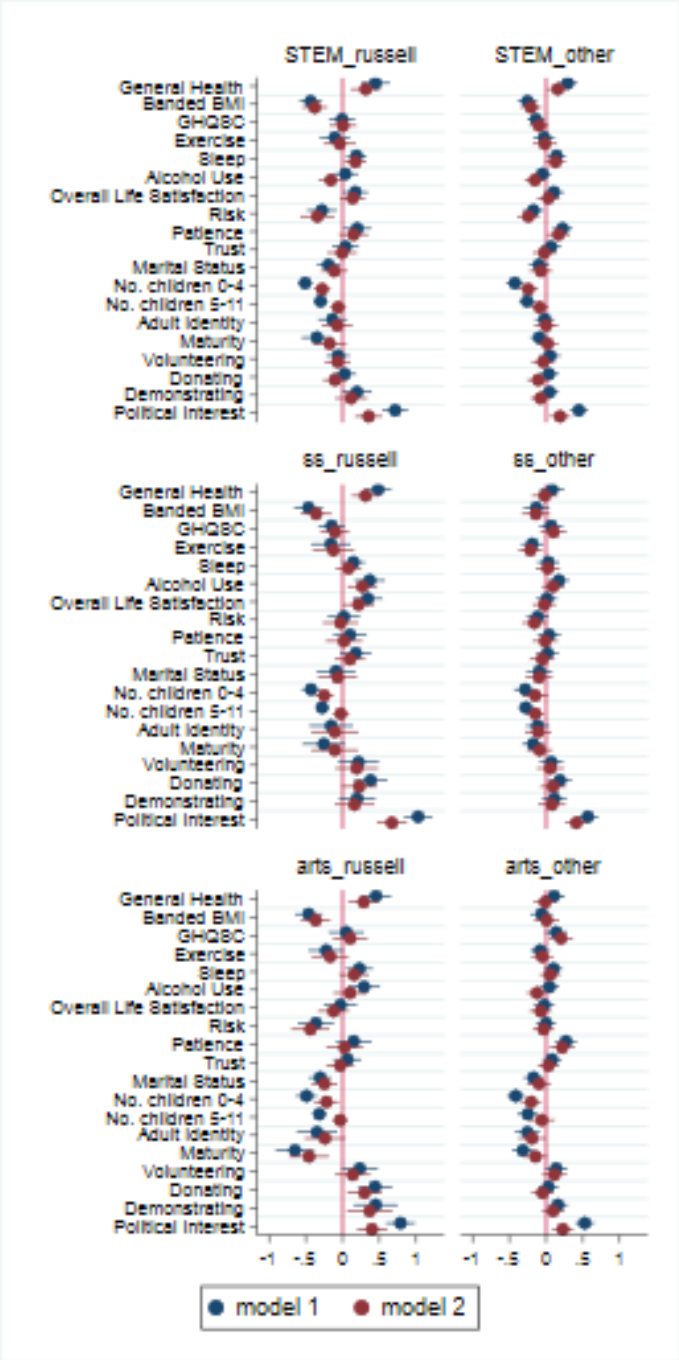
Since our data allows us to further break down degree effects by subject groups at the different HE institution types Figure 3.26 displays the estimates on the individual outcomes, and Figure 3.25 displays results with both model 1 and model 2.

There could be differences in subjects specialisation by institutional selectivity. In particular Russell institutions may have a greater proportion of students studying more academic and less practical subjects. Similarly some subjects might be more commonly offered in more selective institutions, for example Classics. Here our sample size prohibits us from a very detailed decomposition and we restrict ourselves to estimating the averages across broad subject categories by institution type.

Beyond the results of Figure 3.23 Figure 3.26 displays minor further differences between subjects at either Russell group or other universities and effects are moved closer to zero.

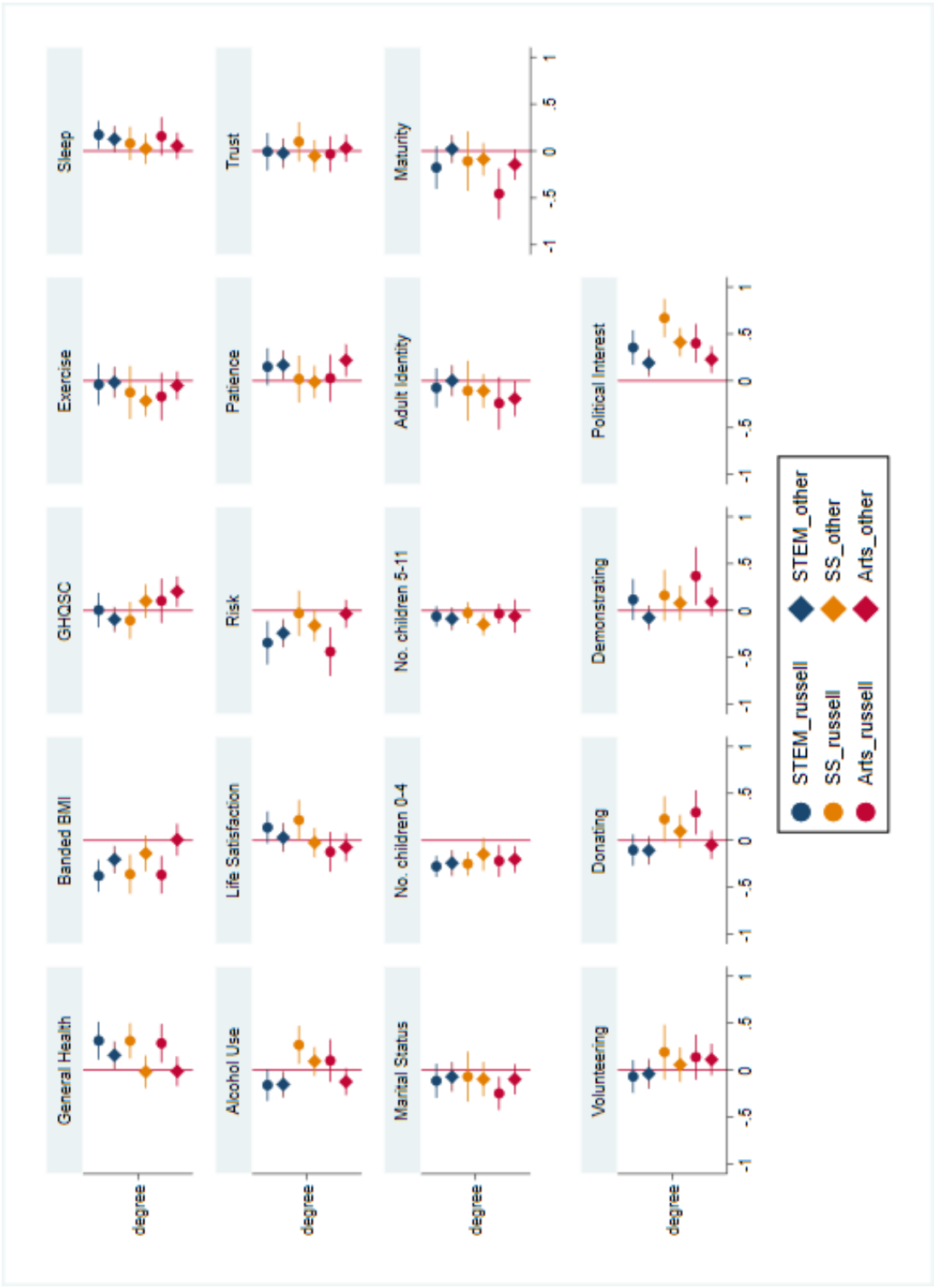
The pattern of difference by subject seems to be similar for both Russell and non-Russell institutions. STEM students seem to be less likely to donate their time or money but the effect seems to be the similar for Russell and non-Russel. On the other hand STEM seem to be more likely to be engaged in demonstrating or politics but the differences in effects are small enough to be insignificant.

Figure 3.25: Coefplot by Degree Subject x Institution type (vertical coefplot, horizontal option also available)



Note: Model 1 includes gender, ethnicity and region as control variables, model 2 additionally controls for the following pre-treatment personal and parental characteristics: parental income, non-cognitive skills, intention of going to university. The confidence interval is set at 95%.

Figure 3.26: Coefplot by Degree Subject x Institution type



Note: The specifications control for gender, ethnicity, region and the following pre-treatment personal and parental characteristics: parental income, non-cognitive skills, intention of going to university. The confidence interval is set at 95%.

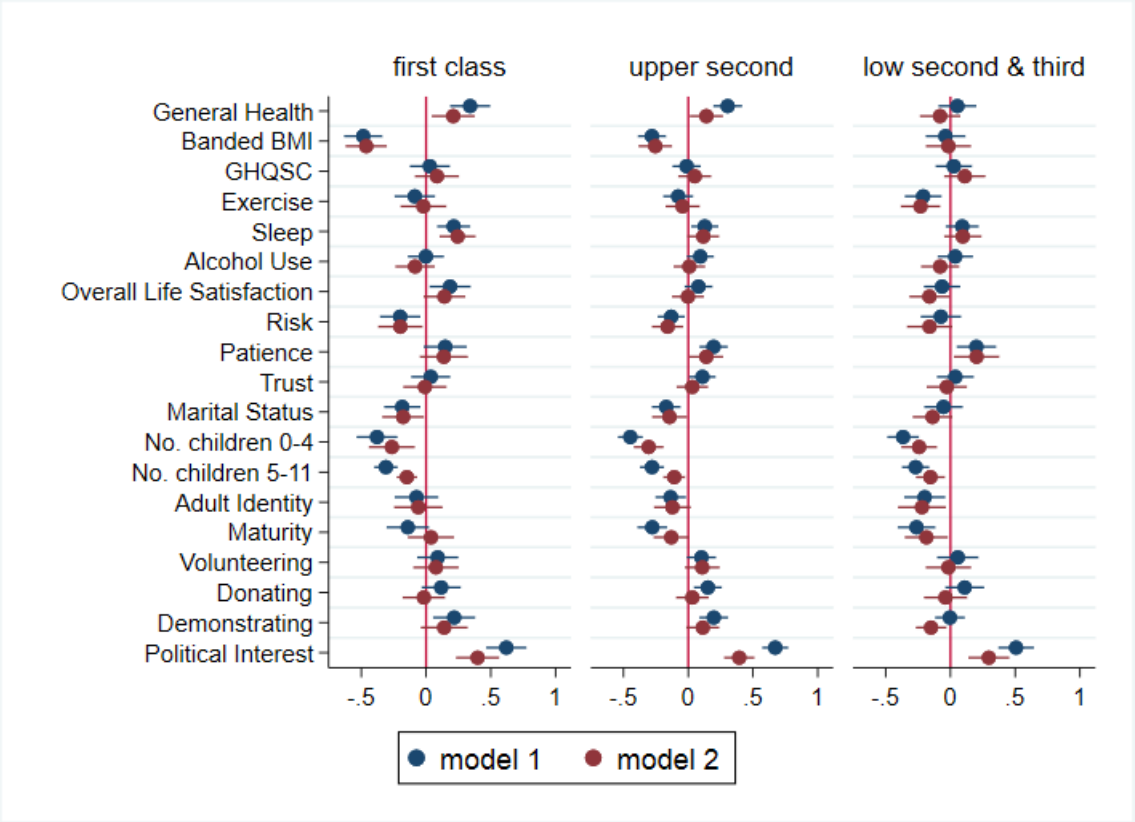
3.5.1.6 by Degree Class

Figure 3.27 shows differences in effects based on degree qualifications: first class, upper second class, and lower second and third class.

Degree effects for outcomes related to health (general health, BMI, and sleep) are largest for first class graduates and progressively decrease in effect size across the other degree classifications. A similar pattern is seen for risk appetite, with first class being negatively correlated with a risk preference. Impacts on family life outcomes, identity, and social engagement do not seem to differ based on degree classification.

There seems to be a degree class gradient on general health and BMI, otherwise the difference across degree class seem to be statistically insignificant.

Figure 3.27: Coefplot by Degree classification



Note: Model 1 includes gender, ethnicity and region as control variables, model 2 additionally controls for the following pre-treatment personal and parental characteristics: parental income, non-cognitive skills, intention of going to university. The confidence interval is set at 95%.

3.5.2 Multiple Hypothesis Testing

This study examines impacts of a degree on an extensive number of outcomes as well as decomposing the treatment by institution type and subject groups. To address concerns about statistical inference given the number of hypothesis tests performed and the limited sample size, we also present adjusted p-values for all outcomes and treatments in Fig 3.3, by performing Familywise error rate (FWER) and False Discovery rate (FDR) adjustments.

The underlying idea behind both adjustment types is to reduce the (potentially) otherwise increased probability of false rejections/positives (Type I errors) due to testing multiple null hypotheses. The Familywise error rate is the probability of having at least one false positive/making any Type I error, and can be illustrated as follows:

$\alpha_{FW} = 1 - (1 - \alpha_{PC})^c$,

Where c equals the number of tests performed and α is the set threshold value for the acceptable probability of a Type I error, in this case 0.05. Assuming there are four hypothesis tests performed the FWER corresponds to 18.5%:

$\alpha_{FW} = 1 - (1 - (0.05)_{PC})^4$

$\alpha_{FW} = 1 - (0.95)^4$

$\alpha_{FW} = 0.185$,

demonstrating that the probability of falsely rejecting the null-hypothesis at least once has actually risen to 18.5% 'instead of being/remaining 5% like initially intended'.

The False Discovery Rate on the other hand is the expected proportion of false rejections/positives (Type I errors) i.e. the 'ratio of the number of false positive results to the number of total positive test results'. A p-value of 5% in a single hypothesis test implies a 5% probability of falsely rejecting the null-hypothesis. Controlling for FDR adjusts the p-value for each test to so-called q-value of 5%, which in turn mean that '5% of significant results will result in false positives'.

An important distinction between both adjustment types is the fact that FWER takes any dependence among outcomes into account (allows for p-values to be correlated) but FDR does not. This leads to the implication that FWER-methods tend to produce relatively conservative p-value adjustments, while FDR (p-values not correlated) is willing to accept some type I error in exchange for more power.

Due to the number of outcomes and the nature of the analysis it is reasonable to want to take into account such p-value dependence among outcomes, but avoiding any false rejection might not be the primary goal. We argue that false rejections are not particularly costly in this analysis.

We present adjusted p-values controlling for FWER presenting the most conservative inference, as well as controlling for FDR potentially increasing power being willing to accept some Type I error.

Table 3.3 presents FWER adjustments using the conservative Bonferroni method, as well as the novel Romano-Wolf correction (Clarke, Romano, and Wolf, 2020) which contrary to the Bonferroni methods takes the dependence structure among p-values (by bootstrap resampling) into account and is therefore statistically more powerful.

For the Bonferroni adjustments p-values are multiplied by the number of tests performed capped at 1 while for the Romano and Wolf corrections we follow the stata code rwolf2, written by Damian Clarke (Clarke, 2021). It allows for multiple treatments, different commands, different controls and allows for clustered standard errors.

Table 3.3 also presents the alternative procedure which controls the False Discovery Rate (FDR) where we follow Michael Andersons (Anderson, 2008) steps to obtain 'sharpened q values'. As argued above these favour higher statistical power compared to FWER adjustments.

The following observations can be made from addressing multiple hypothesis testing: Under very conservative Bonferroni adjustments we find BMI, risk, No. of children aged 0-4, and Political Interest are still statistically significantly associated with a degree in both models. In the more parsimonious specification of model 1 degree effects on General health, marital status, adult identity, maturity, donating and demonstrating remain statistically significant. Under the Romano & Wolf FWER correction degree effects remain statistically significant for BMI, risk, no of children aged 0-4, political interest, in model 2. and model 1: general health, patience, marital status, no of children aged 5-11, adult identity, maturity, donating, demonstrating additionally.

According to FDR corrections: BMI, risk, no. of children aged 0-4, and Political Interest remain statistically significant. And if looking at model 1: general health, exercise, sleep, alcohol use, patience, marital stauts, no of children aged 5-11, adult identity, maturity, donating and demonstrating.

To conclude, we can infer with some confidence that degree effects on BMI, risk, no. of children aged 0-4, and Political Interest are unlikely to suffer from Type I

error stemming from the large number of hypothesis testing. We acknowledge that in carrying out these adjustments we trade off an increased type II error against a type I error. So we use these adjustments as indications of particularly strong suggestions of an effect in some cases while in others we are not prepared to make the trade off. We also acknowledge that the decision about the 'number of tests' is somewhat arbitrary, as there is no definite guideline as to what a family of tests is.

3.6 Discussion & Conclusion

We explore a rich dataset from a large cohort study of young people in England to evaluate the non-pecuniary outcomes associated with HE. The aim is to complement recent research on the pecuniary returns to HE which shows that these vary dramatically across subject and institutional selectivity ((Britton, Dearden, Shephard, et al., 2019)). In particular, we wish to see if subjects (and institutions) that generate high pecuniary returns also generate better non-pecuniary returns. That is, does HE generate non-pecuniary returns that reinforce pecuniary returns, or non-pecuniary returns that counteract the pecuniary returns. We address this by estimating the impact of HE on such outcomes under two specifications. (We further shut down transmission through the effect of income on such outcomes by controlling for income (see Appendix B)).

The results suggest that the differences in social returns across subjects, and across institutional selectivity, are entirely insignificant under a less parsimonious specification that controls for personal and parental background. That is, our findings do not suggest that one can build a case for differential subsidies across HE subjects or across institutions. Similarly, the results for private returns across subjects and institution types do not suggest that these weaken the case for encouraging students to invest in courses that are likely to have high returns in terms of pecuniary returns alone.

What form these non-pecuniary returns take is also of interest. We think of health effects as being largely private non-pecuniary benefits, and, similarly, children have essentially private benefits (and costs). In contrast, we think that political interest, volunteering and donating are largely socially beneficial acts. Significant social benefits would support a case for thinking that Higher Education merits a degree of subsidy from the taxpayer. In fact, we find that while there are statistically significant *private* effects on general health, BMI, risk, and the number of children, it is only political interest where we find a statistically significant*social* benefit. This seems like a thin basis for targeting subsidies to HE by subject.

Interpreting the individual economic significance of the estimate sizes is difficult

Table 3.3: Multiple Hypothesis Testing - adjusted p-values

						FWER corrections				FDR correction	
Outcomes	treatment	original coefficient		**original p-value**		**Bonferroni**		**Romano&Wolf**		**Anderson sharpened q-values**	
		m1	m2	m1	m2	m1	m2	m1	m2	m1	m2
General Health	degree	0.236	0.0996	0.000	(0.054)	0.000	(1)	0.0003	(0.5212)	0.001	(0.124)
BMI	degree	-0.260	-0.206	0.000	(0.000)	0.000	(0.000)	0.0003	(0.0027)	0.001	(0.001)
GHQSC	degree	0.0147	0.0592	0.740	(0.252)	1	(1)	0.7481	(0.8187)	0.185	(0.194)
Exercise	degree	-0.0863	-0.0686	0.061	(0.191)	1	(1)	0.2806	(0.8041)	0.026	(0.169)
Sleep	degree	0.120	0.0917	0.009	(0.076)	0.171	(1)	0.0746	(0.5515)	0.007	(0.124)
Alcohol Use	degree	0.0886	-0.0171	0.036	(0.725)	0.684	(1)	0.2003	(0.9900)	0.016	(0.388)
Life Satisfaction	degree	0.051	-0.0111	0.253	(0.826)	1	(1)	0.6148	(0.990)	0.081	(0.388)
Risk	degree	-0.113	-0.154	0.010	(0.002)	0.19	(0.038)	0.0746	(0.0433)	0.007	(0.009)
Patience	degree	0.141	0.0733	0.003	(0.186)	0.057	(1)	0.0293	(0.8041)	0.003	(0.169)
Trust	degree	0.0370	-0.037	0.399	(0.477)	1	(1)	0.6438	(0.960)	0.098	(0.342)
Marital Status	degree	-0.150	-0.120	0.001	(0.029)	0.019	(0.551)	0.0197	(0.3609)	0.002	(0.096)
No. Children 0-4	degree	-0.411	-0.228	0.000	(0.000)	0.000	(0.000)	0.0003	(0.001)	0.001	(0.001)
No. children 5-11	degree	-0.270	-0.0975	0.000	(0.070)	0.000	(1)	0.0003	(0.5485)	0.001	(0.124)
Adult Identity	degree	-0.148	-0.101	0.001	(0.062)	0.019	(1)	0.0197	(0.5398)	0.002	(0.124)
Maturity	degree	-0.244	-0.109	0.000	(0.035)	0.000	(0.665)	0.0003	(0.3912)	0.001	(0.096)
Volunteering	degree	0.0557	-0.001	0.219	(0.989)	1	(1)	0.6148	(0.9913)	0.074	(0.455)
Donating	degree	0.141	0.0197	0.002	(0.690)	0.038	(1)	0.0197	(0.990)	0.003	(0.388)
Demonstrating	degree	0.170	0.0762	0.000	(0.097)	0.000	(1)	0.0007	(0.6025)	0.001	(0.13)
Political Interest	degree	0.573	0.307	0.000	(0.000)	0.000	(0.000)	0.0003	(0.0003)	0.001	(0.001)

but we can place the estimates in some context. The degree effect on general health is one tenth of a standard deviation but three times the effect size of parental income on health for example. The degree effect size on BMI is similar to the estimate size of the father's education and twice as important as the mother's education. The negative estimate for risk is half the size of the gender effect (as well as almost a tenth of a standard deviation). The degree effect size on the no. of children (0-4) is half of a standard deviation, while being twice the effect as the mother's education. Lastly the degree effect size on political interest is a third of a standard deviation and a bigger effect size than the parents' education.

Chapter 4

The Graduate Well-being Premium: Evidence from Pooled UK Cross-sections

4.1 Introduction

There has been extensive research on the graduate earnings premium - but being a graduate implies life changes that transcend income and we know very little about such wider effects of **Higher** Education (HE) on well-being. We think of well-being measures as catch-all variables that capture the wide variety of effects that an undergraduate education might bring - we use it here because we know that money matters, but we also know that it is very unlikely to be the only thing that matters.

This research addresses this lacuna in our knowledge-base using a large pooled cross-section dataset that is unusually rich in information on individual well-being. Our data shows that graduates feel that life is more worthwhile, are happier, have greater life satisfaction, but suffer from greater anxiety than do non-graduates. We further exploit two periods of rapid expansion in the British Higher Education ((HE) system that drove large gains in educational attainment in the 1960s and again in the early 1990s to elicit causal estimates. In doing so, we find even larger significant wellbeing effects for marginal students. The research here suggests that graduate well-being differences driven by earnings differentials are reinforced by beneficial non-pecuniary effects on well-being.

We make two contributions to the existing literature in our econometric analysis.

First, using OLS, we explore conditional correlations in our extensive data in the spirit of shining a light where there is none, rather than searching under a streetlight. We find that these differences in wellbeing in the raw data are attenuated by allowing for income differentials, but many are not eliminated. Controlling for earnings as well allows us to close the income channel that might account for some of the differentials we find in the raw data. We acknowledge that income is on the causal pathway, and present both specifications to explore any degree effects beyond any potential effect through income. We then show that the large life satisfaction differential seems to vanish; anxiety falls a little but remains significantly positive for both men and women; while happiness and feeling life is worthwhile falls significantly for men but, for women, it falls a little and remains significantly positive. Second, we are able to contribute to the literature which contains (almost) no causal studies by also producing causal estimates using two periods of rapid expansions in the HE system to instrument for HE. We show significantly larger degree effects on wellbeing for students on the margin - with effect sizes that are more than a standard deviation for life satisfaction and things worthwhile, half of a standard deviation for happiness, and a third of a standard deviation for anxiousness.

The overall impression we take away from this is that graduate earnings premia underestimate the overall benefits of being a graduate - there is an additional effect of being a graduate that is not accounted for by income.

Moreover, our dataset is large enough to decompose by gender, birth cohorts, degree subject, and gender. Important differences arise - for example, the anxiety effect is largely driven by Arts graduates, while STEM graduates are *less* anxious than non-graduates - potentially suggesting that anxiety is driven by job insecurity. Recent research (Britton, Dearden, Erve, et al., 2020, Walker and Zhu, 2013 and Walker and Zhu, 2018, as well as Buchmueller and Walker, 2020) suggests much larger estimated earnings premia for graduates in STEM and LEM (Law, Economics and Management) subjects, while Arts degrees have small, sometimes insignificant, earnings premia and other Social Sciences are in between. The research here suggests that earnings premia by subject, far from being compensating differentials that counteract the pecuniary effects, might be reinforced by our estimated non-pecuniary impacts of well-being.

Finally, we find that the data could be construed as reflecting the traditional well-being U-shape in age - but, in our pooled cross-sections dataset, we can show that this seems to be a manifestation of cohort effects that have normally been ignored.

This chapter proceeds as follows: Section 4.2 outlines and discusses the relevant literature related to (determinants of) well-being/life satisfcation, Section 4.3

describes Data used, i.e. the well-being measures (and variations by degree status, age, etc.) as well as well as other relevant variables and Section 4.4 outlines the method used. Section 4.5 presents results before Section 4.6 concludes.

4.2 Related Literature

Well-being has increasingly been a focus of research in Economics. Psychologists and philosophers, have long been interested in self-reported measures of well-being, and what they mean. Economists have developed an interest in well-being only in the last 30 years - although there is a long back story driven by the role of "utility", as a description of preferences, in decision making. Indeed a prominent Princeton psychologist, Daniel Kahneman, received the Economics Nobel prize in 2002 - reflecting the relevance for psychology for economic decision-making around risk where economists had previously taken a narrow view based on additively separable expected utility.

Economists have traditionally avoided direct measures of well-being on methodological grounds - preferring the idea of an axiomatic approach to "utility" that could be supported by rational restrictions on preferences. In contrast, income is often used as a proxy for opportunities and well-being. If people are not fully rational, however, their choices will not necessarily maximize their *experienced* utility, and increasing their opportunities will not necessarily make them better off (Kahneman, 2003; Thaler and Sunstein, 2003). Nonetheless, advances in psychology and neuroscience suggest that experienced utility and well-being can be measured with some accuracy (Kahneman and Tversky, 2013). Robust, and interpersonally consistent, relationships have been observed between subjective measures of experience and both specific measures of brain function and actual health outcomes. It is partly because of these findings that economic research using subjective indicators of happiness and life satisfaction has proliferated in recent years. Indeed, most work on well-being is based on responses to questions on overall life satisfaction and on happiness. Thus, economics research has been focused on measurement, and validating subject well-being measures against other metrics - especially at the individual level.

Many early correlational studies suggested that life satisfaction was only weakly correlated with income (and with religiosity), but was uncorrelated with either education or local climatic conditions (Deaton and Stone, 2013a). Life satisfaction was thought to be U-shaped in age, and self-reported happiness rose with age from early middle age to old age, conditional on health (for the lifecycle pattern of happiness see Blanchflower and Oswald, 2008). Psychologist and Economist have

studied the determinants of well-being alike. Social capital (such as social relations, network, etc), physical health, income, and personality have all been found to impact life satisfaction/well-being (Dolan, Peasgood, and White, 2008; Kahneman and Deaton, 2010). Life satisfaction was found to be low for the unemployed and was positively affected by life events such as marriage and having children, but negatively affected by divorce, and bereavement (Gardner and Oswald, 2006; Oswald and Nattavudh Powdthavee, 2008a). The consensus in the more recent literature is that the effects of shocks tend to fade across time, often quite quickly even when the cause of a shock remains permanent, for example, individuals were able to *adapt* to becoming disabled (Oswald and Nattavudh Powdthavee, 2008b). However, Lindqvist, Östling, and Cesarini, 2020 finds a modest, but statistically significant, impact on well-being of a large win on the Swedish lottery (US$100,000).

A particular focus in Economics has been the role of income in explaining well-being - this is partly a reflection of wanting to know if it would make a difference to policies that get implemented. The goal of public policy is not to maximize measured GDP, so a broader measure of well-being could help to inform policy.

Indeed, one virtue of well-being-measures is that they may capture variation in the circumstances across individuals that are normally difficult to capture - in contrast to income which is easy to measure but conceptually narrow. One might think of well-being measures as being "catch-all" measures that reflect unmeasured (and possibly unobservable) determinants of well-being, as well as income.

Psychologists have been quite specific in the ways (subjective) well-being should be measured. In particular, they distinguish between *hedonic* (such as happiness) and *eudemonic* (such as life satisfaction, which goes beyond emotions of happiness and requires a more considered evaluation of one's life) (Ryff, 1989), as well as 'positive and negative affect' after Bradburn, 1969 classic work calling on the independence of both (rather than, as previously was common, assuming well-being equates lack of 'ill-health'). Happiness has been thereafter seen as a measure of balance between positive and negative affects in life, and empirical studies in economics often tend to focus on using happiness and life satisfaction interchangeably.

While there are differences across measures and there is a general concern associated with self-reported nature of all such measure, their validity and value has been widely accepted in studying the well-being of individuals (Kahneman and Krueger, 2006, Ferrer-i-Carbonell and Frijters, 2004).

Early literature in economics suggested that it was relative, not absolute, income that mattered for well-being. Sometimes income and local area average income was included to explain well-being. And, in some cases, the relative income specification

could not be rejected. However, more thoughtful work by Deaton and Stone, 2013b, for example, highlights the robust nature of the effect of absolute income on *evaluative* well-being based on a *Cantrell* ladder scale that requires subjects to reflect. The coefficient on log income in their life satisfaction modelling was approximately 0.5 which varied insignificantly when the data was collapse to local averages.

Empirical research often controls for educational attainment (with mixed evidence on the sign of its coefficient), but its direct and indirect impacts on measures of well-being has received far less attention than other determinants of well-being. Furthermore evidence of the impact of education on well-being is exclusively correlational - something that is true for almost all studies, whatever the variable of concern. Evidence on the impacts and education remains mixed and sensitive to context. This review of studies focuses on empirical analysis that emphasize education impacts whether direct or indirect. Where relevant we will highlight whether the study differentiates between education attainment levels.

There are several recent studies that report a positive correlation between well-being and education. Gerdtham and Johannesson, 2001 shows positive associations between education and happiness using Swedish individual-level data, while highlighting other determinants such as income, health, and factors negatively linked with happiness such as "unemployment, urbanisation, being single, and male gender." Cuñado and Gracia, 2012 use Spanish individual-level data to establish direct positive and significant effects on happiness even after controlling for socio-economic factors, which is independent of the level of education. The direct effects are interpreted as benefits from 'self-estimation' gained through/by education. Layard et al., 2014 also establishes a positive link between educational attainment and life satisfaction but finds it to be its least important predictor. Nikolaev, 2018 looks at life satisfaction, positive and negative affect (a hedonic measure) and engagement and purpose (in life) (an eudemonic measure) as measures of well-being. They find that higher educated people were more likely to evaluate their lives as meaningful and experience more positive emotions and less negative ones - "reporting higher levels of eudemonic and hedonic subjective wellbeing". Nikolaev also observes the marginal effect of education on well-being to be decreasing with education. Jongbloed, 2018 distinguishes between tertiary education levels and levels below and, although the overall findings vary according to well-being measure, tertiary education has been found to be positively associated with all measures: life satisfaction and a measure that is referred to as 'flourishing'.

Other studies have found positive yet (very) small effects and interpret that most benefits are being mediated through channels such as income, health, social network etc. For example, Helliwell, 2003 uses large international samples of individual

respondents and finds small and insignificant effects of education on well-being - and argues that the benefits derived from higher education are explained by higher income, better health and higher perceived trust. N. Powdthavee, Lekfuangfu, and Wooden, 2015 points to the importance of accounting for indirect effects of education by estimating a structural simultaneous equation model, finding that impacts of education are largely transmitted through income and health. A. Clark et al., 2019 also highlights that overall impacts of education on life-satisfaction are mediated through variables such as not being unemployed, being partnered, non-criminality, physical health and mental health whose coefficients are much larger in sum than the direct effects of education which are positive but small. Other mediating factors that have been found substantial in the impacts on happiness are interpersonal network and degree of cosmopolitanism as Chen, 2012 finds for East Asian countries (Japan, Taiwan, South Korea). Similar findings for European countries have been summarised by Rodríguez-Pose and Von Berlepsch, 2014 highlighting social interaction and social and institutional trust, although significant heterogeneity can be observed between European countries.

Lastly, there is evidence on *negative* links between education and measures of well-being as well. The reasons for a negative link are interpreted and explained through a variety of mechanisms. One such explanation is through the relative income effects (A. E. Clark and Oswald, 1996, G. Ruiu and M. L. Ruiu, 2019) or relative education (Nikolaev, 2016). Similarly higher educated individuals are shown to have higher aspirations which seems to negate (any) positive effects on well-being. Kristoffersen, 2018 look at well-being across different education levels and find that individuals with higher education levels "require better circumstances to be equally satisfied". A. E. Clark, Kamesaka, and Tamura, 2015 draw similar conclusions when exploring Japanese data on reported and desired happiness - establishing that while higher education individuals report higher happiness they also report higher desired happiness. Another attempt at explaining negative or zero effects of education was to look at how education's impact is related to age. Nikolaev and Rusakov, 2016 finds delayed beneficial effects of education on happiness from early to mid-30s but not before.

Overall, the evidence does not distinguish very often between levels of education and does not focus on the impacts of higher education *per se*. Recent evidence is mixed with largely positive or small associations, of which some are being negated by mediating factors such as income, health, or social network variables, and on the other hand there some negative indirect links through relative comparison effects.

4.3 Data and Descriptive Statistics

The data used for this study is the Annual Population Survey (APS) . It is a major UK survey series at the individual level that contains key variables from the Labour Force survey and covers topics such as education, employment, health and ethnicity. What is of particular interest to this study are the subjective well-being measures which were included in the survey after 2011. The data used here is taken from the surveys of 2012 to 2020. Each annual survey contains on average around 280,000 observations.

Given that the average age of undergraduate degree completion is 22 this study focuses on individuals aged 22-65 which allows for a focus on the working age population. We select on those with positive earnings to make out work comparable with research on earnings effects of HE (and we trimmed the earnings distribution to eliminate outliers). We opt not to control for postgraduate education so our estimates are effectively estimates that include the option value of postgraduate education that an undergraduate education might lead to.

Since we are looking at well-being differences between graduates and non-graduates the variable for degree status is defined as everyone with a degree level qualification including foundation degrees, graduate membership of a professional institute, PGCE, or higher degree. APS also allows for a decomposition by subject group. The remainder are classed as non-graduates.

Given the attention that has been paid to age effects in the well-being literature, we feel compelled to address this here. In our descriptive work we show the effects of age *and* cohort of birth - but we are only able to do this by grouping birth year into *decade* of birth. In our econometric analysis, we control only for decade of birth so as to avoid confounding the separate effects of age and birth cohort. Other control variables included are sex, ethnicity, region, birth cohorts and marital status. In addition, in a second specification we include log earnings for the purpose of extracting the mediating effect of income. This is defined as weekly gross earnings (from both main and second jobs).

4.3.1 Well-being measures

Individuals are asked four questions in total regarding their Life satisfaction, Anxiousness, Happiness, and whether that the things they do in life are worthwhile, on a scale of 0 to 10 where 0 is 'not at all' and 10 is 'completely', as follows:

1. Life satisfaction: Overall, how satisfied are you with your life nowadays?

2. Anxiousness: Overall, how anxious did you feel yesterday?
3. Happiness: Overall, how happy did you feel yesterday?
4. Worth: Overall, to what extent do you feel that the things you do in your life are worthwhile?

Table 4.1 summarizes each outcome by degree status. On average, the differences in subjective well-being by graduate status seem to be small. Graduates score slightly higher on Life satisfaction and happiness; graduates are slightly more anxious; but graduates score a little higher when evaluating whether the things they are doing in life are worthwhile.

Table 4.1: Summary statistic for well-being measures (by degree status)

Subjective Well-being	Degree status	mean	sd	N
Life satisfaction	Nongraduate	7.679	1.610	300694
	Graduate	7.758	1.353	159159
Anxiousness	Nongraduate	2.814	2.816	300471
	Graduate	3.023	2.597	159121
Happiness	Nongraduate	7.461	2.068	300667
	Graduate	7.520	1.780	159157
Things in life worthwhile	Nongraduate	7.905	1.510	300155
	Graduate	7.986	1.338	159068

4.3.1.1 Bar charts

Figures 4.1-4.4 show the well-being distributions in more detail. In terms of life satisfaction (Figure 4.1) non-graduates dominate the lower part of the distribution (from 0 to 6), while graduates dominate the 7-9 range. There is a larger proportion of non-graduates reporting 10, completely satisfied - but this is a thinly populated cell. In the distribution of Anxiousness by degree status almost one third of non-graduates say that they were not anxious at all (=0) compared to only 23% of graduates. Graduates dominate the lower part of the distribution from 1 to 4, while non-graduates dominate the top (8 to 10).

The relative distribution of Happiness by degree status, in Fig 4.3, closely resembles that of life satisfaction in Figure 4.1. Figure 4.4 shows the distribution for 'Things in life worthwhile'. Almost 70% of graduates and 65% of non-graduates scored

Figure 4.1: Score distribution by Graduates vs Nongraduates for Well-being measure: 'Life satisfaction'

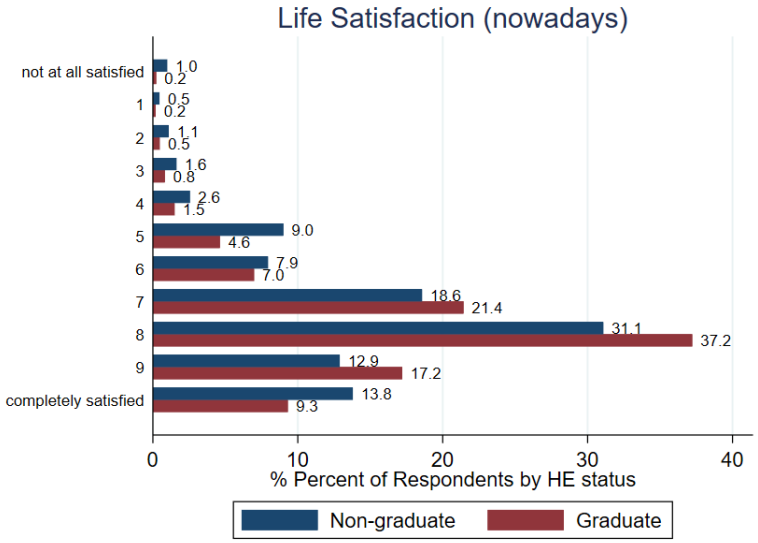


Figure 4.2: Score distribution by Graduates vs Nongraduates for Well-being measure: Anxiousness

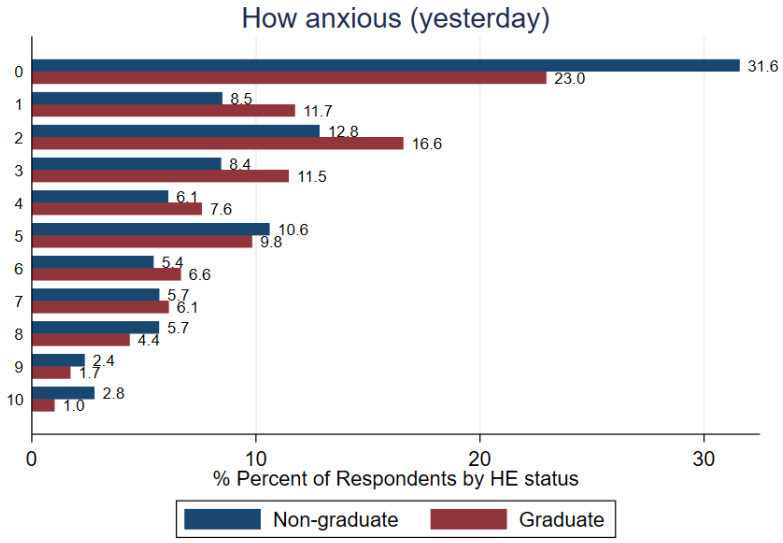
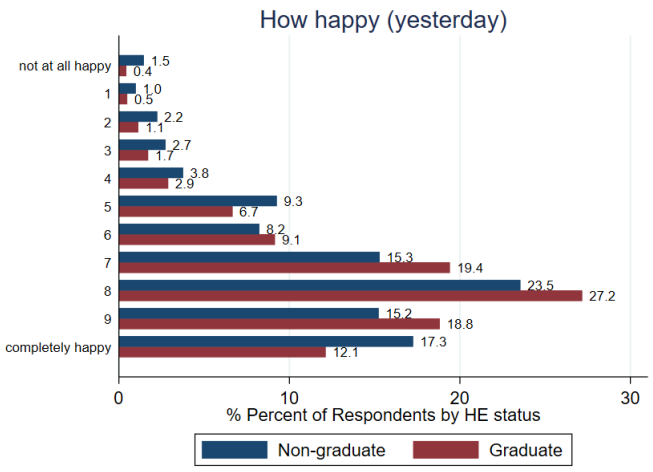


Figure 4.3: Score distribution by Graduates vs Nongraduates for Well-being measure: Happiness



between 8-10.

4.3.1.2 Bar graphs by subject

Since the APS records the subject of the individual's degree it allows for further inspection of how well-being measures differ based on the type of subject you studied at university. Figure 4.5 shows the mean scores of each well-being measure by subject groups such as STEM (Science, Technology, Engineering, and Math), LEM (Law, Economics, Management), Social Sciences, and Arts and Humanities. While there is, on average, a noticeable, albeit small, difference between graduates and non-graduates across well-being outcomes (with the exception of Anxiousness) there are also differences across subject groups. For Life satisfaction, LEM graduates rank highest, closely followed by STEM, and then Social Sciences and Arts.

Figure 4.4: Score distribution by Graduates vs Nongraduates for Well-being measure: Things worthwhile

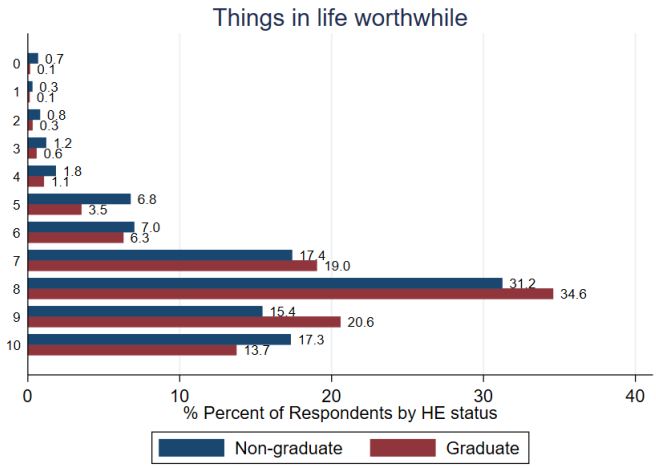
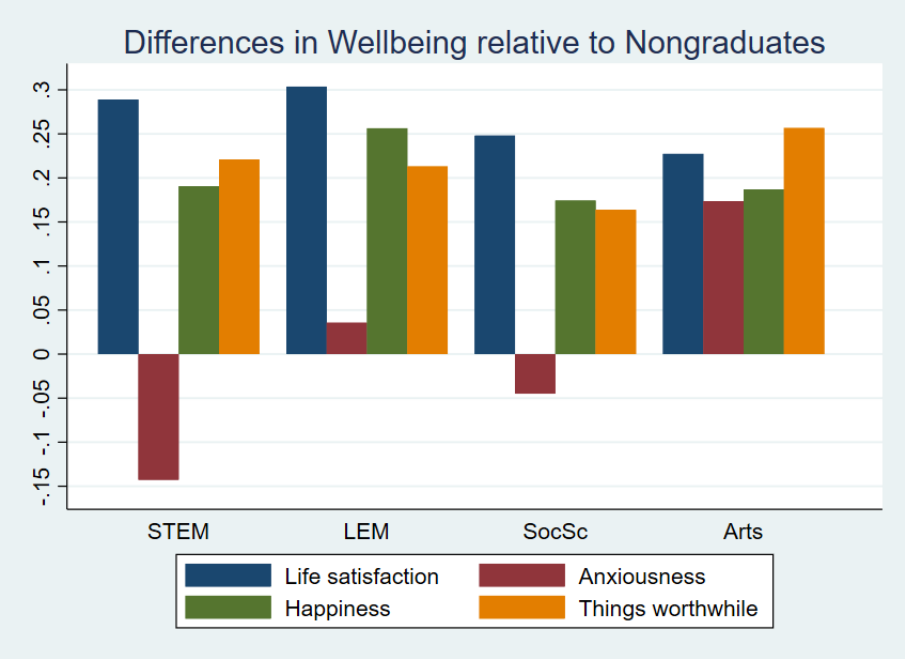


Figure 4.5: Mean score of wellbeing measures by subjects

In terms of Happiness, LEM graduates do better than other subject groups, which score fairly similar. On the other hand while Arts graduates score highest on average

in terms of doing things in life they consider worthwhile, they also top the list for Anxiousness. STEM and LEM score similarly for 'Things in life worthwhile' and Social Science graduates score lowest. With regard to anxiousness, LEM and Social Science graduates compare to non-graduates while STEM graduates seem to score as least anxious on average. The overall greater anxiety of graduates seems to be driven mostly by Arts graduates - which may be a reflection of their less stable job security. Figure 4.6 illustrates solely the differences in mean scores of well-being measures by subjects *relative to non-graduates*.

Figure 4.6: Differences in Wellbeing relative to Nongraduates



4.3.1.3 Variation across age in the well-being measures (pooled)

This section illustrates variations in well-being across age. As discussed in Section 4.2 Happiness and Life satisfaction have, in previous literature, been shown to follow a U-curve across an individual's life span, with self-reported happiness rising with age from early middle age to old age, conditional on health (Blanchflower and Oswald, 2008).

One of the advantages of APS is the large sample size which allows us to inspect differences in well-being across different ages. Figure 4.7 shows a smoothed kernel-weighted local polynomial regression model for the outcomes, showcasing differences by graduates vs non-graduates over the ages 22-65. There is a strong

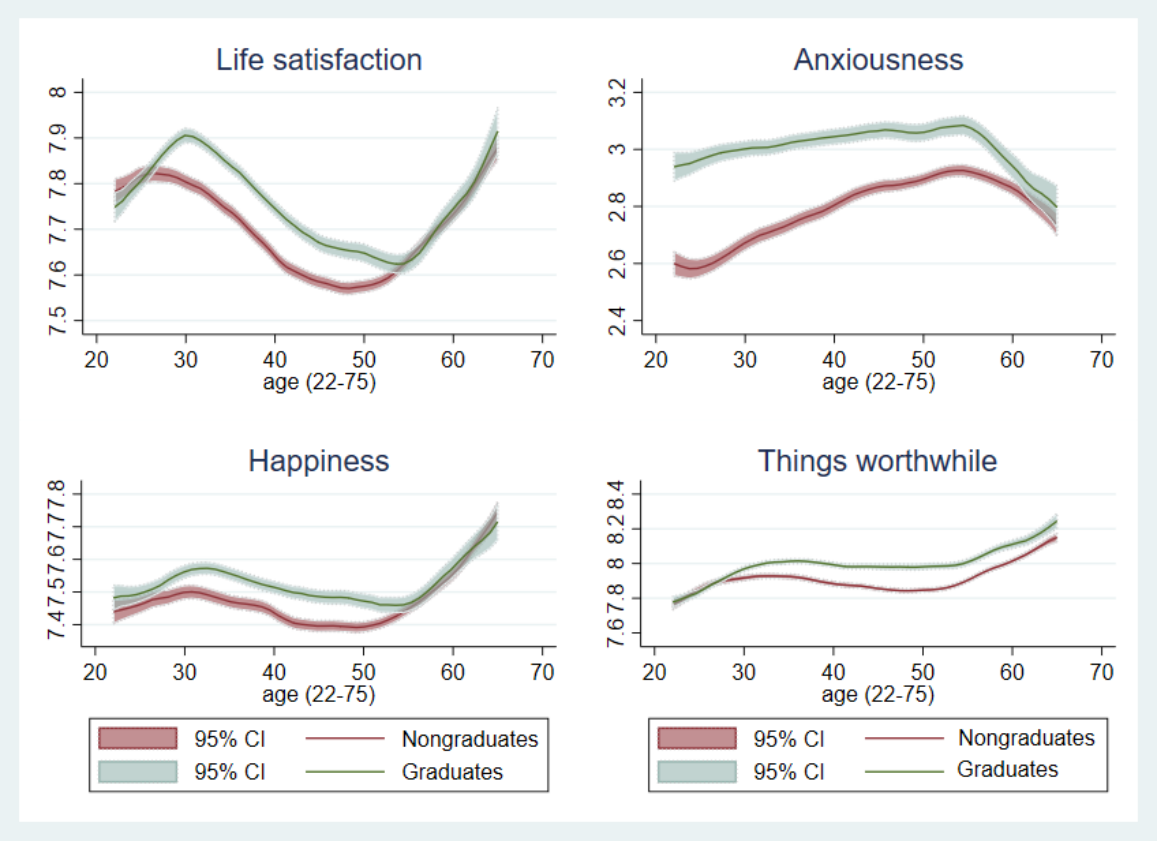
indication for a U-curve for life satisfaction and happiness. Graduates start out as less satisfied compared to non-graduates at age 22 but overtake non-graduates at around 26 years of age peaking with the highest score (7.9) at 30-31 after which life satisfaction decreases steadily all the way to the lowest score and bottom of the U at age 55, before rising again to a high score of 7.9 (the same as 30 year olds). Non-graduates peak at a younger age (28) with an average score of 7.8, following the same U-shaped curve but not catching up to graduates until aged 55. From age 55 onward, graduates and non-graduates mean life satisfaction scores merge, rising all the way to the life satisfaction scores of a 30-year-old graduate.

Happiness follows a very similar trend across age as life satisfaction. Contrary to life satisfaction graduates already score slightly above non-graduates at age 22, and this gap widens until average happiness peaks for both in their early thirties, after which the curve follows the same U-shaped trend as for life satisfaction. Happiness is lowest for non-graduates aged 42-50 (7.47) and for graduates aged 52-55 before it starts to rise again. The gap in happiness between graduates and non-graduates closes for people aged 55 onward and average happiness keeps rising for all well beyond peak levels of the early thirties.

In terms of individuals evaluating whether the things they are doing in their lives are worthwhile, the average score rises for both graduates and non-graduates without a gap until the late 20s. For graduates the belief in things being worthwhile levels out in their early thirties at 8 and remains fairly constant all the way until their mid 50s where the sense of life being worthwhile further increases with each year. The gap between graduates and non-graduates, which becomes apparent in individuals aged 28 and older, never closes but non-graduates follow a similar trajectory compared to graduates.

Anxiousness is the only outcome out of the four where non-graduates are doing significantly better over the entire course of the working age. The biggest difference in anxiousness-levels shows in the mid-twenties (graduate average equalling around 3 while non-graduate average lies at 2.6). Anxiousness levels keep rising for both although at a steeper slope for non-graduates and peak for both around age 55, after which they keep declining and the difference between graduates and non-graduates becomes continuously smaller (almost closing the gap by the end of the working life).

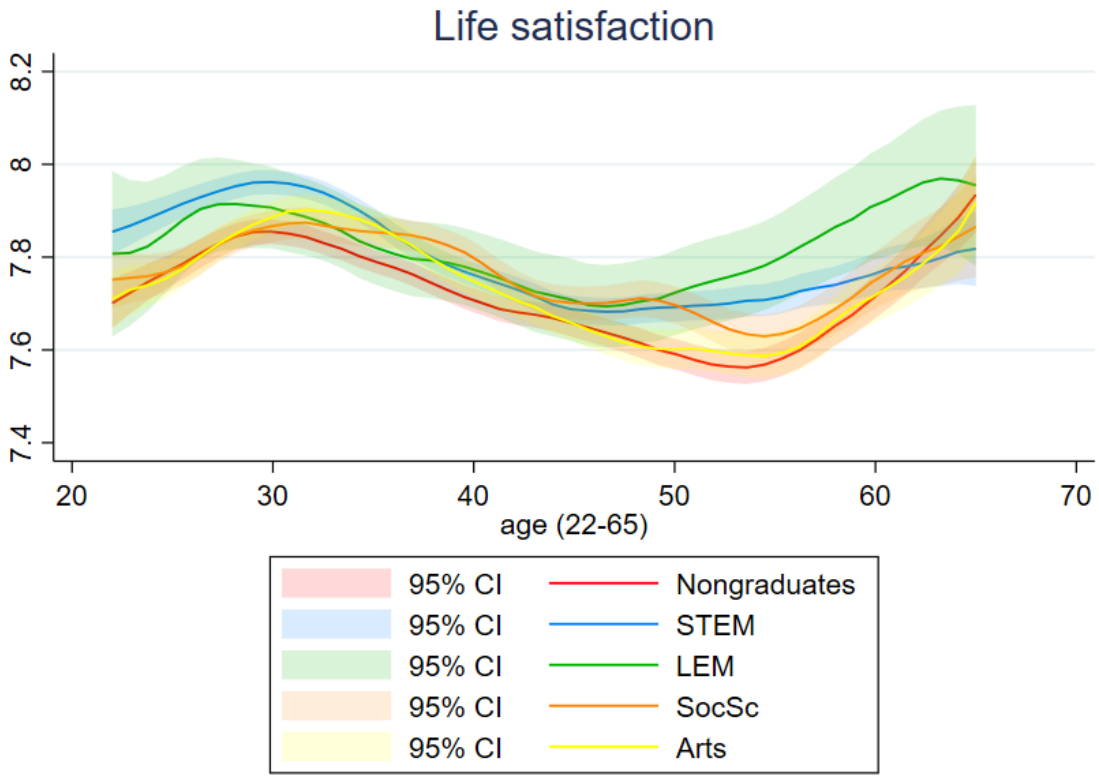
Figure 4.7: Variation across age



4.3.1.4 Variation of well-being measures across age by different subject groups

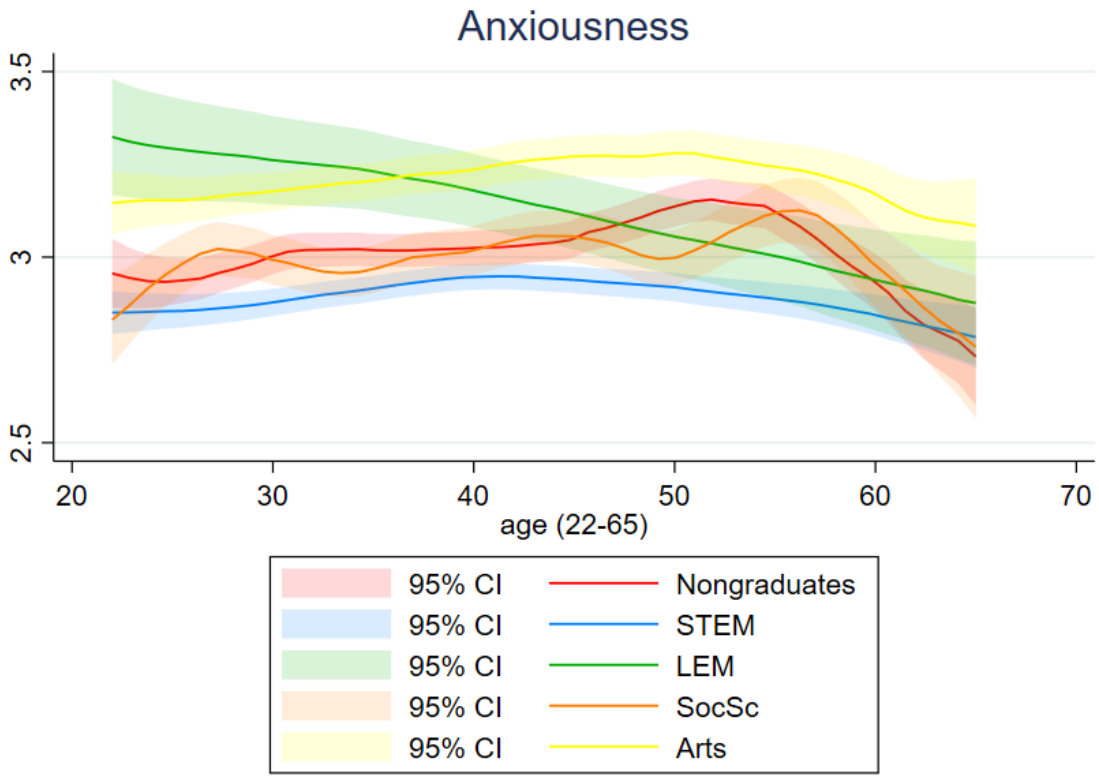
This section decomposes variation in the outcomes by subject for graduates and compares to non-graduates. It echoes what can be seen in Figure 4.5 and Figure 4.6 but in addition shows how variations behave across the working age span (22-65). It is worth pointing out that non-graduates and Arts graduates score very similar throughout the lifespan except with people in their thirties where Arts graduates are slightly more satisfied with life. While STEM graduates top the left peak of the U-shape around age 30, LEM graduates fare better from age 50 onward, scoring the highest life satisfaction out of all graduates (but have a wider confidence interval as well).

Figure 4.8: Variation of 'Life satisfaction' across subjects



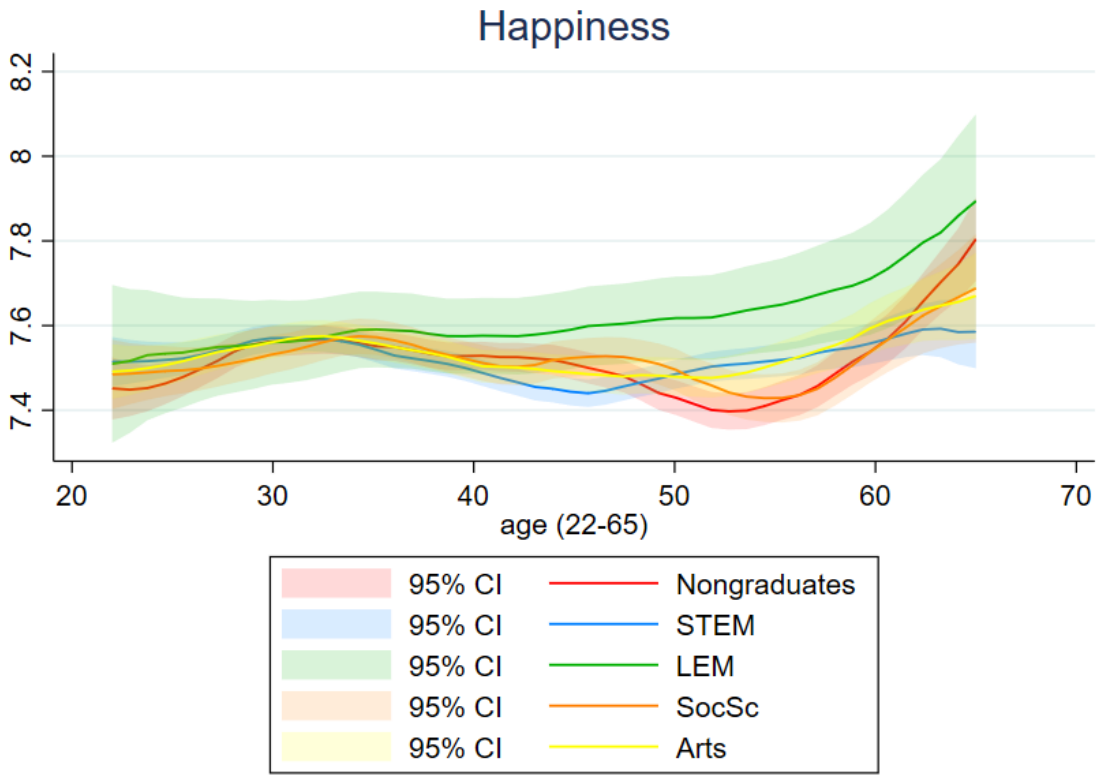
While non-graduates seemed clearly less anxious throughout life in Figure 4.7, once decomposed by subjects, it becomes apparent that STEM graduates are actually the least anxious throughout all ages until the early 60s where non-graduates and Social Science graduates join in as well. Highest levels of anxiety seem to prevail in LEM graduates throughout their 20s and early 30s, and Arts graduates aged 40 to late 50s. The highest levels of anxiety for non-graduates and Social Science graduates shows at age 50-55.

Figure 4.9: Variation of 'Anxiousness' across subjects



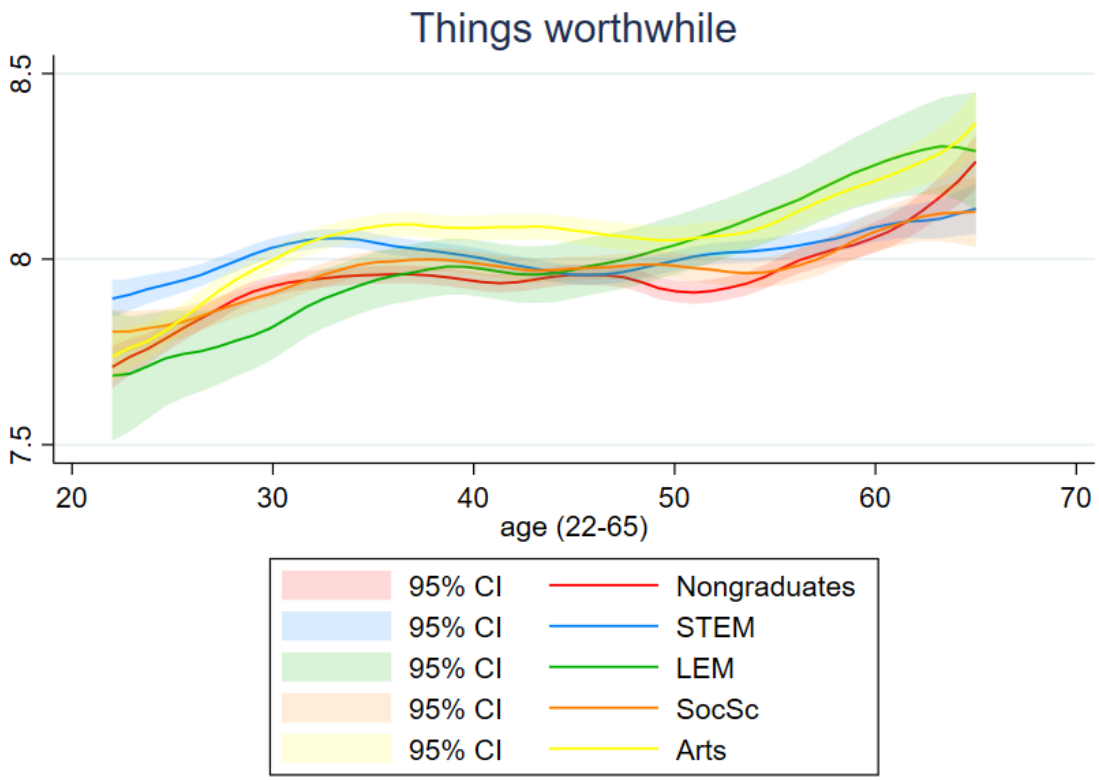
There seems to be smaller differences in happiness across subjects for ages 22-35 (Figure 4.10). A slightly flatter U-shaped curve can still be observed for all groups with the exception of LEM graduates (where happiness levels simply flatten between 30-50 years of age instead of decreasing and following the U-shaped trajectory). STEM graduates are least happy in their mid-forties, after which happiness levels rise again with each year. Non-graduates are least happy in their early and mid-fifties (reaching similar pre-peak happiness levels as non-graduates 22 years of age), before reaching the second highest levels (after LEM graduates) by age 65.

Figure 4.10: Variation of 'Happiness' across subjects



Lastly Figure 4.11 shows a similar pattern for 'life is worthwhile' as Figure 4.7. Across all subject groups as well as non-graduates the sense of things being worthwhile in life seems to increase quickly until around age 30, and then flattens until age 50, before it continues rising at a similar rate as seen prior to 30. LEM graduates begin with the lowest scores at age 22 but reach among the highest levels, together with Arts graduates, which may seem surprising giving the trends in all other outcomes, by age 65. Arts graduates actually fare best throughout their thirties, forties, and fifties and top the list at age 65.

Figure 4.11: Variation of 'Things worthwhile' across subjects



4.3.1.5 Variation of wellbeing measures across age by deciles of birth

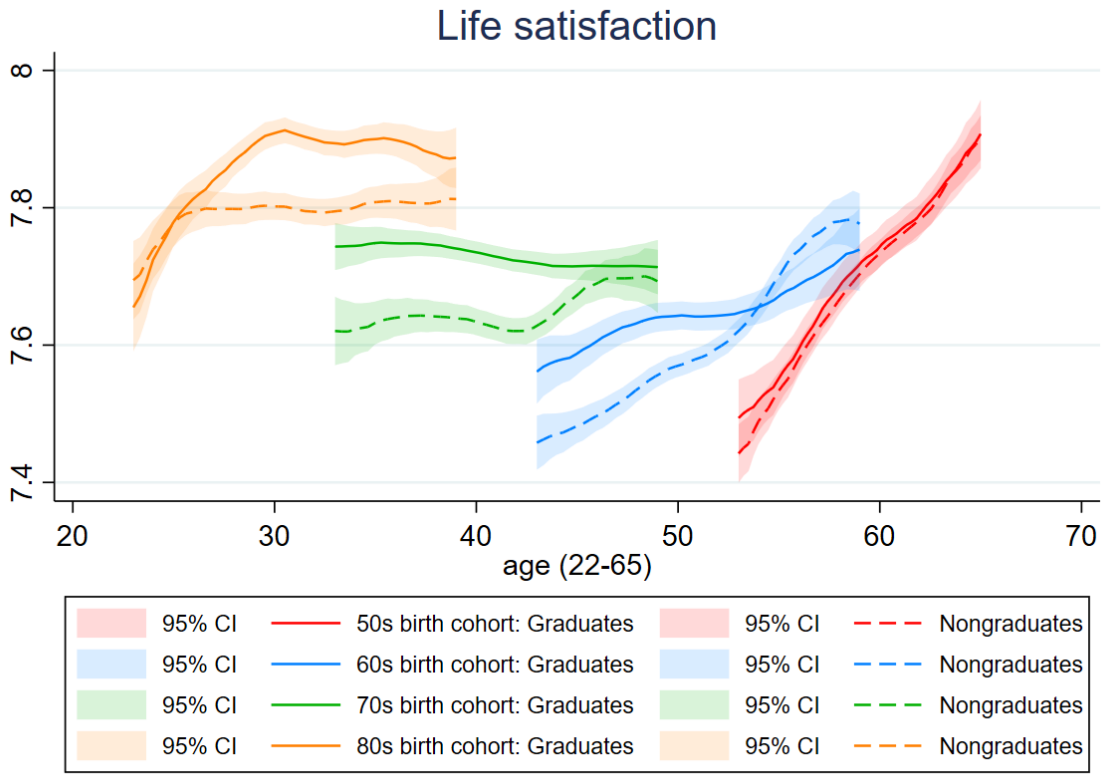
To be able to examine more closely how non-graduates compare to graduates we also decompose variations in well-being by deciles of birth. There are two reasons for trying to unpick lifecycle and cohort effects. First, the lifecycle U-shape is well-established in the well-being literature and yet there are no convincing attempts to separate age from cohort effects. Here we rely of within birth decade cohort variation across age with overlapping decades. Secondly, particularly low well-being may be indicative of depression which is, itself, correlated with suicide ideation. We are inclined to explore cohort differences in difference between graduate and non-graduates because of the prominence this is given in the Case and Deaton, 2021, deaths of despair narrative.

Unfortunately there is no other large UK dataset that allows one to sense-check the graduate/non-graduate well-being differential that Deaton and Case demonstrate convincingly in US data and then relate to deaths of despair - suicide, drug and

alcohol-related deaths.

Figures 4.12-4.15 illustrates that the biggest differences between graduates and non-graduates occur in people aged 30-50 i.e. the 60s, 70s and 80s birth cohorts (with the exception of anxiousness, see below). The overall U-shaped curve is still noticeable for general life satisfaction (Figure 4.12) but decomposing by birth deciles we find that the age patterns slopes are either flat (for the second half of the 80's cohort and through the 70's cohort) or increasing (for the 50's and 60's cohorts). In the oldest cohort (red) the graduate/non graduate differential is very small, while the graduate differential in the 60's cohort (blue) closes at the older end of the age range. In contrast, for much of the two most recent cohorts there are positive graduate/non-graduate differentials for much of the time.

Figure 4.12: Variation of 'Life satisfaction' by age deciles



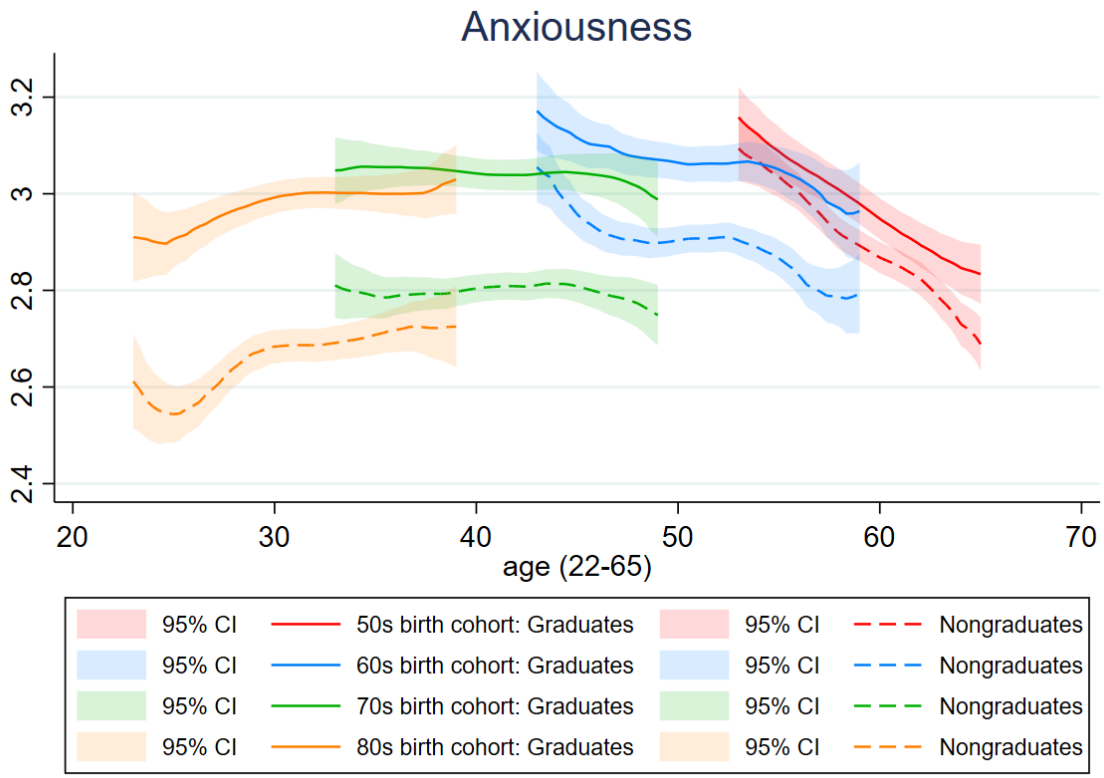
However, within-cohorts there seems to be no strong U shape in all cases. And the later cohorts do seem to have greater life satisfaction for graduates, while the earliest has no differential. The overall pat curve for happiness (Figure 4.14) is

similar to life satisfaction - there are positive well-being differentials that are larger for the recent cohorts and close to zero in the earliest cohort. Again there is no apparent U-shape in the within-decade life cycles.

Anxiousness in Figure 4.13 draws the most consistent picture for both graduates and non-graduates across ages. There are consistently positive graduate/non-graduate differentials. But, here there is a suggestion of an inverted U-shape for all - and since anxiety is negative well-being this could be interpreted as being consistent with a U-shape in positive well-being.

It is evident that non-graduates, throughout all birth cohorts, are consistently less anxious than graduates but although the gap between graduates and non-graduates decreases with age, overall anxiousness levels rise for both groups. For individuals in the 80s birth cohort anxiousness levels rise with age, for individuals from the 70s cohort (covering ages mid thirties and forties) anxiousness remains constant with increasing age, and only the 60s birth cohort and 50s birth cohort exhibit decreasing levels of anxiety with increasing age.

Figure 4.13: Variation of 'Anxiousness' by age deciles



It is interesting to note here that non-graduates aged 55 from the 50s birth cohort are as anxious as same-age graduates from the 60s birth cohort. The least anxious are twenty-something year old non-graduates but non-graduate anxiousness levels rise (more) with age until they reach graduate level anxiousness at age 45-55.

Figure 4.14: Variation of 'Happiness' by age deciles

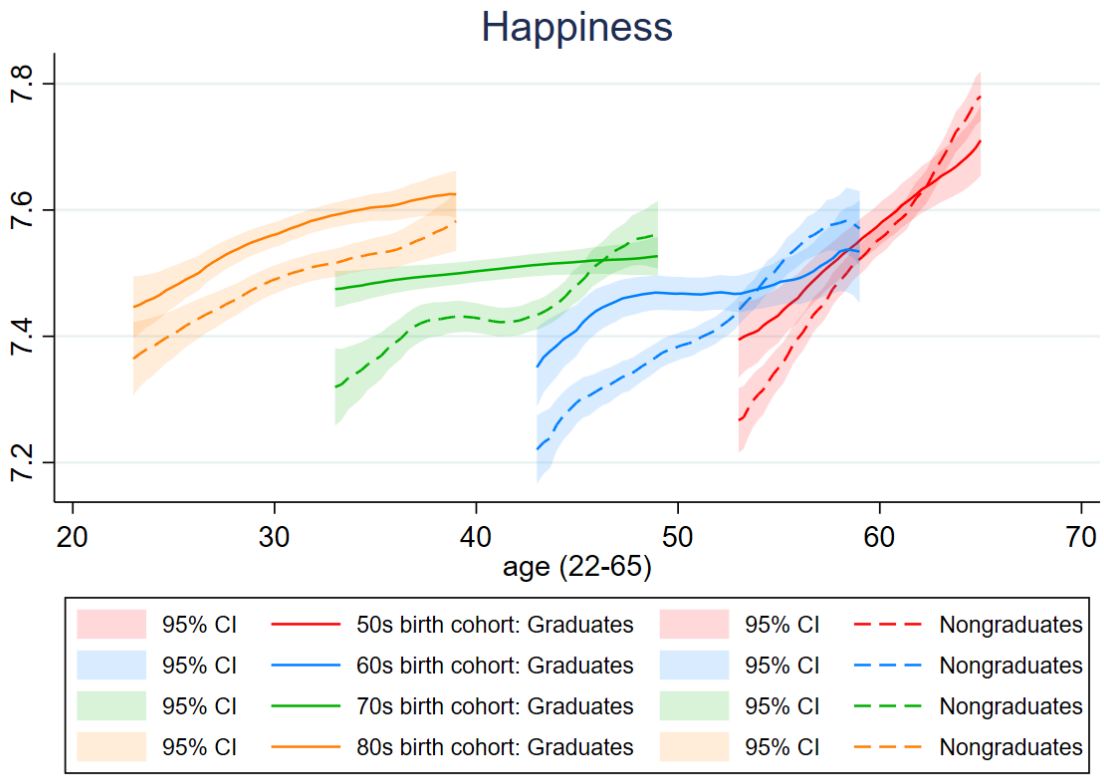
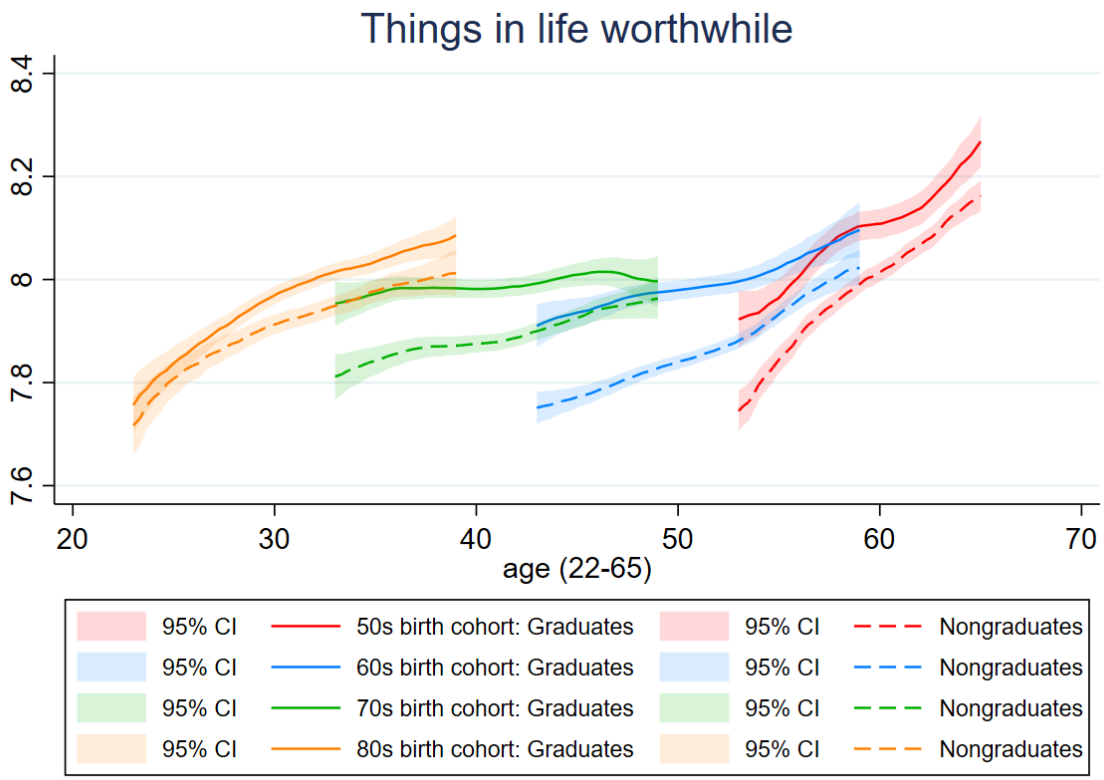


Figure 4.15 shows the breakdown by age cohorts for the sense of 'things being worthwhile' in your life. While one can observe a similar pattern as with life satisfaction and happiness, i.e. initial increase with age (until mid-thirties for the birth cohorts 80s), then flattening of the curve until late forties for people born in the 70s, and an increase again in feeling life is worthwhile for individuals in their forties but belonging to the 60s birth cohort, with highest levels of feeling worthwhile being achieved from the 50s birth cohort at the normal retirement age. It is noteworthy that, for this measure of well-being graduates always fare better across cohorts, and with age within cohorts.

Figure 4.15: Variation of 'Things worthwhile' by age deciles



While there is a strong suggestion of higher well-being for graduates in all measures, there is no evidence here that more recent cohorts of non-graduates are experiencing any sense of despair.

4.3.1.6 Variation across age in the well-being measures (by gender)

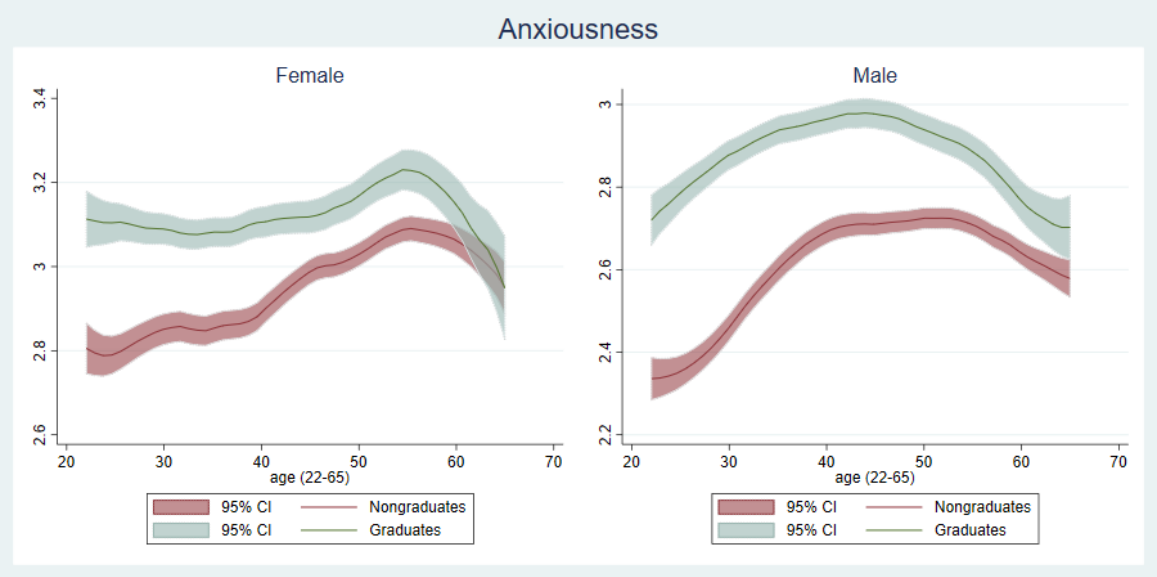
While previous sections have looked at variations across ages for a pooled sample, this section looks at differences in variations by gender. Figure 4.16 shows variations in Life satisfaction across ages by gender. Female graduates are overall more satisfied in life at age 30 relative to their male peers (reaching a score of almost 8), while male graduates peak in their early thirties at just over 7.8. And while female graduates and non-graduates score similarly at age 22 before the gap widens, male graduates fare worse comparatively – scoring lower/less satisfied with life than non-graduates (at 7.7) and only catch up with non-graduates just before 30. Otherwise men and women follow similar trends/slope trajectories.

Figure 4.16: Variation of 'Life satisfaction' across age by Gender

Anxiousness (Figure 4.17) seems to depend significantly on gender. In terms of the shape of the curves: Males follow an inverted U-shaped curve across age, with graduates consistently exceeding non-graduate anxiousness levels, and non-graduates increases in anxiousness with a slight delayed onset. Female graduates anxiousness levels are fairly constant until mid-40s, then increase slightly over late 40s, before a sharp increase to peak levels in mid 50s, after which anxiousness decreases sharply again.

Female non-graduates anxiousness levels are ever-increasing across age, and similarly to graduates peak in mid fifties before decreasing sharply, as well as closing the gap between graduates and non-graduates. Overall levels of anxiousness differ by genders as follows: Male graduates start at just over 2.7 peak at 3 and reach 2.7 again by retirement. These levels are comparable to female non-graduates which start at 2.8, peak at 3.1, and decrease to just under 3. Female graduates on the other hand start at just over 3.1 stay there until age 40, peak at just over 3.2 and then decrease to just under 3. Male non-graduates record the lowest overall scores but also the biggest increase: starting at under 2.4, rise to 2.75 and decrease to 2.6.

Figure 4.17: Variation of 'Anxiousness' across age by Gender



Happiness (Figure 4.18) differs by age before age 55. After age 55 both male and female irrespective of degree status converge on the same levels and trajectories of happiness. Overall happiness echoes the picture of life satisfaction (Figure 4.16). Female score higher happiness throughout their twenties and peak higher in their early thirties at 7.6. And while female non-graduates in their twenties are less happy than female graduates they are as happy as male graduates and follow a similar trajectory. Although male non-graduates do not differ much in terms of happiness in their mid-twenties either.

Lastly Figure 4.19 shows variations in 'life being worthwhile' across ages by gender. Similar to previous well-being measures the main difference in the sense of life being worthwhile, between males and females, is with the level. Females place themselves on average around 0.2 scores above males across the lifecycle. And there is a slightly bigger gap between female graduates and non-graduates than there is for their male counterparts.

Figure 4.18: Variation of 'Happiness' across age by Gender

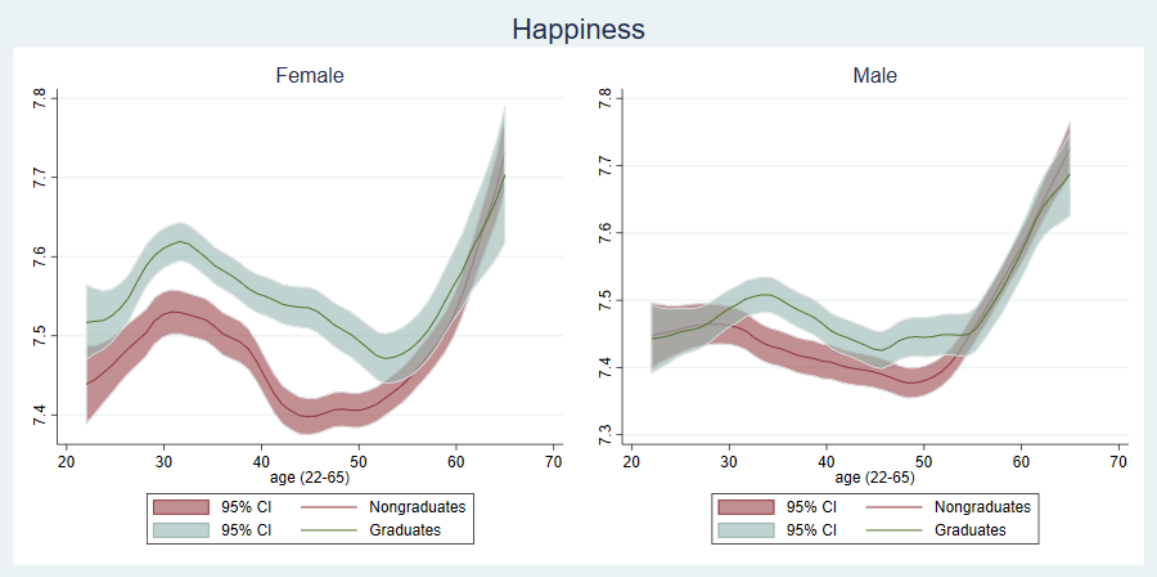
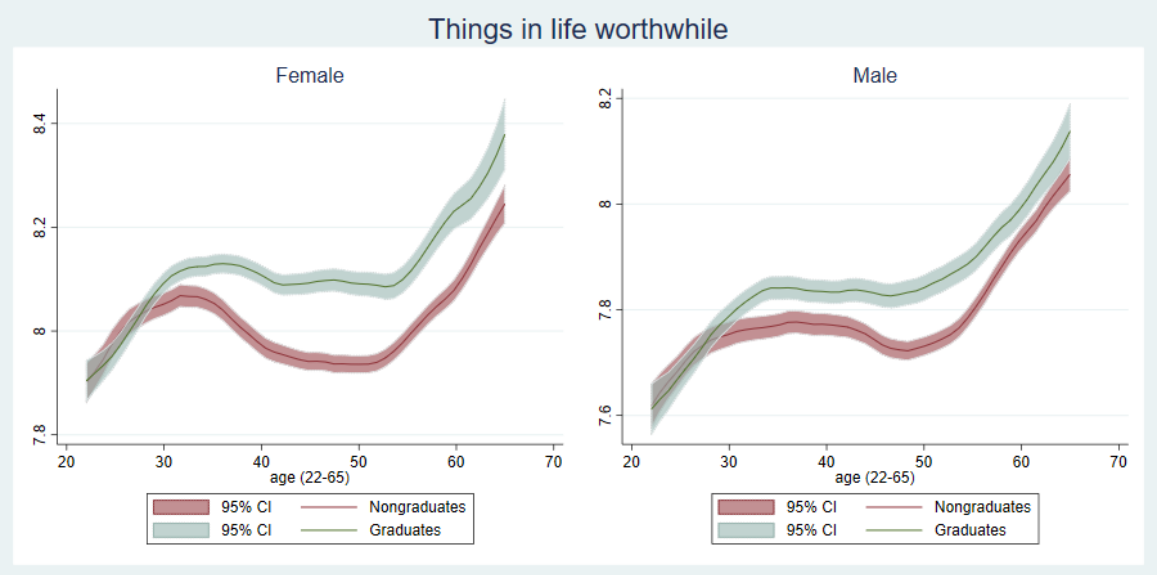


Figure 4.19: Variation of 'Things worthwhile' across age by Gender



4.4 Methodology

To document the basic correlation between a degree and subjective well-being we estimate the following regression:

$$Outcome_i = c + \beta D_i + X_i\delta + \epsilon_i$$

where $Outcome_i$ is a measure of the individuals i's subjective well-being, (Satis_i, Anxious_i, Happy_i, Worth_i), and D_i is a dummy variable indicating the individuals i's degree status, X_i is a vector of individual characteristics that includes race, gender, and birth cohort (1950s, 1960s, 1970s, 1980s, 1990s) dummies, c is a constant term and ϵ_i is the error term. The coefficient on degree status, β, is the object of interest and measures the effect of a degree on subjective well-being measures. We focus on individuals aged 22-65 (individuals of working age).

Since we are looking at well-being differences between graduates and non-graduates the variable for degree status is defined as everyone with a degree level qualification including foundation degrees, graduate membership of a professional institute, PGCE, or higher. APS also allows for a decomposition by individual subjects and subject groups. Other controls included are log earnings, sex, ethnicity, region, birth cohorts and marital status. Log earnings are constructed by taking the log of the sum of weekly gross earnings and birth cohort is included to factor out any cohort effects.

It is arguable that conditioning on earnings is a 'bad control' given that income is on the causal pathway from HE to wellbeing. Higher Education affects income as well as potentially wellbeing, so drawing conclusions on the relationship between HE and wellbeing by only looking at a specification that controls for both, HE and income, will likely be misleading (and potentially introduce a downward bias since income might capture some of the effects of a degree). We present both specifications in the section below: one that does not take earnings into account and one that does. We argue that it is still useful to explore and show whether HE/a degree has an effect on wellbeing through some other variable than income. If so, the estimates would demonstrate that there is a degree effect beyond any potential effect through income.

Below we report the coefficient plots of the β coefficients for the entire sample and then for males and females separately, by different subject groups. Finally, we compare more specific subjects comparable to the ones used in Belfield et al., 2018b study. Throughout the results presented here we estimate linear probability models for all outcomes.

We additionally follow Devereux and Fan, 2011 closely in methodology to elicit causal estimates by using cohort-level variation in degree attainment to estimate a Two Stage Least Squares specified as seen below.

British Higher Education system and attainment observed large growth during the 1960s (i.e. attainment tripled over an 8 year period) as well as the early 1990s (where attainment doubled over the span of 5 years). We use these variations and group cohorts into three categories: cohorts born between 1947-52, which could have benefited from the 60s HE expansion, cohorts born between 1953-1969, cohorts born between 1970-1975, which could have benefited from the 1990s expansion, and cohorts born between 1976-1998.

We model a function of Degree attainment as follows:

$E_{ic} = \alpha + \sum_{c=47}^{52} \beta_c 60exp_c + \sum_{c=70}^{75} \delta_c 90exp_c + \gamma postexp_c + \theta X_i + \epsilon_i c$

E_{ic} is having obtained at least a first degree, equal to the OLS specification, $60exp_c$ and $90exp_c$ are the cohort years benefiting from the respective HE expansions, $postexp_c$ is a dummy variable for cohorts post expansions (born 1976-1998), and X_i are individual characteristics such as sex, a quadratic of age, regional controls, and race.

In a 2SLS we estimate our base specification for the respective wellbeing outcomes instrumenting for degree attainment with the function for degree attainment. The specifications are kept parsimonious.

4.5 Results

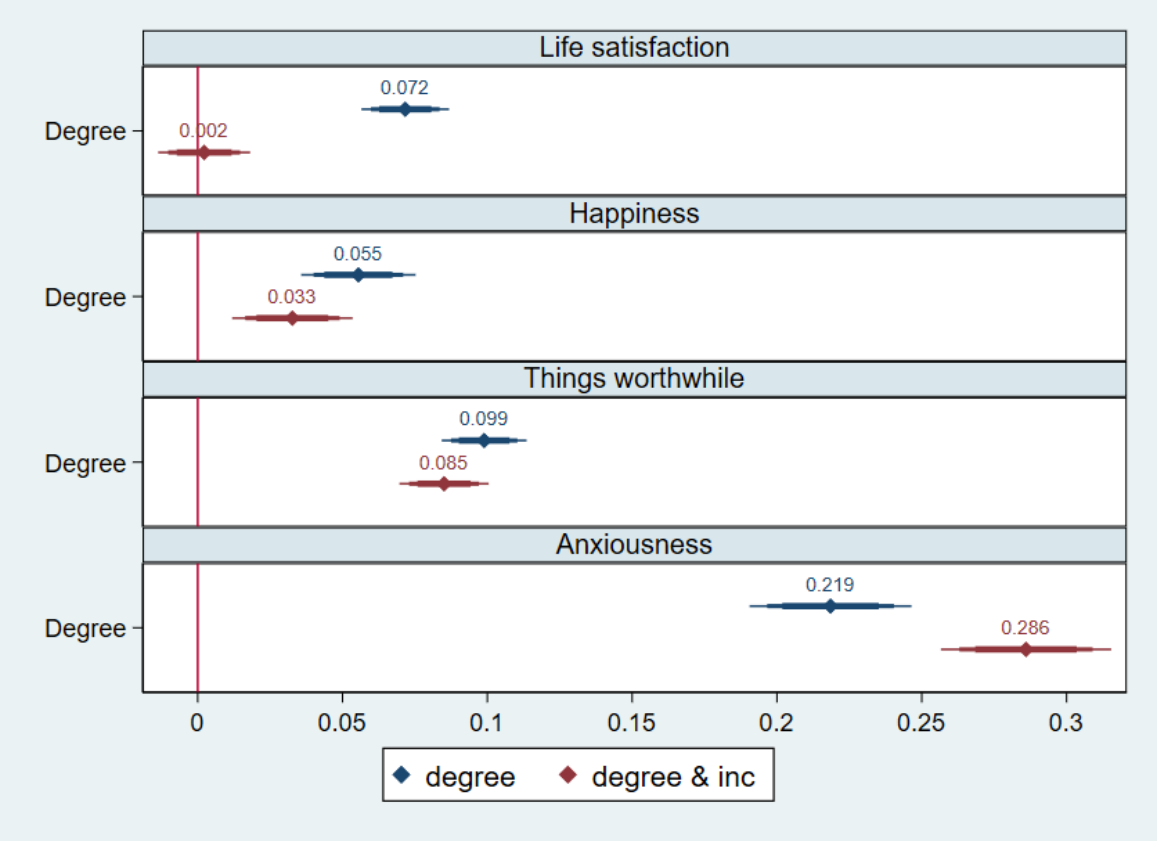
Results across all outcomes are shown with two specifications: model one (blue) shows the degree effect not controlling for income, while model two (red) shows the degree effect after controlling for income.

4.5.1 Coefficient plots

Figure 4.20 plots the degree coefficients for each well-being measure for a pooled sample, together with the confidence intervals at a 99.9, 99 and 95% level. We plot the coefficients for two models - one without and one with income (where income is the log of weekly earnings). On average, comparing between the measures of well-being, a degree has the largest effect on anxiousness, and controlling for income increases the effect (meaning a higher income cushions/offsets some of the increased anxiety correlated with a degree). On the 0-10 scale graduates score 0.22

points higher in terms of anxiousness than non-graduates. When income is taken into account, graduates score 0.29 higher. A degree also seems to be (significantly) correlated with a stronger believe that the things one is doing in life is in fact worthwhile. Graduates score 0.099 scores higher, although there is a suggestion to a small income effect since controlling for income reduces the effect of a degree to 0.085. While graduates are slightly happier, and remain so after taking income into account, similar differences in the level of life satisfaction are erased once we control for income.

Figure 4.20: Degree estimate for each Well-being measure (pooled sample)



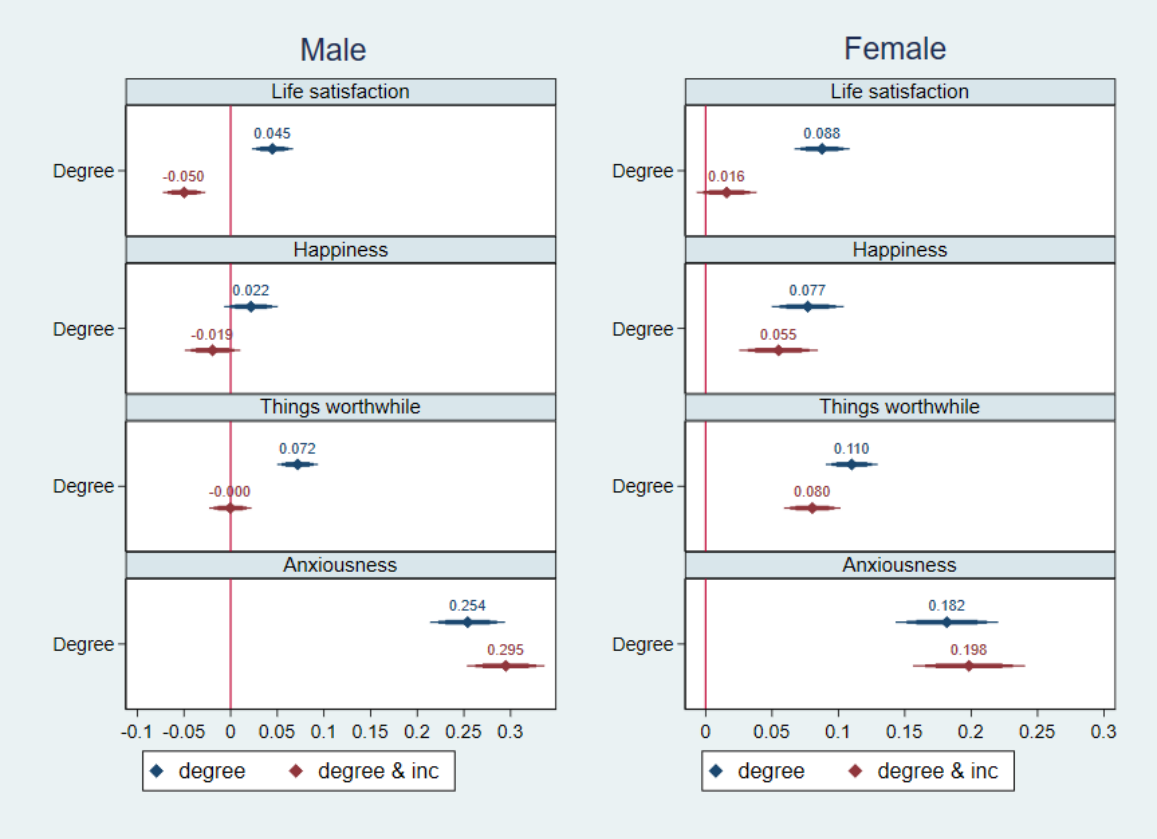
The results above are not differentiated by gender, but provide average estimates for a pooled sample. Figure 4.21 examines how degree effects differ by gender. Overall female graduates report higher levels across all measures of well-being which also holds after taking income into account. In terms of life satisfaction, while female graduates score 0.0088% higher than their non-graduate counterparts they score 50% higher than male graduates. For male graduates, income seems to play a large

role in evaluating life satisfaction. The degree effect on life satisfaction becomes negative once income is taken into account. For female graduates income almost erases any positive effect on life satisfaction that is associated with a degree.

Note that a degree does not seem to be statistically significantly correlated with happiness for males, and even turns negative (albeit statistically insignificantly so) once income is controlled for. For females, on the other hand, a degree is associated with similar levels of happiness - with and without controlling for income.

A similar picture presents itself for feeling life is worthwhile. Once income is controlled for (model 2), the significantly positive impact of a degree on feeling life is worthwhile (0.072 points) for males becomes statistically insignificant. The impact on female graduates is more robust to income and remains positive, moving from a 0.110 to 0.080 score increase. While graduates are more anxious for both genders, male graduates are 30% more anxious than female graduates. Income, similar to what can be seen in Figure 4.20, seems to cushion some of the anxiousness; and controlling for income, the degree effect rises, but only slightly, for both females and males.

Figure 4.21: Degree estimate for each Well-being measure by gender



Figures 4.22-4.25 decompose degree effects by subjects (STEM, LEM, social sciences, arts) for both males and females. The degree effect on life satisfaction is highest for female stem graduates with 0.143 score increases, which halves to 0.073 once we control for income. For male STEM graduates the degree effect, although positive in model 1, turns negative once income is accounted for (-0.045). The effect on life satisfaction for both male and female LEM graduates is very similar. The effect is positive at 0.124 for females and 0.115 for males, but becomes insignificant after taking income into account. Social Science graduates generate with higher life satisfaction (both males and females) but this, similar to LEM graduates, reduces to an insignificant effect after controlling for income. Female Arts graduates show a positive effect on life satisfaction which becomes close to zero and insignificant in model 2, while their male peers do worse in terms of life satisfaction than non-graduates. The degree effect is negative without taking income into account and becomes smaller once controlling for income.

Figure 4.22: Degree estimate for Life satisfaction by subjects & gender

Figure 4.23 looks at the happiness outcome. The differences between males and females are most notable for STEM and Arts graduates and to a lesser degree for social science graduates. While for females a STEM degree is associated with statistically significant increased happiness, even controlling for income; male STEM graduates are no happier than non-graduates, and once income is taken into account this is associated with decreased happiness. Arts graduates seem to fare very similarly to STEM graduates in terms of happiness. Again female Arts graduates show a positive effect on happiness even after controlling for the income effect, while male Arts graduates show a negative but statistically insignificant effect on happiness, regardless of controlling for income. The degree effect on happiness is least evident for Social Science and LEM graduates. For female LEM graduates the effect is 0.122, significant at the 1% level, but once income is taken into account it decreases insignificantly to 0.094 but remains significantly different from zero at the 5% level. For male LEM graduates results are similar with a slightly bigger effect on happiness with a higher 0.154 effect, and 0.105 with a 5% significance level

once income is taken into account. A degree effect on happiness for male Social Science graduates remains almost zero and statistically insignificant, regardless of income. For female Social Science graduates this effect is positive at a 0.061 effect size but decreases to an insignificant 0.040 in model 2.

Figure 4.23: Degree estimate for Happiness by subjects & gender

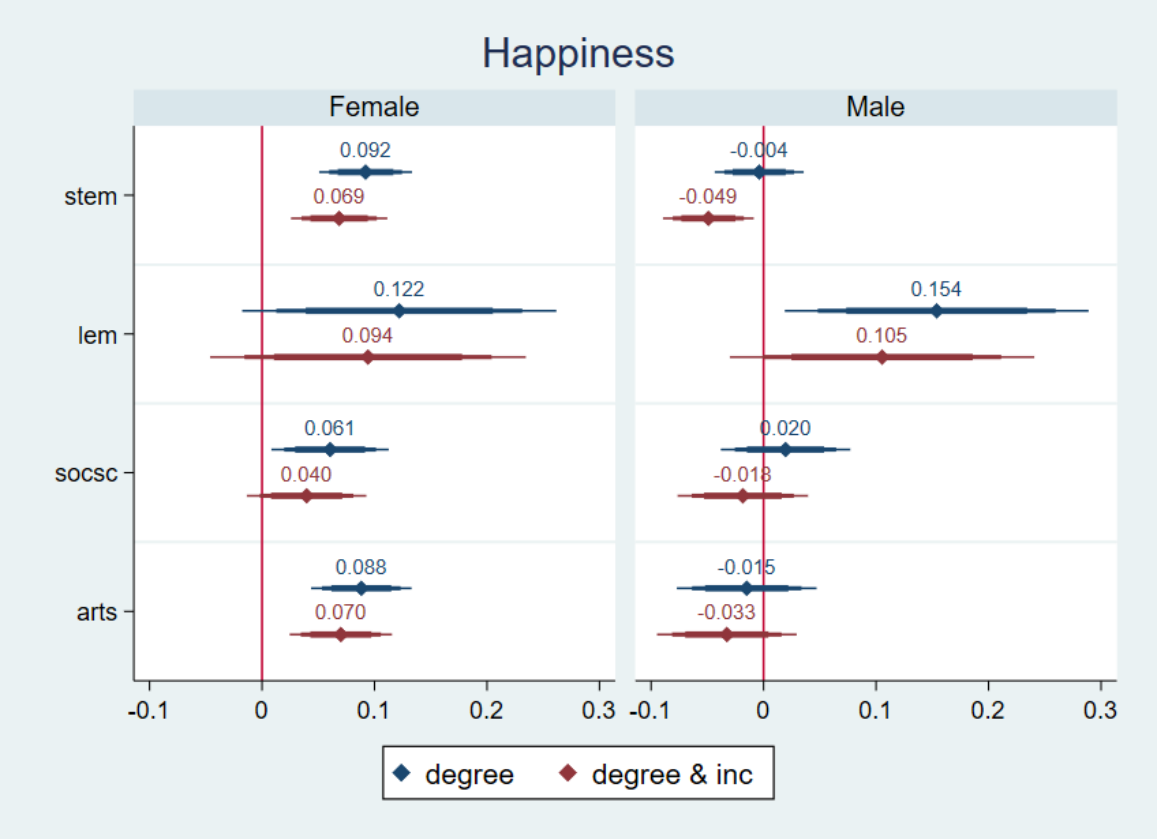


Figure 4.24 presents degree effects on anxiousness. Overall it is notable that the degree effect across all subjects is positive except in the case of STEM for females where the effect is almost zero and statistically insignificant (and male graduates across all subjects are more anxious than females). There is no observed income effect for females.

The subject group associated with the highest levels of anxiousness for both females and males is Arts, with male Art graduates being more anxious than females, and a 0.434 effect size in anxiousness levels without controlling for income which becomes 0.437 once controlling for income. Female Arts graduates show, in both models, higher anxiousness.

The second-most anxious subject group is LEM. The degree effect for male LEM graduates is 0.342, which rises to 0.379 controlling for income, while the degree effect for females is 0.216 in both models. Male graduates with a Social Science degree have a similar effect on anxiousness as female LEM graduates (0.204 compared to 0.233). Female Social Science graduates have a degree effect of 0.130 on anxiousness. Finally, while a STEM degree for males has a similar effect size on anxiousness as a Social Science degree for females of 0.161, and 0.195 controlling for income, for females a STEM degree does not seem to be associated with any (statistically significant) increases in anxiety.

Figure 4.24: Degree estimate for Anxiousness by subject and gender

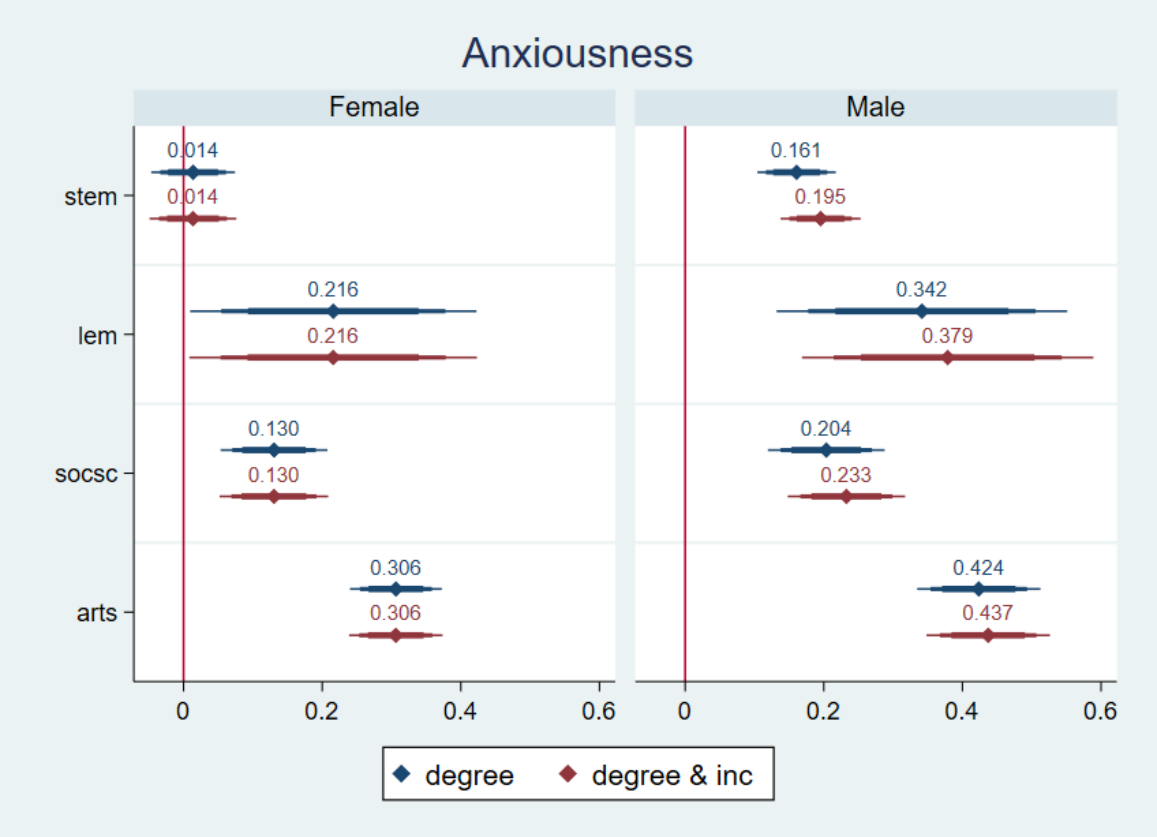
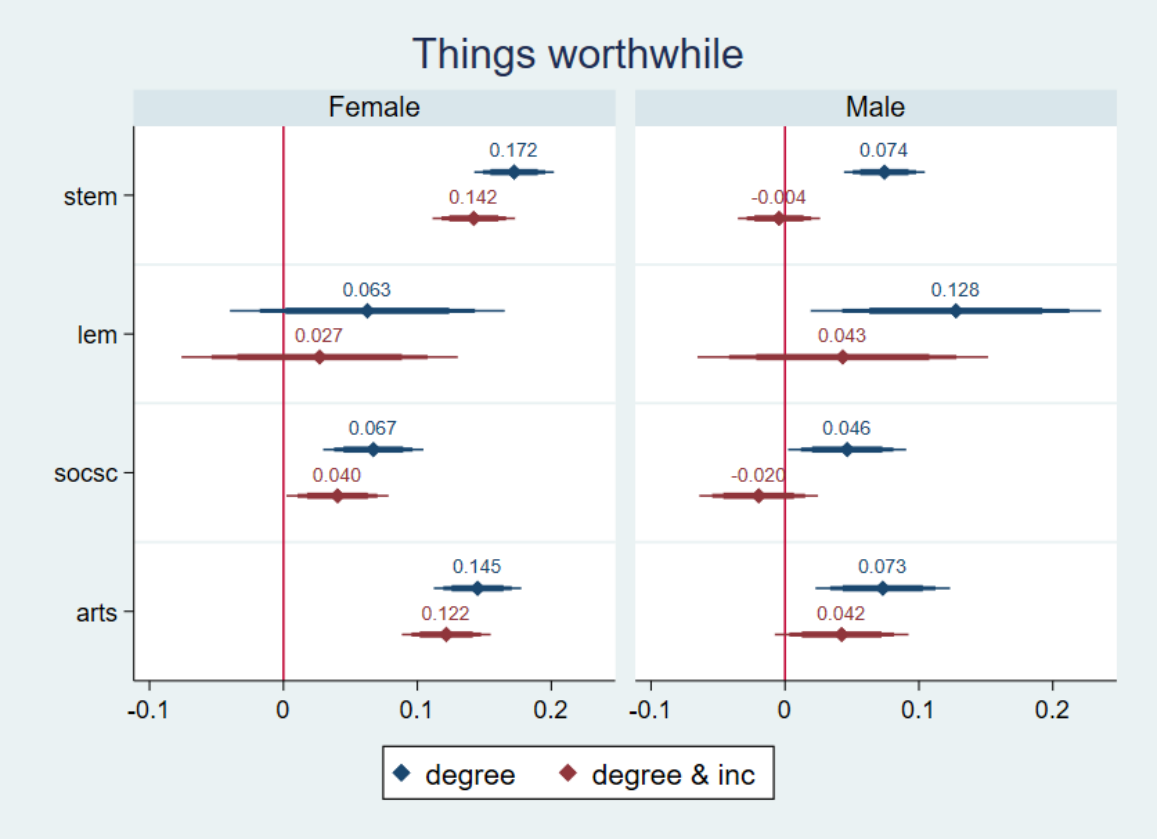


Figure 4.25 presents estimates on the feeling that life is worthwhile. Interestingly effects seem to be overall bigger for female graduates across subjects with the exception of LEM subjects, while for male graduates across all subjects except arts controlling for income seemed to erase any positive effect on feeling life is worthwhile or make them statistically insignificant.

Figure 4.25: Degree estimate for feeling life is worthwhile by subject and gender



A degree in a STEM subject for females has the largest effect across all subjects on the belief of things being worthwhile, increasing by 0.172 and 0.142 once controlling for income. For their male counterparts the effect is less than half of that at 0.074 without controlling for income and gets erased to zero once controlling for income. The second-biggest effect on feeling life is worthwhile is for Arts graduates. The effect for female Arts graduates is also twice as large as for males. For female arts graduates the effect is 0.145 before controlling for income and 0.122 after, while for males its 0.073 (model 1) and 0.042 (model 2). The degree effect on the feeling of life being worthwhile for male LEM graduates seems to be the largest of all subjects (comparing within male graduates) but becomes statistically insignificant once income is taken into account.

This suggests that income seems to be an important mediator in feeling life is worthwhile. For female LEM graduates the degree effect is positive, but is only statistically significantly so in model 1 (not taking income into account) which

suggests, similar to men, income is an important mediator.

Social Science degrees show the smallest effect on the feeling that life is worthwhile for men and does not differ much from a LEM degree for women. The degree effect for men is 0.046 which becomes negative, but statistically insignificant, after controlling for income. The degree effect for women is 0.067 before, and 0.040 after, controlling for income.

4.5.2 Bias-adjusted treatment effects - Oster bounds

Table 4.2 presents original treatment effects as well as bias-adjusted treatment effects, following Oster, 2019, with the aim to address threats to validity through bias arising from unobservables (e.g. (upward) bias due to lack of prior attainment controls). Oster's approach builds on Altonji, Elder, and Taber, 2005 and extends the methodology for evaluating robustness to omitted variable bias by providing a) a method for estimating an unbiased treatment effect (using information from coefficient movements and movement in R-squared when adding further controls to the specification) and b) the proportional degree of selection between observables and unobservables (delta) which would be required to confound the observed treatment effects - that is, drive the effects to zero (to evaluate robustness of results). Thus we present bias-adjusted treatment effects which assume selection on unobservables is proportional to selection on observables, (as well as bias-adjusted treatment effects which assume the arguably less likely scenario of selection on unobservables being twice as important as selection on observables) and the proportional degree of selection between observables and unobservables (delta) which would be required to confound the observed treatment effects.

Bias-adjusted treatment effects seem to be insensitive to the assumption of delta for all outcomes. The adjusted treatment effects for life satisfaction is not very different from the original coefficient in specification 1 (not controlling for income), but switches signs in specification 2 (controlling for income) from an original statistically insignificant zero effect to a significant small negative effect. This suggests that income largely drives the positive associations between higher education and life satisfaction.

Anxiousness seems to be the most robust to sensitivity to selection. Bias-adjusted treatment effects are only slightly larger than the original coefficients. The original estimates (in both specifications) for anxiousness therefore seem to be a lower bound.

The measure of 'things in life worthwhile' is noticeably unaffected by bias-adjustments as well and reflects almost no sensitivity to selection bias. This holds

Table 4.2: OLS estimates & Oster test for all well-being measures

	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
	satis	satis	anxious	anxious	happy	happy	worth	worth
_60s	-0.0970***	-0.116***	0.0254**	0.0442***	-0.120***	-0.127***	-0.124***	-0.128***
	(0.00692)	(0.00692)	(0.0125)	(0.0125)	(0.00897)	(0.00899)	(0.00660)	(0.00661)
_70s	-0.0226***	-0.0362***	-0.0594***	-0.0462***	-0.0840***	-0.0884***	-0.0950***	-0.0977***
	(0.00715)	(0.00714)	(0.0129)	(0.0129)	(0.00926)	(0.00927)	(0.00681)	(0.00682)
_80s	0.130***	0.133***	-0.157***	-0.160***	-0.0246***	-0.0236**	-0.0820***	-0.0814***
	(0.00736)	(0.00735)	(0.0133)	(0.0132)	(0.00954)	(0.00954)	(0.00702)	(0.00702)
_90s	0.127***	0.154***	-0.187***	-0.213***	-0.0337**	-0.0249*	-0.167***	-0.162***
	(0.0106)	(0.0106)	(0.0191)	(0.0191)	(0.0138)	(0.0138)	(0.0101)	(0.0101)
nonwhite	-0.176***	-0.158***	0.0601***	0.0423***	0.0575***	0.0635***	-0.0571***	-0.0535***
	(0.00824)	(0.00824)	(0.0148)	(0.0149)	(0.0107)	(0.0107)	(0.00787)	(0.00788)
north	0.00321	0.0110	0.0532***	0.0456***	-0.0246***	-0.0221**	0.0380***	0.0395***
	(0.00680)	(0.00679)	(0.0122)	(0.0122)	(0.00881)	(0.00881)	(0.00648)	(0.00649)
south	-0.0330***	-0.0435***	0.140***	0.150***	-0.0271***	-0.0306***	-0.0488***	-0.0509***
	(0.00673)	(0.00672)	(0.0121)	(0.0121)	(0.00872)	(0.00872)	(0.00642)	(0.00642)
wales	0.0354***	0.0441***	0.0235	0.0150	0.0336***	0.0364***	0.0424***	0.0441***
	(0.00869)	(0.00868)	(0.0156)	(0.0156)	(0.0113)	(0.0113)	(0.00829)	(0.00829)
scotland	0.0964***	0.0965***	-0.0937***	-0.0938***	0.0676***	0.0676***	0.0797***	0.0797***
	(0.00815)	(0.00813)	(0.0147)	(0.0147)	(0.0106)	(0.0106)	(0.00777)	(0.00777)
ireland	0.267***	0.277***	-0.175***	-0.185***	0.332***	0.335***	0.282***	0.284***
	(0.0179)	(0.0179)	(0.0322)	(0.0322)	(0.0232)	(0.0232)	(0.0171)	(0.0171)
qual_1	0.0717***	0.00222	0.219***	0.286***	0.0555***	0.0327***	0.0989***	0.0851***
	(0.00483)	(0.00509)	(0.00870)	(0.00918)	(0.00626)	(0.00661)	(0.00461)	(0.00486)
ln_grsswk		0.178***		-0.173***		0.0586***		0.0356***
		(0.00419)		(0.00755)		(0.00544)		(0.00400)
Oster test								
bias adj. beta (delta=1)	0.0690***	-0.0254***	0.223***	0.324***	0.0546***	0.0231**	0.106***	0.0868***
	(0.0047)	(0.00614)	(0.00845)	(0.00773)	(0.00614)	(0.00734)	(0.00408)	(0.00491)
bias adj. beta (delta=2)	0.0663***	-0.0578***	0.229***	0.371***	0.0536***	0.0121	0.113***	0.0889***
	(0.00543)	(0.0093)	(0.00792)	(0.0143)	(0.00636)	(0.0103)	(0.00405)	(0.00536)
delta for beta=0	15.413***	0.0829	150.242	-4.170***	22.505*	2.886*	-8.780***	14.967***
	(2.821)	(0.184)	(1776.217)	(0.497)	(11.221)	(1.155)	(1.103)	(4.524)
N	459853	459853	459592	459592	459824	459824	459223	459223

true for happiness as well.

Estimates for delta, the proportional degree of selection between observables and unobservables which would be required to confound the observed treatment effects, are all well above 2 (with the exception for life satisfaction controlled for income). This further underlines our previous suggestions that the original estimates are highly likely to be robust to selection on unobservables.

To conclude, the original estimates seem to be unlikely affected by a significant sensitivity to selection bias.

4.5.3 Multiple Hypotheses Adjustments

To address concerns about statistical inference given the number of hypothesis tests performed, we also present adjusted p-values for all outcomes and treatments in

Table 4.3, by performing Familywise error rate (FWER) and False Discovery rate (FDR) adjustments.

The underlying idea behind both adjustment types is to reduce the (potentially) otherwise increased probability of false rejections/positives (Type I errors) due to testing multiple null hypotheses. The Familywise error rate is the probability of having at least one false positive/making any Type I error, and can be illustrated as follows:

$\alpha_{FW} = 1 - (1 - \alpha_{PC})^c,$

Where c equals the number of tests performed and α is the set threshold value for the acceptable probability of a Type I error, in this case 0.05. Assuming there are four hypothesis tests performed the FWER corresponds to 18.5%:

$\alpha_{FW} = 1 - (1 - (0.05)_{PC})^4$

$\alpha_{FW} = 1 - (0.95)^4$

$\alpha_{FW} = 0.185,$

demonstrating that the probability of falsely rejecting the null-hypothesis at least once has actually risen to 18.5% 'instead of being/remaining 5% like initially intended'.

The False Discovery Rate on the other hand is the expected proportion of false rejections/positives (Type I errors) i.e. the 'ratio of the number of false positive results to the number of total positive test results'. A p-value of 5% in a single hypothesis test implies a 5% probability of falsely rejecting the null-hypothesis. Controlling for FDR adjusts the p-value for each test to so-called q-value of 5%, which in turn mean that '5% of significant results will result in false positives'.

An important distinction between both adjustment types is the fact that FWER takes any dependence among outcomes into account (allows for p-values to be correlated) but FDR does not. This leads to the implication that FWER-methods tend to produce relatively conservative p-value adjustments, while FDR (p-values not correlated) is willing to accept some type I error in exchange for more power.

Due to analysing the effect of multiple treatments on four facets of overall well-being it is reasonable to want to take into account such p-value dependence among outcomes, but avoiding any false rejection might not be the primary goal. We argue that false rejections are not particularly costly in this analysis.

We present adjusted p-values controlling for FWER presenting the most conservative

inference, as well as controlling for FDR potentially increasing power being willing to accept some Type I error.

Table 4.3 presents FWER adjustments using the conservative Bonferroni method, as well as the novel Romano-Wolf correction (Clarke, Romano, and Wolf, 2020 which contrary to the Bonferroni methods takes the dependence structure among p-values (by bootstrap resampling) into account and is therefore statistically more powerful.

For the Bonferroni adjustments p-values are multiplied by the number of tests performed capped at 1 while for the Romano and Wolf corrections we follow the stata code rwolf2, written by Damian Clarke (Clarke, 2021). It allows for multiple treatments, different commands, different controls and allows for clustered standard errors.

Table 4.3 also presents the alternative procedure which controls the False Discovery Rate (FDR) where we follow Michael Andersons (Anderson, 2008) steps to obtain 'sharpened q values'. As argued above these favour higher statistical power compared to FWER adjustments.

We draw the following conclusions: in the case of one treatment (degree) the baseline specifications for all outcomes remain statistically significant under Bonferroni adjustments (most conservative adjustments).

We will focus on the p-values provided by the Romano & Wolf FWER correction and Anderson's sharpened q-values in the case of multiple treatments (by subjects). All wellbeing measures remain statistically significant in the base specification which does not control for income. Only Anxiousness remains statistically significant after all corrections for *all* treatments in the model controlling for income.

When focusing only at the effect estimates from model 2, we see that under Romano-Wolf corrections only Arts remains to be significantly positively associated with life satisfaction. LEM is the only degree effect that remains significant for the outcome of happiness and STEM and Arts effects remain significant on 'Things in life worthwhile'.

Under less conservative FDR-adjustments: STEM and Arts effects on life satisfaction remain significant; LEM effects on happiness remain significant and STEM, LEM, and Arts degree effects remain significant on 'things in life worthwhile'.

Overall, adjusting for multiple hypotheses does not largely affect the significance of the estimates, and especially for the particular subject treatments on certain outcomes mentioned above degree effects are likely to be robust to Type I error (from multiple hypothesis testing). We acknowledge that in carrying out these

adjustments we trade off an increased type II error against a type I error as well as that the decision about the 'number of tests' is somewhat arbitrary, as there is no definite guideline as to what a family of tests is.

4.5.4 Exploiting the British HE expansion - IV estimates

To elicit causal estimates for the relationship between degree attainment and later-life wellbeing we also use cohort-level variation in degree attainment, estimating a 2SLS as outlined in Section 4.4. The estimates below show the first stage of degree attainment, as well as, the degree effects on the same four wellbeing measures (Life satisfaction, happiness, things being worthwhile, anxiousness) while instrumenting for a degree with the function for degree attainment.

The first stage is presented below in table 4.4 (standard errors are presented in brackets).

Figure 4.26 shows pooled estimates, Figure 4.27 estimates for men and Figure 4.28 for women. While previous (OLS) estimates for wellbeing measure lie between 0 and 0.2 (in terms of increased score) for a pooled sample, IV estimates seen in 4.26 show a significantly larger effect of increase: between 1-2 scores. The biggest wellbeing effect is on life satisfaction and 'things being worthwhile' with 1.82 and 1.76 respectively, followed by happiness with 1.41 while anxiousness is not statistically significant. It translates into an effect size which is more than a standard deviation for life satisfaction and 'things being worthwhile', half of a standard deviation for happiness and third of a standard deviation for anxiousness - standing in big contrast to the average OLS estimates.

Decomposing the degree effects by gender in Figure 4.27 and Figure 4.28 that women drive the positive effects on happiness while having a slightly higher effect on life satisfaction but equal effects on 'things being worthwhile' as men. Degree effects on anxiousness are less obvious as the for both male and female the effect is statistically insignificant.

It remains striking how much significantly larger we observe wellbeing effects to be on the marginal student.

Table 4.3: p values with FWER and FDR corrections

	Life satisfaction		Anxiousness		Happiness		Things in life worthwhile	
Degree (average)	base	w/ income	base	w/ income	base	w/ income	base	w/ income
Original coeff	0.0713***	-0.015**	0.213***	0.245***	0.055***	0.0222***	0.095***	0.042***
Original p-value	0.0000	0.002	0.000	0.000	0.000	0.001	0.000	0.000
FWER-corrections								
Bonferroni	0.000	0.008	0.000	0.000	0.000	0.004	0.000	0.000
Romano-Wolf	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
FDR-corrections								
Anderson	0.001	0.002	0.001	0.001	0.001	0.001	0.001	0.001
N	459853	459853	459592	459592	459824	459824	459223	459223
STEM subjects								
Original coeff	0.101***	0.016*	0.0868***	0.105***	0.045***	0.0115	0.124***	0.071***
Original p-value	0.000	0.015	0.000	0.000	0.000	0.196	0.000	0.000
FWER-corrections								
Bonferroni	0.000	0.24	0.000	0.000	0.000	1	0.000	0.000
Romano-Wolf	0.002	0.118	0.002	0.002	0.002	0.643	0.002	0.002
FDR-corrections								
Anderson	0.001	0.013	0.001	0.001	0.001	0.109	0.001	0.001
N	459853	459853	459592	459592	459824	459824	459223	459223
LEM								
Original coeff	0.124***	0.023	0.274***	0.295***	0.140***	0.101***	0.096***	0.034
Original p-value	0.000	0.277	0.000	0.000	0.000	0.001	0.000	0.135
FWER-corrections								
Bonferroni	0.000	1	0.000	0.000	0.000	0.016	0.000	1
Romano-Wolf	0.002	0.643	0.002	0.002	0.002	0.012	0.002	0.523
FDR-corrections								
Anderson	0.001	0.125	0.001	0.001	0.001	0.002	0.001	0.08
N	459853	459853	459592	459592	459824	459824	459223	459223
Social Sciences								
Original coeff	0.072***	-0.0048	0.160***	0.177***	0.0438***	0.0132	0.0588***	0.0105
Original p-value	0.000	0.592	0.000	0.000	0.000	0.269	0.000	0.231
FWER-corrections								
Bonferroni	0.000	1	0.000	0.000	0.000	1	0.000	1
Romano-Wolf	0.002	0.643	0.002	0.002	0.004	0.643	0.002	0.643
FDR-corrections								
Anderson	0.001	0.245	0.001	0.001	0.001	0.125	0.001	0.12
N	459853	459853	459592	459592	459824	459824	459223	459223
Arts								
Original coeff	0.0312***	-0.0318***	0.346***	0.360***	0.0552***	0.0300**	0.122***	0.0823***
Original p-value	0.000	0.000	0.000	0.000	0.000	0.007	0.000	0.000
FWER-corrections								
Bonferroni	0.000	0.000	0.000	0.000	0.000	0.112	0.000	0.000
Romano-Wolf	0.004	0.004	0.002	0.002	0.002	0.060	0.002	0.002
FDR-corrections								
Anderson	0.001	0.001	0.001	0.001	0.001	0.007	0.001	0.001
N	459853	459853	459592	459592	459824	459824	459223	459223

Table 4.4: First stage of Degree Attainment

	Degree			
	Men		Women	
post_exp	0.027*	(0.012)	0.100***	(0.010)
cohort 47	0.205*	(0.102)	-0.082	(0.175)
cohort 48	0.072	(0.056)	0.071	(0.080)
cohort 49	0.080*	(0.036)	0.018	(0.048)
cohort 50	0.058*	(0.031)	-0.047	(0.041)
cohort 51	0.044	(0.027)	-0.049	(0.030)
cohort 52	0.013	(0.024)	-0.013	(0.028)
cohort 70	0.063***	(0.014)	0.050***	(0.012)
cohort 71	0.088***	(0.013)	0.077***	(0.012)
cohort 72	0.026	(0.015)	0.079***	(0.012)
cohort 73	0.062***	(0.014)	0.091***	(0.012)
cohort 74	0.028	(0.015)	0.091***	(0.012)
cohort 75	0.014	(0.015)	0.091***	(0.012)
N	42,664	42,664	57,805	57,805

Note: The dependent variable is having obtained at least a first degree, and the specification contains exogenous variables that are used in the second stage as well: sex, quadratic of age, regional controls, and race.

Figure 4.26: IV estimates on wellbeing measures (pooled)

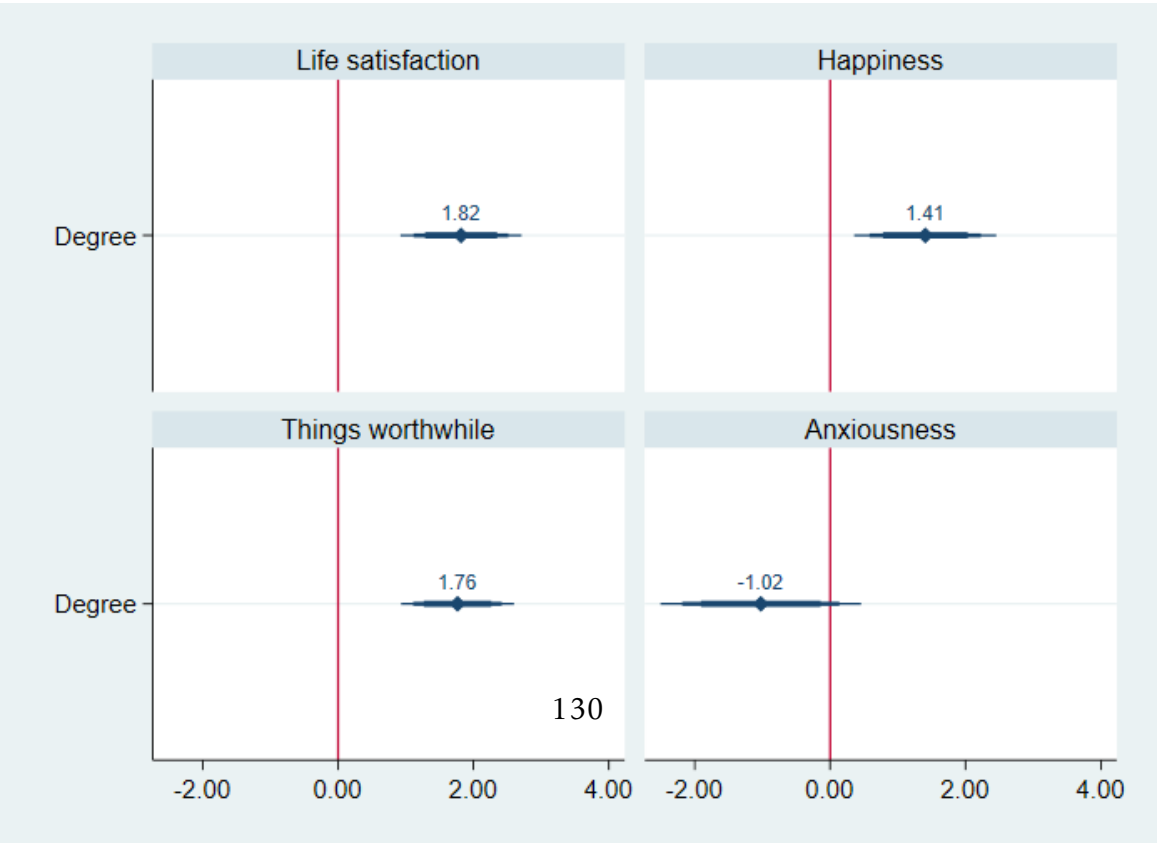


Figure 4.27: IV estimates on wellbeing measures (Men)

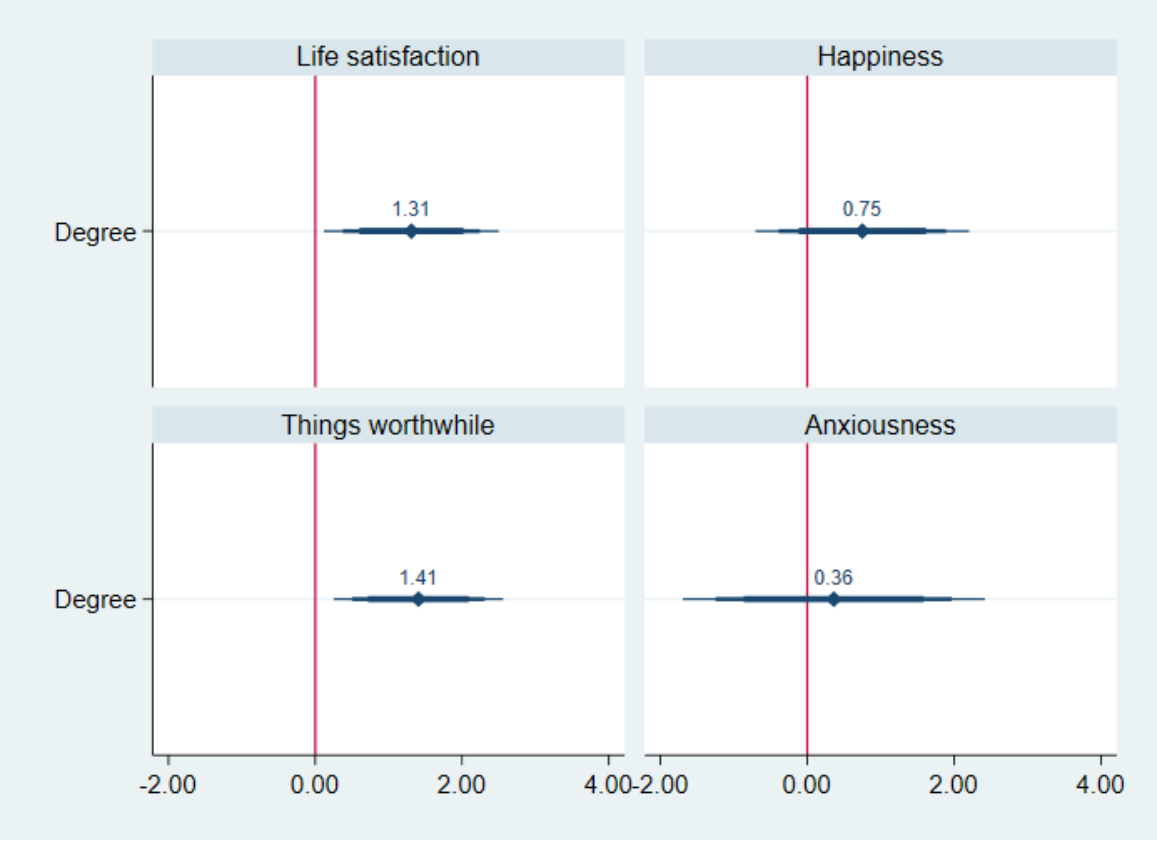


Figure 4.28: IV estimates on wellbeing measures (Women)

4.5.5 Comparison to LEO subjects

The dataset used here does contain more detailed information on subject than is used above - where we group subjects into: STEM, LEM, Social Sciences, and Arts. In particular, the LEO research (Belfield et al., 2018b) used a much finer breakdown on subject and there is sufficient heterogeneity in their results within groups to explore here in more detail as well, although, we compromise precision. We decompose by the same subjects: Medicine&Dentistry, Economics, Maths, Engineering, Pharmacology, Architecture, Physics, Politics, Chemistry, Geography, Linguistics, Law, Computing, Business, History, Theology, Philosophy, Med allied, Bio-sciences, Physics, Sports science, Technology, English, Nursing, Communication, Sociology, Psychology, Education, Agriculture, Creative Arts, and Social Work. One can see in Figure 4.29 and Figure 4.30 that, in many cases, even without income, the estimates are not sufficiently precise to be able to reject small effect sizes. Adding income makes the effects sizes smaller (except for Anxiety), but usually

not significantly so, and in some cases the effect sizes net of the income effect are not significantly different from zero. With the exception of medicine and nursing, education and business further decomposing by subjects does mostly not return consistently significant results once we control for income (although some differences by gender still exist). Medicine, for example, seems to be correlated with increased life satisfaction, happiness and feeling worthwhile and also reduced anxiousness across the board. Nursing paints a largely similar picture, although the effects on male become statistically insignificant for males with the exlusion of 'things being worthwhile'. It is also interesting to observe that certain subjects stand out with their high correlation with 'Things being worthwhile in life', e.g. social work, education, psychology, nursing, sport science, medicine, and med allied, theology, and business. It is probable that these subject have lead to particularly fulfilling/purpose driven jobs/roles in the job market. Pharmacology stands out further as the only subject to have a statistically significant negative correlation with worthwhileness across genders and specifications.

4.5.5.1 Degree estimate for Well-being measures by LEO subjects

Figure 4.29: Degree estimate on 'Life satisfaction' & 'Anxiousness' by LEO-subjects

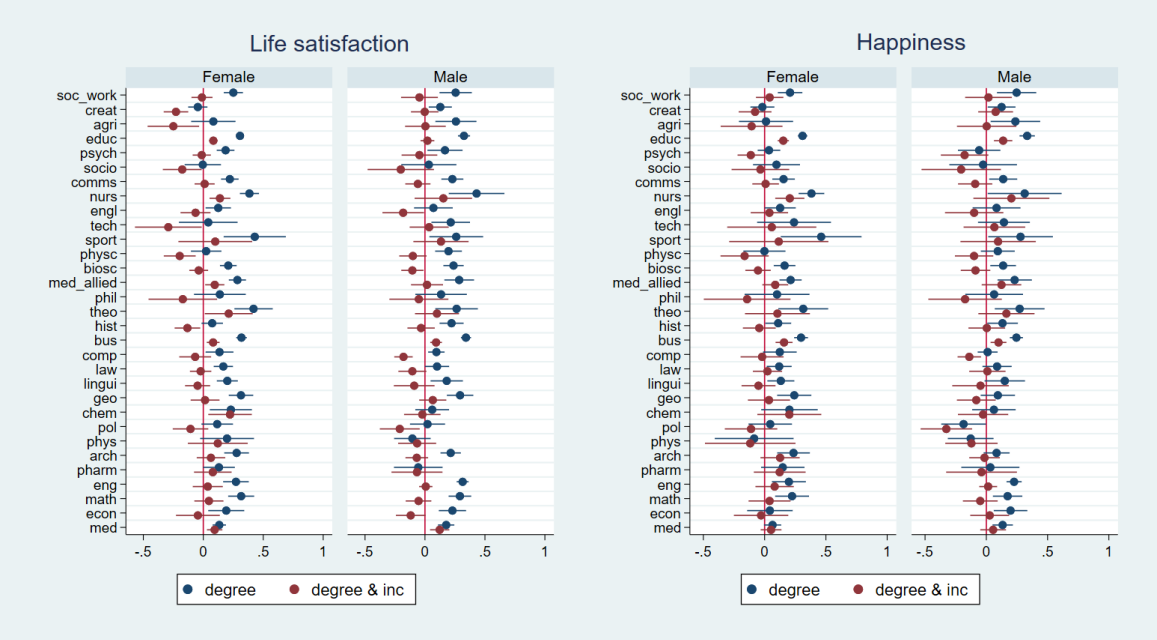
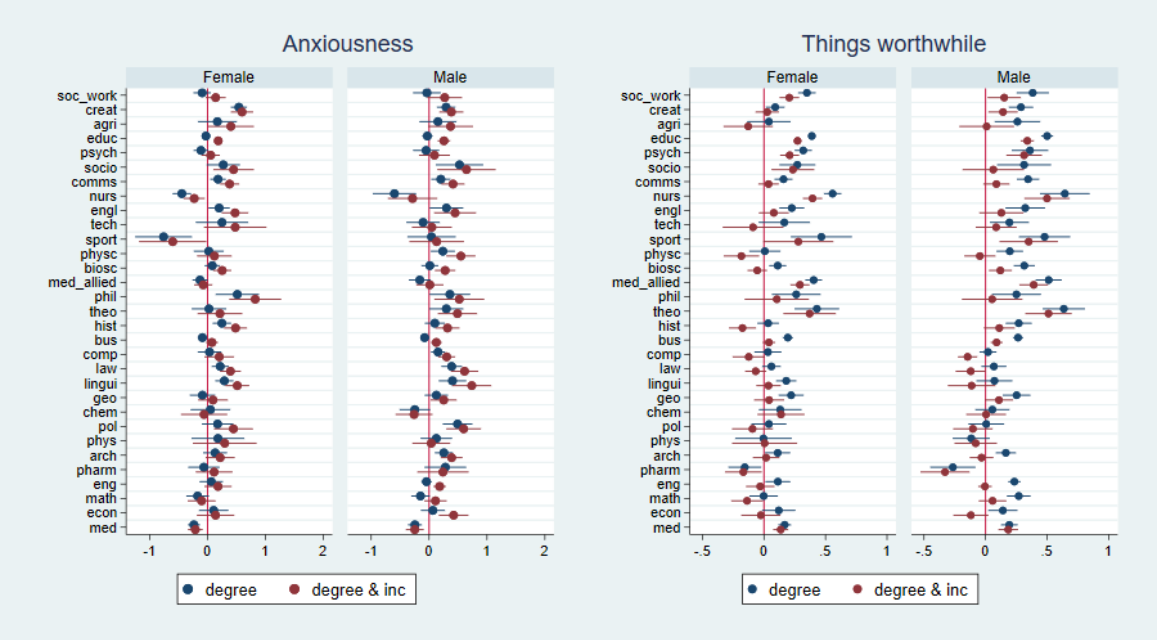


Figure 4.30: Degree estimate on 'Happiness' & 'Things in life worthwhile' by LEO-subjects



4.6 Discussion & Conclusion

This analysis has been motivated partly by the desire to explore the extent to which pecuniary effects of being a graduate are correlated with the overall non-pecuniary effects. To implement this we exploit data that contains several measures of subjective well-being as well as information on earnings, and on higher education. Well-being measures can be thought of as capturing a wide range of outcomes - many of which would be difficult to capture in a more direct way. The additional well-being, over an above the pecuniary effects, are our measure of non-pecuniary well-being. That is the well-being effects net of the income effects - that can be estimated as well-being effects when we control for income differences.

It could be that high pecuniary returns are compensating differentials for some aspects of the nature of the work - for example, pressure or lack of esteem. One might imagine that economics graduates feel that their work is not held in high esteem (a disproportionate number work in the finance and business services industries). In which case, they may need to be better paid than would otherwise be the case to be attracted to study it. While nurses, for example, enjoy high job satisfaction and, perhaps, respect from the public at large. This may partly be

a reflection of what Besley and Ghatak, 2005, refer to as mission orientation. In which case, one might expect them to still enjoy positive graduate differentials in well-being net of the income effect. For them, life remains worthwhile even after controlling for their (low) pay. In fact, Belfield et al., 2018b showed that (female) nurse pay relative to the counterfactual was reasonably high, and the findings here suggest that they also enjoy significant well-being effects on top of their pay.

We obtain estimates using OLS, as well as 2SLS by exploiting cohort-level variation in degree attainment due to a rapid expansion in the British HE system, to elicit causal estimates on marginal effects. We show that graduates feel that life is more worthwhile, are happier, have greater life satisfaction, but suffer from greater anxiety than do non-graduates and that these differences in wellbeing in the raw data are attenuated by allowing for income differentials, but many are not eliminated. While the OLS estimates are positive, the effects are much smaller than what we see in terms of IV estimates for students on the margin. We observe an increase of up to 0.2 scores (on a 0-10 scale) in wellbeing measures for graduates, yet causal estimates for wellbeing effects on the margin are up to 2 scores. This translates into an effect size which is more than a standard deviation for life satisfaction and 'things being worthwhile', half of a standard deviation for happiness and third of a standard deviation for anxiousness - standing in big contrast to the average OLS estimates.

While we do obtain Oster 'bounds' (Oster, 2019) which show that the original OLS estimates seem to be unlikely affected by a significant sensitivity to selection bias, we only are able to show *marginal* causal effects on wellbeing. As far as marginal students differ from the average student we cannot make inference on the wellbeing effects from a degree on the average graduate.

When we further decompose by subject (groups) the results suggest that earnings premia by subject, far from being compensating differentials that counteract the pecuniary effects, might be reinforced by our estimated non-pecuniary impacts of wellbeing.

Overall, we see that the returns to a degree are not just about pecuniary benefits, and that our results show that it is an important implication for potential students themselves considering going to HE.

Finally, we find that the data could be construed as reflecting the traditional well-being U-shape in age - but, in our pooled cross-sections dataset, we can show that this seems to be a manifestation of cohort effects that have normally been ignored.

Chapter 5

Conclusion

The aim of this thesis was to explore the wider returns to *Higher* Education and heterogeneity of effects by type of graduates within the UK context. Each chapter focused on a particular area of research within this scope, that is, on the role of non-cognitive skills, the (relative) impacts on a multitude of private and social non-market benefits, and the impact on measures of subjective wellbeing as a 'catch-all' outcome. The analyses largely address gaps left by studies which heavily rely on administrative datasets with certain limitations and allow us to draw conclusions on the interplay between pecuniary and nonpecuniary outcomes.

For the analysis of the first two areas of interest we exploit the most recent large-scale cohort study in the UK, the Longitudinal Study of Young People (LSYPE), spanning the lives of individuals starting aged 13/14 until they are aged 25. It is a very rich dataset containing considerable detail on the characteristics and traits of the young individuals as well as updated information on the individual's life (outcomes) at age 25 including early labor market outcomes.

Chapter 2 particularly explores the shortcomings of (administrative) datasets that NC skills are not observable and examines the question whether estimates are contaminated by such selection on unobservables. In other words it examines the robustness of estimates of the financial return to Higher Education to the inclusion of non-cognitive skills such as locus of control, conscientiousness (proxied by adolescent work ethic) and self-esteem. We are interested in both wage rates as well as weekly earnings as outcomes and obtained estimates using both OLS and Inverse Probability Weighted Regression Adjustment - both of which rely on no selection on unobservables. We and apply 'Oster bounds' (following Oster, 2019) to address bias arising from all potential unobservables (including NC skills).

The analysis particularly relies on the latter to address the limitation of not being able to control for prior attainment. Prior attainment is effectively an unobserved characteristic affecting selection, yet the Oster bounds analysis suggests that the exclusion of prior attainment does not affect the estimates very much (they only fall a few percentage points). A further way of minimising the confounding effect of higher prior attainment levels that opens the door to HE, was to restrict the sample to individuals who have at least two A levels - the minimum entry requirement to UK HE. We are able to show that our headline estimates do not differ significantly from estimates using the restricted sample.

We show that controlling for non-cognitive skills makes largely no significant difference to our estimates of the return to a degree, though there is some evidence for caution depending on the outcome (wages vs earnings). This remains true, when we disaggregate degree by subject groups, by elite vs non-elite HEIs, and by both.

In the case of the wage rate premium which lies which lies here on average at 10% (in line with previous literature) the omission of non-cognitive skills (as common in other studies looking at wages) does not appear to be a cause for concern, as controlling for NC skills does not significantly decrease selection.

A large distinction between the wage vs earnings outcome lies in the significance of particular NC skills. Contrary to the wage specifications, where only locus of control stands out as a statistically significant NC skill, work ethic is highly statistically significant in all earnings specifications, with a similar return (as locus of control). This is observed to be consistent with high work ethic graduates working longer hours. Furthermore, our sensitivity to selection analysis à la Oster, suggests that in terms of earnings, the two statistically significant non-cognitive skills locus of control and work ethic do improve on the specification and reduce bias. This leads us to conclude that it warrants caution for earnings regressions which are not able to control for NC skills (especially literature using administrative data). The bias may be more of an issue because the effect of a degree on hours worked and controlling for a form of work ethic would be more important. We further conclude that that NC skills are important for earnings but there is not any more of an effect for graduates compared to nongraduates.

In terms of outcome estimates we find much larger graduate earnings premia, overall, than graduate wage premia - this is consistent with the idea that graduates have greater human capital and may wish to use it more intensively. This is also reflected in work ethic being a more important determinant of earnings than of wages.

We also explored the premia associated with the different degree classifications as

these are more likely to be included in administrative data and the assumption/hypothesis is that the NC skills that students on a course have are the important unobservable, to the course admission authority, that drives academic success conditional on being admitted. While we show that around *one third* of students experience no significant financial gain from university if looking at degree class as an outcome, our analysis shows that NC skills conditional on degree class will not greatly affect wages (remain insignificant) and that degree class, at least in the short run, acts as a sufficient statistic for NC skills. It follows that if NC skills are missing in the dataset, degree class may be a suitable proxy for it. Furthermore, one role that a degree might play, is to signal skills to the potential employers of recent graduates, and being able to credibly communicate NC skills through degree class might be a reliable way for good graduates to do so.

While it is not unusual to exploit outcomes at age 25, one should bear in mind that these individuals are still relatively early in their career path so graduates will have much less work experience relative to those that some have just finished university while those who did not pursue Higher Education would have acquired more work experience. In particular, it is possible that the effects of NC skills may only become apparent later, after more work experience has been accumulated. So far we show that the effects of these NC skills are important, but its not yet clear whether or not they fade in later life. There are certainly many extensions that would be interesting to explore further: i.e. Whether NC skills fade in later life, a more comprehensive analysis by gender, or given a larger sample obtaining estimates with the help of a latent factor model as seen in Heckman, Stixrud, and Urzua, 2006.

One such extension that is explored here is the evaluation of the various other (nonpecuniary) life outcomes beyond the labour market. In Chapter 3 we exploit the richness of LSYPE to complement recent research on the pecuniary returns to HE which shows that these vary dramatically across subject and institutional selectivity ((Britton, Dearden, Shephard, et al., 2019)). We are interested in the private and social nonmarket benefits/'wider outcomes' and in particular whether pecuniary effects are reinforced or compensated by differing nonpecuniary benefits.

We are faced with similar limitations due to lack of prior attainment but address these concerns through the use of Oster bounds, estimation on a restricted sample (of individuals with at least 2+ A levels). We also adjust p-values for multiple hypothesis as we look at a sizable number of outcomes.

In particular, we wish to see if subjects (and institutions) that generate high pecuniary returns also generate better non-pecuniary returns. That is, does HE generate non-pecuniary returns that reinforce pecuniary returns, or non-pecuniary returns that counteract the pecuniary returns.

We estimate the impact of HE on outcomes such as (self-reported) physical and mental health, overall life satisfaction, family life and fertility, trust, risk, and patience profiles, adult identities, and social engagement and participation, under two specifications. We further shut down transmission through the effect of income on such outcomes by controlling for income.

The results suggest that the differences in social returns across subjects, and across institutional selectivity, are entirely insignificant under a less parsimonious specification that controls for personal and parental background. That is, our findings do not suggest that one can build a case for differential subsidies across HE subjects or across institutions. Similarly, the results for private returns across subjects and institution types do not suggest that these weaken the case for encouraging students to invest in courses that are likely to have high returns in terms of pecuniary returns alone.

What form these non-pecuniary returns take is also of interest. We think of health effects as being largely private non-pecuniary benefits, and, similarly, children have essentially private benefits (and costs). In contrast, we think that political interest, volunteering and donating are largely socially beneficial acts. Significant social benefits would support a case for thinking that Higher Education merits a degree of subsidy from the taxpayer. In fact, we find that while there are statistically significant *private* effects on general health, BMI, risk, and the number of children, it is only political interest where we find a statistically significant*social* benefit. This seems like a thin basis for targeting subsidies to HE by subject.

Lastly, in Chapter 4 we examine the graduate premium on wellbeing - which we think of as a 'catch-all' outcome - complementing out findings on nonpecuniary/wider returns to HE. We use a large pooled cross-section dataset, the Annual Population Survey, to explore the effects of Higher Education on four outcomes of wellbeing: happiness, life satisfaction, things in life being worthwhile, and (lack of) anxiety. Well-being measures can be thought of as capturing a wide range of outcomes - many of which would be difficult to capture in a more direct way. The additional well-being, over an above the pecuniary effects, are our measure of non-pecuniary well-being.

We obtain estimates using OLS, as well as 2SLS by exploiting cohort-level variation in degree attainment due to a rapid expansion in the British HE system, to elicit causal estimates on marginal effects. We show that graduates feel that life is more worthwhile, are happier, have greater life satisfaction, but suffer from greater anxiety than do non-graduates and that these differences in wellbeing in the raw data are attenuated by allowing for income differentials, but many are not eliminated. While the OLS estimates are positive, the effects are much smaller than

what we see in terms of IV estimates for students on the margin. We observe an increase of up to 0.2 scores (on a 0-10 scale) in wellbeing measures for graduates, yet causal estimates for wellbeing effects on the margin are up to 2 scores. This translates into an effect size which is more than a standard deviation for life satisfaction and 'things being worthwhile', half of a standard deviation for happiness and third of a standard deviation for anxiousness - standing in big contrast to the average OLS estimates.

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Overall, we see that the returns to a degree are not just about pecuniary benefits, and that our results show that it is an important implication for potential students themselves considering going to HE.

Appendix A

Add. Material Chapter 2

Figure A.1: Hours worked per week by Work Ethic

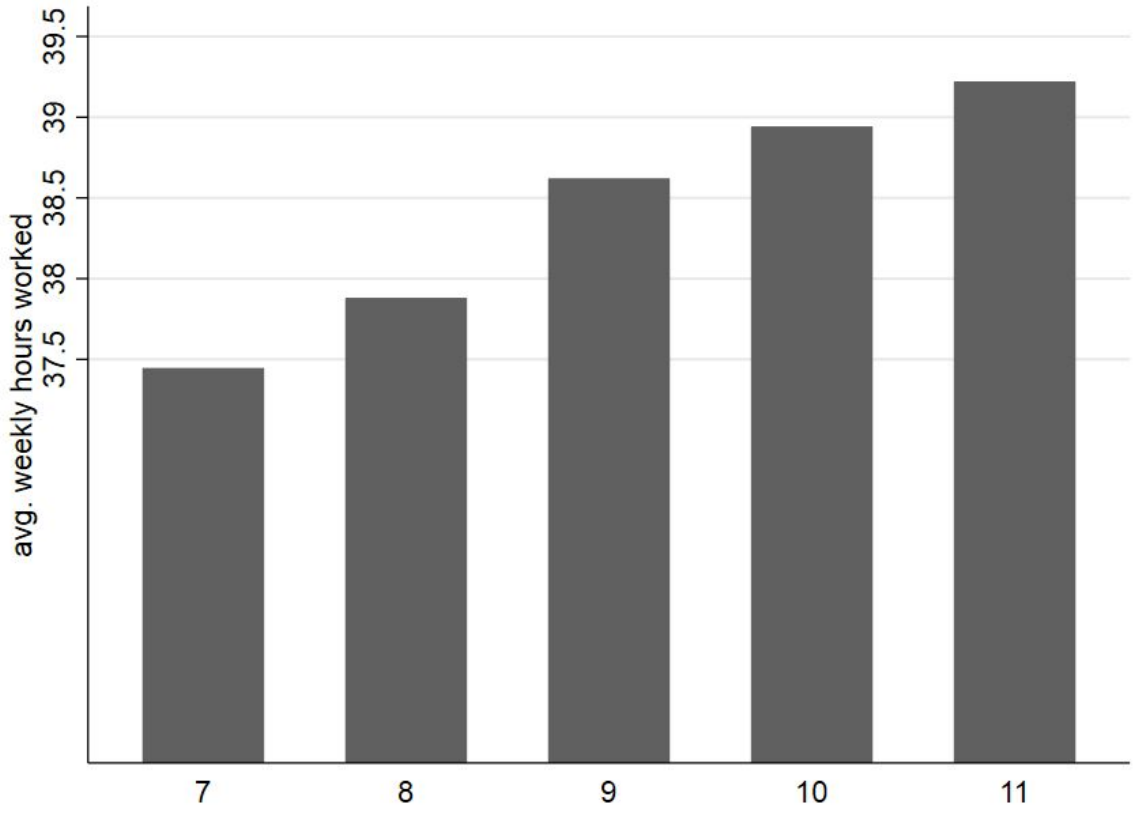


Table A.1: Wage returns to having obtained a degree - OLS & PSM (standardized NC skills)

	OLS						PSM					
	Pooled		Men		Women		Pooled		Men		Women	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Degree	0.104***	0.095***	0.089***	0.082**	0.124***	0.111***	0.082***	0.052	0.089*	0.106*	0.085**	0.029
	(0.019)	(0.019)	(0.027)	(0.027)	(0.026)	(0.026)	(0.024)	(0.037)	(0.040)	(0.042)	(0.033)	(0.064)
Locus of control		0.033***		0.036**		0.030**		✓		✓		✓
		(0.008)		(0.013)		(0.010)						
Work Ethic		0.016		0.007		0.023*		✓		✓		✓
		(0.009)		(0.014)		(0.011)						
Self-Esteem		-0.007		-0.001		-0.011		✓		✓		✓
		(0.012)		(0.023)		(0.010)						
R-sqr	0.072	0.081	0.073	0.082	0.059	0.071	-	-	-	-	-	-
N	3301	3301	1506	1506	1795	1795	1547	1547	718	718	829	829

Note: The dependent variable is log of gross hourly wage. Specification (1) does not control for non-cognitive skills, while specification (2) does. Non-cognitive skills included are: Locus of control, a proxy for conscientiousness, and a proxy for self-esteem where the higher the score the more non-cognitive skills the individual has. All specifications include the following additional controls: gender, ethnicity as well as regional dummies. PSM obtains the average treatment effect on treated. All observations are weighted by the most recent LSYPE sample weights.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A.2: Wage returns to having obtained a degree - OLS & PSM (standardized NC skills) controlling for missings

	OLS						PSM					
	Pooled		Men		Women		Pooled		Men		Women	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Degree	0.113***	0.106***	0.101***	0.094***	0.130***	0.121***	0.099***	0.061*	0.113***	0.103*	0.087**	0.048
	(0.016)	(0.017)	(0.024)	(0.025)	(0.022)	(0.022)	(0.021)	(0.028)	(0.030)	(0.044)	(0.029)	(0.042)
Locus of control		0.033***		0.034**		0.032***		✓		✓		✓
		(0.008)		(0.012)		(0.009)						
Work Ethic		0.013		0.006		0.020		✓		✓		✓
		(0.008)		(0.013)		(0.010)						
Self-Esteem		-0.004		-0.001		-0.008		✓		✓		✓
		(0.011)		(0.022)		(0.010)						
R-sqr	0.073	0.082	0.071	0.081	0.066	0.077	-	-	-	-	-	-
N	4077	4077	1849	1849	2228	2228	1794	1794	823	823	971	971

Note: The dependent variable is log of gross hourly wage. Specification (1) does not control for non-cognitive skills, while specification (2) does. Non-cognitive skills included are: Locus of control, a proxy for conscientiousness, and a proxy for self-esteem where the higher the score the more non-cognitive skills the individual has. All specifications include the following additional controls: gender, ethnicity as well as regional dummies, as well as controls for missing-NC-skill-observations. PSM obtains the average treatment effect on treated. All observations are weighted by the most recent LSYPE sample weights.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A.3: Wage returns to a degree - PCA (OLS)

	Overall		by Institution		by Subject		by Subject x Institution	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Degree	0.104***	0.092***						
	(0.019)	(0.019)						
Russell			0.198***	0.179***				
			(0.030)	(0.030)				
other HEI			0.049*	0.040				
			(0.021)	(0.021)				
STEM					0.133***	0.120***		
					(0.025)	(0.025)		
Social Sciences					0.132***	0.122***		
					(0.030)	(0.030)		
Arts&Humanities					0.004	-0.011		
					(0.026)	(0.027)		
STEM*Russell							0.229***	0.214***
							(0.043)	(0.044)
STEM*Other							0.098***	0.088***
							(0.027)	(0.27)
SocSc*Russell							0.238***	0.222***
							(0.050)	(0.049)
SocSc*Other							0.089**	0.082*
							(0.034)	(0.034)
A&H*Russell							0.117**	0.094*
							(0.045)	(0.045)
A&H*Other							-0.040	-0.050
							(0.029)	(0.029)
Locus		0.006		0.005		0.005		0.004
		(0.007)		(0.007)		(0.007)		(0.007)
Work ethic		0.025***		0.024***		0.026***		0.024***
		(0.007)		(0.007)		(0.007)		(0.007)
Self-esteem		-0.004		-0.005		-0.006		-0.006
		(0.007)		(0.008)		(0.008)		(0.008)
R-sqr	0.072	0.079	0.070	0.077	0.069	0.77	0.076	0.083
N	3301	3301	2860	2860	2865	2865	2856	2856

Note: The dependent variable is log of gross hourly wage. Specification (1) does not control for non-cognitive skills, while specification (2) does. All specifications include the following additional controls: gender, ethnicity as well as regional dummies. Further control for missing values in the sample for degree-observations are also included (see Section 4). All observations are weighted by the most recent LSYPE sample weights.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A.4: Wage returns to a degree (OLS, pooled, restricted sample: 2+ A levels)

	Overall		by Institution		by Subject		by Subject x Institution	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Degree	0.109***	0.101***						
	(0.023)	(0.024)						
Russell Group			0.211***	0.198***				
			(0.031)	(0.032)				
Other HEI			0.058***	0.051**				
			(0.025)	(0.025)				
STEM					0.143***	0.131***		
					(0.027)	(0.028)		
Social Sciences					0.142***	0.131***		
					(0.031)	(0.031)		
Arts&Humanities					0.013	0.000		
					(0.029)	(0.030)		
STEM*Russell							0.252***	0.241***
							(0.041)	(0.042)
STEM*Other							0.103***	0.094***
							(0.029)	(0.030)
SocSc*Russell							0.229***	0.214***
							(0.048)	(0.049)
SocSc*Other							0.107***	0.101***
							(0.034)	(0.034)
A&H*Russell							0.137***	0.123**
							(0.046)	(0.046)
A&H*Other							-0.034	-0.043
							(0.031)	(0.032)
Female	-0.066***	-0.062***	-0.041***	-0.041***	-0.035***	-0.037***	-0.029***	-0.031***
	(0.018)	(0.019)	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)
Locus of control		0.029***		0.018***		0.020***		0.017***
		(0.010)		(0.011)		(0.011)		(0.011)
Work ethic		0.008		0.010		0.019		0.011
		(0.012)		(0.013)		(0.013)		(0.013)
Self-esteem		0.002		-0.003		-0.006		-0.006
		(0.010)		(0.011)		(0.011)		(0.011)
F-test of NC coeffs		F(3, 2124)=3.33		F(3, 3515)=1.37		F(3, 3516)=2.27		F(3, 3504)=1.38
		p <.001		p <.25		p <.079		p <.25
R-sqr	0.073	0.079	0.100	0.104	0.095	0.101	0.117	0.121
N	2137	2137	1589	1589	1591	1591	1582	1582

Note: The dependent variable is log of gross hourly wage. Specification (1) does not control for non-cognitive skills, while specification (2) does. All specifications include the following additional controls: gender, ethnicity as well as regional dummies. All observations are weighted by the most recent LSYPE sample weights.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A.5: Earnings returns to a degree (OLS, pooled, restricted sample: 2+ A levels)

	Overall		by Institution		by Subject		by Subject x Institution	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Degree	0.189***	0.167***						
	(0.032)	(0.033)						
Russell Group			0.382***	0.341***				
			(0.040)	(0.041)				
Other HEI			0.110***	0.090**				
			(0.035)	(0.036)				
STEM					0.254***	0.227***		
					(0.037)	(0.038)		
Social Sciences					0.227***	0.202***		
					(0.042)	(0.043)		
Arts&Humanities					0.076	0.044		
					(0.041)	(0.041)		
STEM*Russell							0.389***	0.358***
							(0.058)	(0.058)
STEM*Other							0.203***	0.183***
							(0.039)	(0.040)
SocSc*Russell							0.434***	0.393***
							(0.056)	(0.058)
SocSc*Other							0.144***	0.130***
							(0.047)	(0.047)
A&H*Russell							0.318***	0.277***
							(0.052)	(0.052)
A&H*Other							-0.012	-0.032
							(0.044)	(0.045)
Female	-0.121***	-0.159***	-0.137***	-0.141***	-0.127***	-0.131***	-0.115***	-0.226***
	(0.029)	(0.025)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.020)
Locus of control		0.039***		0.025		0.030*		0.024
		(0.015)		(0.016)		(0.016)		(0.016)
Work ethic		0.059***		0.064***		0.068***		0.055***
		(0.020)		(0.023)		(0.021)		(0.021)
Self-esteem		-0.002		-0.007		-0.013		-0.015
		(0.015)		(0.018)		(0.016)		(0.017)
F-test of NC coeffs		F(3, 4160)=7.2		F(3, 3602)=4.43		F(3, 3603)=6.07		F(3, 3591)=3.98
		p <.001		p <.001		p <.001		p <.001
R-sqr	0.108	0.124	0.149	0.163	0.131	0.148	0.165	0.177
N	2184	2184	1627	1627	1629	1629	1620	1620

Note: The dependent variable is log of gross weekly earnings. Specification (1) does not control for non-cognitive skills, while specification (2) does. All specifications include the following additional controls: gender, ethnicity as well as regional dummies. Further control for missing values in the sample for degree-observations as well as non-cognitive skill observation are also included (see Section 4). All observations are weighted by the most recent LSYPE sample weights.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Appendix B

Add. Material Chapter 3

B.1 Parental Income vs Education

Figure B.1: Coefplot Parental Income vs Parental Education

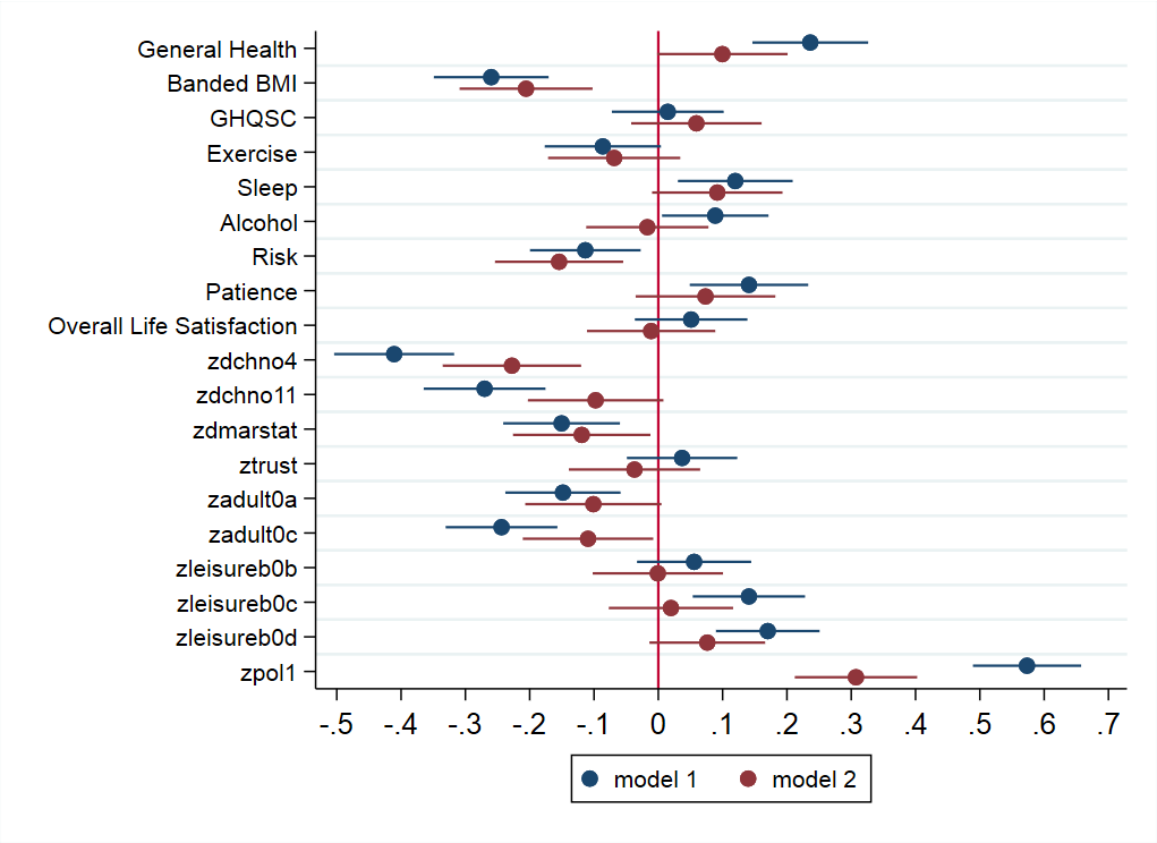


Table B.1: Gena & Parental Controls

	(1)	(2)	(3)	(4)
	zgena	zgena	zgena	zgena
degree	0.102*	0.0970**	0.0996*	0.0919*
	(0.0530)	(0.0491)	(0.0517)	(0.0477)
NA_degree	0.0297	-0.00347	0.0343	-0.000411
	(0.0536)	(0.0502)	(0.0530)	(0.0494)
intent	0.0884***	0.105***	0.0681***	0.0846***
	(0.0222)	(0.0211)	(0.0224)	(0.0213)
parental_income	0.0344***		0.0318***	
	(0.00763)		(0.00756)	
gender	-0.0723*	-0.0810**	-0.0216	-0.0226
	(0.0396)	(0.0370)	(0.0392)	(0.0367)
ethnicity	-0.0983*	-0.144***	-0.0858	-0.120**
	(0.0576)	(0.0480)	(0.0567)	(0.0480)
north	0.00649	-0.00863	-0.00554	-0.0222
	(0.0513)	(0.0476)	(0.0501)	(0.0464)
south	0.00627	0.00887	0.0179	0.0224
	(0.0455)	(0.0430)	(0.0448)	(0.0423)
mum_degree		-0.0118		-0.00157
		(0.0544)		(0.0535)
dad_degree		0.136***		0.135***
		(0.0500)		(0.0494)
z1locus			0.0395*	0.0417**
			(0.0228)	(0.0212)
z1school_importanceW3			0.0674***	0.0559**
			(0.0256)	(0.0233)
z1self_esteem			0.136***	0.146***
			(0.0208)	(0.0196)
N	3312	3917	3312	3917

Table B.2: DBMICA & Parental Controls

	(1)	(2)	(3)	(4)
	zdbmica	zdbmica	zdbmica	zdbmica
degree	-0.205***	-0.178***	-0.206***	-0.180***
	(0.0526)	(0.0495)	(0.0527)	(0.0494)
NA_degree	-0.106**	-0.0830*	-0.108**	-0.0838*
	(0.0536)	(0.0496)	(0.0535)	(0.0495)
intent	-0.000190	-0.0114	0.00837	-0.00551
	(0.0224)	(0.0209)	(0.0237)	(0.0221)
parental_income	-0.0377***		-0.0384***	
	(0.00770)		(0.00770)	
gender	-0.0395	-0.0443	-0.0398	-0.0491
	(0.0401)	(0.0372)	(0.0408)	(0.0381)
ethnicity	-0.131**	-0.0913*	-0.122**	-0.0815
	(0.0622)	(0.0514)	(0.0616)	(0.0507)
north	0.00638	0.00377	0.0103	0.00734
	(0.0488)	(0.0451)	(0.0485)	(0.0449)
south	-0.0561	-0.0629	-0.0501	-0.0605
	(0.0481)	(0.0447)	(0.0480)	(0.0447)
mum_degree		-0.0990*		-0.104**
		(0.0526)		(0.0526)
dad_degree		-0.225***		-0.223***
		(0.0507)		(0.0506)
z1locus			0.0419*	0.0324
			(0.0226)	(0.0215)
z1school_importanceW3			-0.0562**	-0.0443**
			(0.0235)	(0.0217)
z1self_esteem			-0.0178	-0.0212
			(0.0211)	(0.0196)
N	3312	3917	3312	3917

Table B.3: zdghqsc & Parental Controls

	(1)	(2)	(3)	(4)
	zdghqsc	zdghqsc	zdghqsc	zdghqsc
degree	0.0460	0.0197	0.0592	0.0316
	(0.0537)	(0.0505)	(0.0517)	(0.0487)
NA_degree	0.0952*	0.0740	0.0910*	0.0726
	(0.0532)	(0.0502)	(0.0516)	(0.0488)
intent	0.0426*	0.0102	0.0555**	0.0228
	(0.0240)	(0.0224)	(0.0234)	(0.0220)
parental_income	-0.0349***		-0.0316***	
	(0.00802)		(0.00783)	
gender	0.0887**	0.0864**	0.00737	-0.00523
	(0.0418)	(0.0390)	(0.0404)	(0.0378)
ethnicity	-0.0540	0.0234	-0.0647	0.00280
	(0.0632)	(0.0537)	(0.0598)	(0.0507)
north	-0.0108	0.0705	0.0101	0.0924**
	(0.0518)	(0.0488)	(0.0494)	(0.0466)
south	0.0212	0.0254	0.00339	0.00455
	(0.0486)	(0.0449)	(0.0473)	(0.0435)
mum_degree		-0.0552		-0.0729
		(0.0517)		(0.0507)
dad_degree		-0.0240		-0.0199
		(0.0475)		(0.0467)
z1locus			-0.0432*	-0.0497**
			(0.0225)	(0.0206)
z1school_importanceW3			-0.0667**	-0.0485*
			(0.0276)	(0.0257)
z1self_esteem			-0.240***	-0.247***
			(0.0225)	(0.0214)
N	3312	3917	3312	3917

Table B.4: exercise & Parental Controls

	(1)	(2)	(3)	(4)
	zexercise	zexercise	zexercise	zexercise
degree	-0.0700	-0.0727	-0.0686	-0.0738
	(0.0525)	(0.0494)	(0.0524)	(0.0494)
NA_degree	-0.125**	-0.148***	-0.124**	-0.146***
	(0.0550)	(0.0519)	(0.0548)	(0.0518)
intent	-0.0393*	-0.0216	-0.0581**	-0.0361
	(0.0229)	(0.0217)	(0.0239)	(0.0227)
parental_income	0.000596		-0.000199	
	(0.00819)		(0.00812)	
gender	-0.285***	-0.292***	-0.275***	-0.283***
	(0.0411)	(0.0386)	(0.0421)	(0.0394)
ethnicity	-0.183***	-0.167***	-0.180***	-0.157***
	(0.0619)	(0.0528)	(0.0613)	(0.0522)
north	-0.0237	-0.0465	-0.0309	-0.0502
	(0.0519)	(0.0484)	(0.0514)	(0.0482)
south	-0.0953*	-0.0976**	-0.0928*	-0.0944**
	(0.0487)	(0.0460)	(0.0486)	(0.0458)
mum_degree		-0.0254		-0.0213
		(0.0546)		(0.0545)
dad_degree		0.00867		0.00935
		(0.0504)		(0.0503)
z1locus			0.0314	0.0205
			(0.0242)	(0.0227)
z1school_importanceW3			0.0521**	0.0357
			(0.0259)	(0.0239)
z1self_esteem			0.0192	0.0197
			(0.0219)	(0.0205)
N	3312	3917	3312	3917

Table B.5: sleep & Parental Controls

	(1)	(2)	(3)	(4)
	zsleep2	zsleep2	zsleep2	zsleep2
degree	0.100*	0.117**	0.0917*	0.106**
	(0.0527)	(0.0505)	(0.0517)	(0.0493)
NA_degree	-0.0423	-0.00509	-0.0392	-0.00510
	(0.0569)	(0.0547)	(0.0568)	(0.0542)
intent	-0.00459	0.00552	-0.0130	-0.00342
	(0.0228)	(0.0215)	(0.0243)	(0.0233)
parental_income	0.0177**		0.0168**	
	(0.00798)		(0.00792)	
gender	0.0511	0.0440	0.0745*	0.0754*
	(0.0408)	(0.0385)	(0.0411)	(0.0393)
ethnicity	-0.0735	-0.117**	-0.0661	-0.106*
	(0.0588)	(0.0564)	(0.0572)	(0.0548)
north	0.00767	0.00797	-0.000667	-0.00173
	(0.0522)	(0.0488)	(0.0516)	(0.0482)
south	-0.0267	-0.0398	-0.0191	-0.0293
	(0.0452)	(0.0435)	(0.0449)	(0.0431)
mum_degree		0.0524		0.0656
		(0.0477)		(0.0476)
dad_degree		0.00586		0.00364
		(0.0440)		(0.0435)
z1locus			0.0198	0.0260
			(0.0234)	(0.0217)
z1school_importanceW3			0.0391*	0.0319
			(0.0227)	(0.0217)
z1self_esteem			0.0821***	0.0956***
			(0.0206)	(0.0200)
N	3312	3917	3312	3917

Table B.6: audit & Parental Controls

	(1)	(2)	(3)	(4)
	zdaudit	zdaudit	zdaudit	zdaudit
degree	-0.0219	-0.00484	-0.0171	0.000372
	(0.0487)	(0.0455)	(0.0485)	(0.0454)
NA_degree	-0.0564	-0.0472	-0.0591	-0.0486
	(0.0509)	(0.0480)	(0.0510)	(0.0480)
intent	0.0347	0.0565***	0.0534**	0.0765***
	(0.0213)	(0.0206)	(0.0224)	(0.0214)
parental_income	0.0448***		0.0446***	
	(0.00744)		(0.00739)	
gender	-0.323***	-0.324***	-0.325***	-0.331***
	(0.0372)	(0.0354)	(0.0385)	(0.0367)
ethnicity	-0.682***	-0.788***	-0.680***	-0.785***
	(0.0536)	(0.0496)	(0.0529)	(0.0488)
north	0.144***	0.130***	0.153***	0.137***
	(0.0468)	(0.0444)	(0.0469)	(0.0445)
south	0.110**	0.0949**	0.110**	0.0928**
	(0.0453)	(0.0435)	(0.0452)	(0.0433)
mum_degree		0.118**		0.104**
		(0.0496)		(0.0494)
dad_degree		0.0983**		0.101**
		(0.0455)		(0.0455)
z1locus			0.00883	0.0171
			(0.0215)	(0.0205)
z1school_importanceW3			-0.0753***	-0.0758***
			(0.0256)	(0.0237)
z1self_esteem			-0.0329	-0.0358*
			(0.0208)	(0.0198)
N	3312	3917	3312	3917

Table B.7: risk & Parental Controls

	(1)	(2)	(3)	(4)
	zrisk	zrisk	zrisk	zrisk
degree	-0.153***	-0.128***	-0.154***	-0.129***
	(0.0511)	(0.0476)	(0.0508)	(0.0475)
NA_degree	-0.107*	-0.124**	-0.107**	-0.125**
	(0.0547)	(0.0514)	(0.0542)	(0.0509)
intent	0.0170	0.0303	0.0344	0.0484**
	(0.0217)	(0.0211)	(0.0227)	(0.0222)
parental_income	0.0176**		0.0157**	
	(0.00768)		(0.00765)	
gender	-0.374***	-0.380***	-0.334***	-0.336***
	(0.0407)	(0.0379)	(0.0430)	(0.0397)
ethnicity	0.0175	0.0146	0.0252	0.0321
	(0.0631)	(0.0512)	(0.0630)	(0.0510)
north	0.0232	0.0199	0.0233	0.0187
	(0.0530)	(0.0495)	(0.0520)	(0.0485)
south	0.0224	0.0348	0.0315	0.0436
	(0.0459)	(0.0427)	(0.0457)	(0.0425)
mum_degree		-0.0258		-0.0343
		(0.0500)		(0.0498)
dad_degree		-0.0652		-0.0650
		(0.0475)		(0.0473)
z1locus			0.0230	0.0267
			(0.0233)	(0.0217)
z1school_importanceW3			-0.0575**	-0.0602**
			(0.0283)	(0.0259)
z1self_esteem			0.0931***	0.100***
			(0.0241)	(0.0224)
N	3312	3917	3312	3917

Table B.8: zpatience & Parental Controls

	(1)	(2)	(3)	(4)
	zpatience	zpatience	zpatience	zpatience
degree	0.0800	0.110**	0.0734	0.102**
	(0.0564)	(0.0515)	(0.0554)	(0.0512)
NA_degree	-0.0272	-0.0352	-0.0240	-0.0331
	(0.0569)	(0.0523)	(0.0563)	(0.0519)
intent	0.0706***	0.0481**	0.0410*	0.0176
	(0.0233)	(0.0214)	(0.0248)	(0.0227)
parental_income	0.00311		0.00289	
	(0.00787)		(0.00786)	
gender	0.0448	0.0383	0.0590	0.0573
	(0.0417)	(0.0385)	(0.0429)	(0.0394)
ethnicity	0.0830	0.0983**	0.0796	0.0999**
	(0.0585)	(0.0498)	(0.0575)	(0.0494)
north	-0.00297	-0.0361	-0.0190	-0.0489
	(0.0522)	(0.0477)	(0.0513)	(0.0472)
south	-0.0332	-0.0426	-0.0316	-0.0370
	(0.0503)	(0.0465)	(0.0502)	(0.0464)
mum_degree		0.0512		0.0719
		(0.0526)		(0.0527)
dad_degree		-0.0110		-0.0139
		(0.0487)		(0.0488)
z1locus			0.00314	-0.000990
			(0.0244)	(0.0227)
z1school_importanceW3			0.116***	0.106***
			(0.0286)	(0.0261)
z1self_esteem			0.0689***	0.0689***
			(0.0258)	(0.0237)
N	3312	3917	3312	3917

Table B.9: osatis & Parental Controls

	(1)	(2)	(3)	(4)
	zosatis	zosatis	zosatis	zosatis
degree	-0.00405	0.00256	-0.0112	-0.00846
	(0.0523)	(0.0496)	(0.0509)	(0.0483)
NA_degree	-0.168***	-0.176***	-0.162***	-0.173***
	(0.0533)	(0.0497)	(0.0523)	(0.0485)
intent	-0.0143	0.0158	-0.0415*	-0.0174
	(0.0221)	(0.0208)	(0.0221)	(0.0209)
parental_income	0.0376***		0.0349***	
	(0.00741)		(0.00734)	
gender	0.116***	0.0970***	0.170***	0.161***
	(0.0398)	(0.0373)	(0.0398)	(0.0370)
ethnicity	-0.171***	-0.220***	-0.160***	-0.201***
	(0.0612)	(0.0529)	(0.0587)	(0.0511)
north	-0.0104	-0.0749	-0.0265	-0.0939**
	(0.0494)	(0.0458)	(0.0479)	(0.0445)
south	-0.0416	-0.0646	-0.0290	-0.0485
	(0.0471)	(0.0445)	(0.0463)	(0.0437)
mum_degree		0.0785		0.100*
		(0.0534)		(0.0527)
dad_degree		0.0555		0.0512
		(0.0500)		(0.0492)
z1locus			0.0249	0.0254
			(0.0238)	(0.0223)
z1school_importanceW3			0.0942***	0.0988***
			(0.0256)	(0.0235)
z1self_esteem			0.165***	0.180***
			(0.0236)	(0.0221)
N	3312	3917	3312	3917

Table B.10: dchno4 & Parental Controls

	(1)	(2)	(3)	(4)
	zdchno4	zdchno4	zdchno4	zdchno4
degree	-0.227***	-0.250***	-0.228***	-0.250***
	(0.0548)	(0.0505)	(0.0549)	(0.0509)
NA_degree	0.0330	0.0273	0.0310	0.0268
	(0.0650)	(0.0610)	(0.0647)	(0.0608)
intent	-0.128***	-0.149***	-0.134***	-0.154***
	(0.0251)	(0.0241)	(0.0264)	(0.0254)
parental_income	-0.0279***		-0.0275***	
	(0.00837)		(0.00838)	
gender	0.216***	0.223***	0.211***	0.215***
	(0.0436)	(0.0416)	(0.0472)	(0.0442)
ethnicity	-0.122**	-0.0661*	-0.124**	-0.0744*
	(0.0534)	(0.0400)	(0.0538)	(0.0418)
north	0.0892	0.0652	0.0845	0.0621
	(0.0576)	(0.0534)	(0.0567)	(0.0530)
south	-0.0275	-0.0467	-0.0284	-0.0487
	(0.0491)	(0.0476)	(0.0493)	(0.0476)
mum_degree		-0.123***		-0.119***
		(0.0390)		(0.0391)
dad_degree		-0.0202		-0.0195
		(0.0432)		(0.0434)
z1locus			0.0303	0.0135
			(0.0277)	(0.0255)
z1school_importanceW3			0.0207	0.0196
			(0.0249)	(0.0235)
z1self_esteem			-0.0188	-0.0210
			(0.0302)	(0.0277)
N	3312	3917	3312	3917

Table B.11: dchno11 & Parental Controls

	(1)	(2)	(3)	(4)
	zdchno11	zdchno11	zdchno11	zdchno11
degree	-0.101*	-0.124**	-0.0975*	-0.122**
	(0.0544)	(0.0493)	(0.0538)	(0.0491)
NA_degree	-0.0184	-0.0194	-0.0176	-0.0194
	(0.0688)	(0.0625)	(0.0683)	(0.0622)
intent	-0.155***	-0.158***	-0.144***	-0.148***
	(0.0259)	(0.0239)	(0.0270)	(0.0252)
parental_income	-0.0176***		-0.0179***	
	(0.00663)		(0.00663)	
gender	0.179***	0.191***	0.174***	0.181***
	(0.0450)	(0.0417)	(0.0457)	(0.0420)
ethnicity	-0.00298	0.00871	0.00116	0.0150
	(0.0431)	(0.0325)	(0.0429)	(0.0331)
north	0.0908	0.0886	0.101	0.0974*
	(0.0618)	(0.0556)	(0.0621)	(0.0559)
south	-0.0550	-0.0366	-0.0548	-0.0381
	(0.0417)	(0.0399)	(0.0415)	(0.0399)
mum_degree		-0.0266		-0.0359
		(0.0249)		(0.0265)
dad_degree		-0.0121		-0.0122
		(0.0294)		(0.0294)
z1locus			-0.0220	-0.0239
			(0.0270)	(0.0244)
z1school_importanceW3			-0.0549	-0.0424
			(0.0335)	(0.0302)
z1self_esteem			-0.0233	-0.0272
			(0.0250)	(0.0231)
N	3312	3917	3312	3917

Table B.12: marstat & Parental Controls

	(1)	(2)	(3)	(4)
	zdmarstat	zdmarstat	zdmarstat	zdmarstat
degree	-0.115**	-0.109**	-0.119**	-0.112**
	(0.0550)	(0.0504)	(0.0545)	(0.0501)
NA_degree	-0.0822	-0.0339	-0.0819	-0.0332
	(0.0560)	(0.0520)	(0.0560)	(0.0519)
intent	-0.0136	-0.0309	-0.0274	-0.0478*
	(0.0231)	(0.0221)	(0.0262)	(0.0246)
parental_income	-0.0191**		-0.0197**	
	(0.00801)		(0.00799)	
gender	0.231***	0.219***	0.229***	0.216***
	(0.0426)	(0.0402)	(0.0420)	(0.0392)
ethnicity	0.0180	0.118**	0.0227	0.117**
	(0.0537)	(0.0490)	(0.0537)	(0.0487)
north	-0.0236	-0.0137	-0.0285	-0.0185
	(0.0525)	(0.0488)	(0.0527)	(0.0490)
south	-0.102**	-0.110**	-0.0964**	-0.108**
	(0.0453)	(0.0439)	(0.0456)	(0.0438)
mum_degree		-0.0829*		-0.0752
		(0.0477)		(0.0479)
dad_degree		0.0213		0.0210
		(0.0504)		(0.0505)
z1locus			0.0343	0.0244
			(0.0233)	(0.0223)
z1school_importanceW3			0.0185	0.0307
			(0.0296)	(0.0273)
z1self_esteem			-0.000466	-0.00772
			(0.0243)	(0.0225)
N	3312	3917	3312	3917

Table B.13: trust & Parental Controls

	(1)	(2)	(3)	(4)
	ztrust	ztrust	ztrust	ztrust
degree	-0.0250	-0.0122	-0.0371	-0.0220
	(0.0530)	(0.0493)	(0.0521)	(0.0485)
NA_degree	0.0209	0.0179	0.0258	0.0191
	(0.0548)	(0.0515)	(0.0532)	(0.0505)
intent	0.0148	0.0247	-0.00787	0.00383
	(0.0232)	(0.0222)	(0.0231)	(0.0225)
parental_income	0.0297***		0.0285***	
	(0.00754)		(0.00736)	
gender	0.0612	0.0696*	0.0936**	0.113***
	(0.0405)	(0.0380)	(0.0410)	(0.0385)
ethnicity	-0.112*	-0.111**	-0.107*	-0.107**
	(0.0578)	(0.0507)	(0.0554)	(0.0490)
north	0.0211	-0.00613	0.00525	-0.0222
	(0.0532)	(0.0501)	(0.0519)	(0.0492)
south	0.0840*	0.0702*	0.0929**	0.0809*
	(0.0449)	(0.0424)	(0.0441)	(0.0417)
mum_degree		0.0541		0.0741
		(0.0489)		(0.0493)
dad_degree		0.0916**		0.0876**
		(0.0437)		(0.0434)
z1locus			0.0141	0.0130
			(0.0233)	(0.0218)
z1school_importanceW3			0.0914***	0.0763***
			(0.0276)	(0.0258)
z1self_esteem			0.123***	0.132***
			(0.0237)	(0.0222)
N	3312	3917	3312	3917

Table B.14: adult0a & Parental Controls

	(1)	(2)	(3)	(4)
	zadult0a	zadult0a	zadult0a	zadult0a
degree	-0.0973*	-0.0814	-0.101*	-0.0864*
	(0.0539)	(0.0506)	(0.0540)	(0.0503)
NA_degree	-0.0427	-0.0464	-0.0401	-0.0445
	(0.0510)	(0.0477)	(0.0510)	(0.0476)
intent	-0.0529**	-0.0424**	-0.0727***	-0.0646***
	(0.0208)	(0.0197)	(0.0215)	(0.0203)
parental_income	0.00774		0.00654	
	(0.00768)		(0.00761)	
gender	-0.0263	-0.0268	-0.00335	-0.00134
	(0.0404)	(0.0374)	(0.0407)	(0.0377)
ethnicity	-0.0601	-0.0467	-0.0537	-0.0383
	(0.0711)	(0.0601)	(0.0698)	(0.0581)
north	0.0553	0.0166	0.0447	0.00566
	(0.0478)	(0.0447)	(0.0479)	(0.0445)
south	-0.110**	-0.118***	-0.104**	-0.111**
	(0.0493)	(0.0453)	(0.0491)	(0.0451)
mum_degree		-0.0386		-0.0258
		(0.0574)		(0.0575)
dad_degree		-0.0412		-0.0421
		(0.0532)		(0.0534)
z1locus			0.0345	0.0275
			(0.0247)	(0.0228)
z1school_importanceW3			0.0652**	0.0673***
			(0.0262)	(0.0239)
z1self_esteem			0.0679***	0.0688***
			(0.0217)	(0.0201)
N	3312	3917	3312	3917

Table B.15: adult0c & Parental Controls

	(1)	(2)	(3)	(4)
	zadult0c	zadult0c	zadult0c	zadult0c
degree	-0.107**	-0.0928*	-0.109**	-0.0979**
	(0.0519)	(0.0482)	(0.0517)	(0.0479)
NA_degree	0.0223	0.0234	0.0248	0.0259
	(0.0500)	(0.0468)	(0.0501)	(0.0468)
intent	-0.131***	-0.102***	-0.152***	-0.129***
	(0.0199)	(0.0190)	(0.0207)	(0.0198)
parental_income	-0.00752		-0.00882	
	(0.00738)		(0.00731)	
gender	0.172***	0.158***	0.195***	0.182***
	(0.0384)	(0.0358)	(0.0394)	(0.0365)
ethnicity	0.0442	0.0308	0.0506	0.0412
	(0.0597)	(0.0513)	(0.0598)	(0.0504)
north	0.0851*	0.0610	0.0744	0.0497
	(0.0468)	(0.0433)	(0.0469)	(0.0434)
south	-0.0962**	-0.117***	-0.0901*	-0.110**
	(0.0480)	(0.0444)	(0.0476)	(0.0439)
mum_degree		-0.141**		-0.127**
		(0.0550)		(0.0549)
dad_degree		-0.160***		-0.161***
		(0.0517)		(0.0517)
z1locus			0.0382*	0.0292
			(0.0230)	(0.0211)
z1school_importanceW3			0.0687***	0.0796***
			(0.0241)	(0.0222)
z1self_esteem			0.0632***	0.0642***
			(0.0212)	(0.0198)
N	3312	3917	3312	3917

Table B.16: zleisureb0b & Parental Controls

	(1)	(2)	(3)	(4)
	zleisureb0b	zleisureb0b	zleisureb0b	zleisureb0b
degree	0.000766	-0.0258	-0.000736	-0.0265
	(0.0518)	(0.0490)	(0.0517)	(0.0490)
NA_degree	-0.143***	-0.156***	-0.142***	-0.155***
	(0.0515)	(0.0475)	(0.0518)	(0.0476)
intent	0.0508**	0.0359*	0.0417*	0.0297
	(0.0220)	(0.0200)	(0.0234)	(0.0213)
parental_income	-0.0144*		-0.0136*	
	(0.00749)		(0.00754)	
gender	-0.0226	-0.0169	-0.0344	-0.0224
	(0.0377)	(0.0354)	(0.0390)	(0.0365)
ethnicity	0.0515	0.102**	0.0481	0.101**
	(0.0589)	(0.0487)	(0.0588)	(0.0489)
north	-0.0427	-0.0805*	-0.0451	-0.0812*
	(0.0474)	(0.0434)	(0.0476)	(0.0435)
south	-0.00770	-0.0524	-0.0109	-0.0535
	(0.0458)	(0.0432)	(0.0458)	(0.0432)
mum_degree		0.0570		0.0604
		(0.0563)		(0.0563)
dad_degree		0.0705		0.0706
		(0.0537)		(0.0535)
z1locus			-0.0136	-0.00696
			(0.0231)	(0.0218)
z1school_importanceW3			0.0388	0.0272
			(0.0249)	(0.0227)
z1self_esteem			-0.0172	-0.0102
			(0.0212)	(0.0197)
N	3312	3917	3312	3917

Table B.17: zleisureb0c & Parental Controls

	(1)	(2)	(3)	(4)
	zleisureb0c	zleisureb0c	zleisureb0c	zleisureb0c
degree	0.0211	0.00327	0.0197	0.00157
	(0.0494)	(0.0473)	(0.0493)	(0.0471)
NA_degree	-0.150***	-0.185***	-0.147***	-0.184***
	(0.0493)	(0.0468)	(0.0494)	(0.0468)
intent	0.111***	0.0894***	0.0986***	0.0780***
	(0.0207)	(0.0195)	(0.0219)	(0.0206)
parental_income	0.0168**		0.0169**	
	(0.00705)		(0.00709)	
gender	0.0864**	0.0930***	0.0838**	0.0953***
	(0.0370)	(0.0349)	(0.0384)	(0.0360)
ethnicity	0.199***	0.253***	0.198***	0.255***
	(0.0517)	(0.0502)	(0.0517)	(0.0492)
north	0.0170	-0.0134	0.0154	-0.0150
	(0.0452)	(0.0423)	(0.0453)	(0.0423)
south	0.0187	-0.00412	0.0180	-0.00305
	(0.0454)	(0.0429)	(0.0453)	(0.0428)
mum_degree		0.0500		0.0549
		(0.0523)		(0.0524)
dad_degree		0.230***		0.228***
		(0.0502)		(0.0501)
z1locus			-0.0283	-0.0173
			(0.0226)	(0.0209)
z1school_importanceW3			0.0400	0.0321
			(0.0245)	(0.0225)
z1self_esteem			0.0113	0.0142
			(0.0208)	(0.0194)
N	3312	3917	3312	3917

Table B.18: zleisureb0d & Parental Controls

	(1)	(2)	(3)	(4)
	zleisureb0d	zleisureb0d	zleisureb0d	zleisureb0d
degree	0.0715	0.0594	0.0762*	0.0643
	(0.0463)	(0.0435)	(0.0459)	(0.0432)
NA_degree	0.0264	0.0208	0.0261	0.0201
	(0.0450)	(0.0436)	(0.0442)	(0.0434)
intent	0.0923***	0.0538***	0.104***	0.0667***
	(0.0174)	(0.0165)	(0.0191)	(0.0181)
parental_income	0.000141		0.00153	
	(0.00746)		(0.00742)	
gender	-0.0609*	-0.0558	-0.0673*	-0.0605*
	(0.0364)	(0.0339)	(0.0374)	(0.0349)
ethnicity	0.0543	0.0653	0.0380	0.0488
	(0.0674)	(0.0523)	(0.0658)	(0.0511)
north	-0.0220	-0.0221	-0.0173	-0.0185
	(0.0439)	(0.0416)	(0.0435)	(0.0415)
south	0.0915**	0.0668	0.0803*	0.0611
	(0.0449)	(0.0424)	(0.0451)	(0.0426)
mum_degree		0.163***		0.159**
		(0.0618)		(0.0619)
dad_degree		0.154***		0.152***
		(0.0558)		(0.0558)
z1locus			-0.0864***	-0.0622**
			(0.0288)	(0.0265)
z1school_importanceW3			-0.00170	-0.0130
			(0.0218)	(0.0210)
z1self_esteem			-0.00461	-0.000157
			(0.0189)	(0.0178)
N	3312	3917	3312	3917

Table B.19: zpol1 & Parental Controls

	(1)	(2)	(3)	(4)
	zpol1	zpol1	zpol1	zpol1
degree	0.302***	0.310***	0.307***	0.311***
	(0.0485)	(0.0456)	(0.0485)	(0.0456)
NA_degree	-0.0906*	-0.124***	-0.0887*	-0.122***
	(0.0494)	(0.0463)	(0.0492)	(0.0462)
intent	0.230***	0.217***	0.219***	0.205***
	(0.0206)	(0.0192)	(0.0220)	(0.0205)
parental_income	0.0407***		0.0408***	
	(0.00700)		(0.00699)	
gender	-0.449***	-0.401***	-0.463***	-0.415***
	(0.0359)	(0.0338)	(0.0366)	(0.0344)
ethnicity	-0.0428	-0.132***	-0.0419	-0.122***
	(0.0532)	(0.0488)	(0.0530)	(0.0474)
north	-0.0678	-0.0940**	-0.0644	-0.0903**
	(0.0457)	(0.0425)	(0.0461)	(0.0426)
south	0.133***	0.132***	0.130***	0.130***
	(0.0433)	(0.0413)	(0.0431)	(0.0410)
mum_degree		0.206***		0.204***
		(0.0498)		(0.0503)
dad_degree		0.200***		0.201***
		(0.0487)		(0.0487)
z1locus			-0.0147	0.00346
			(0.0224)	(0.0211)
z1school_importanceW3			0.0188	0.0139
			(0.0223)	(0.0208)
z1self_esteem			-0.0401**	-0.0440**
			(0.0199)	(0.0186)
N	3312	3917	3312	3917

B.2 Coefplots - personal income

Figure B.2: Coefplot of degree effects (pooled, controlled for income)

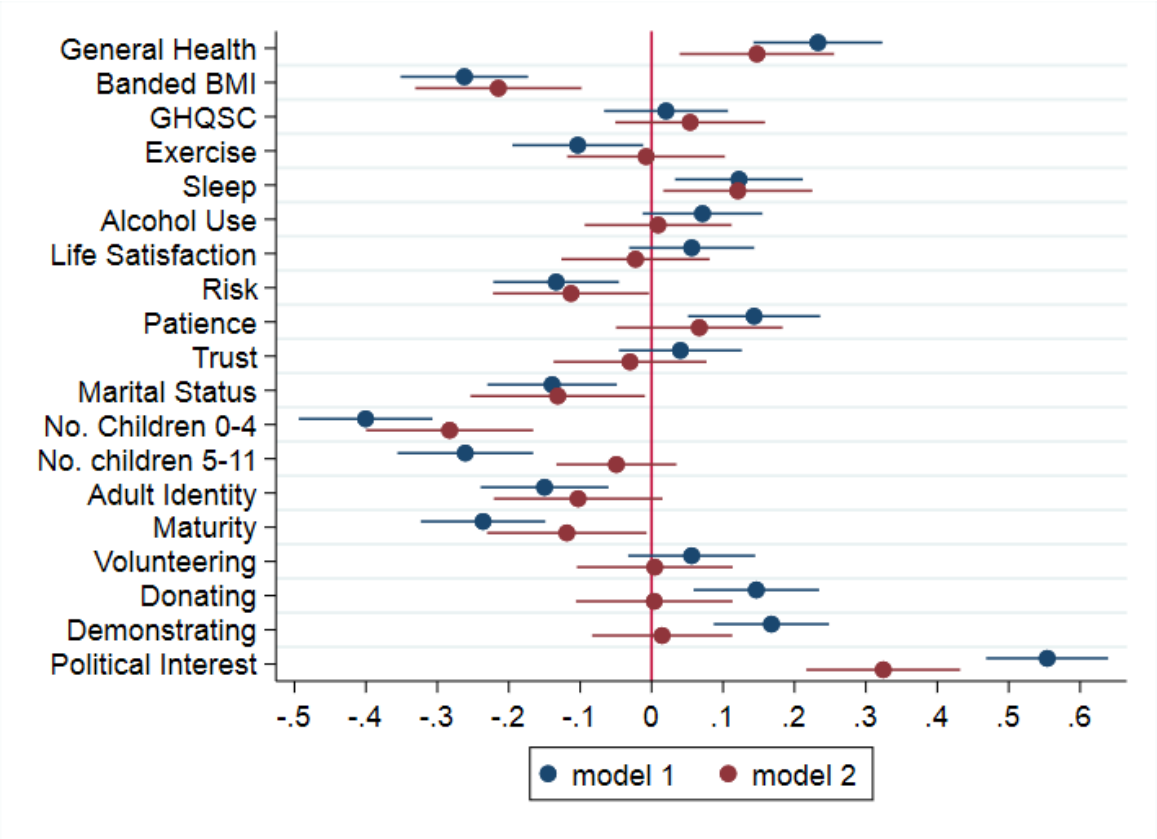


Figure B.3: Degree effects by gender (controlled for income)

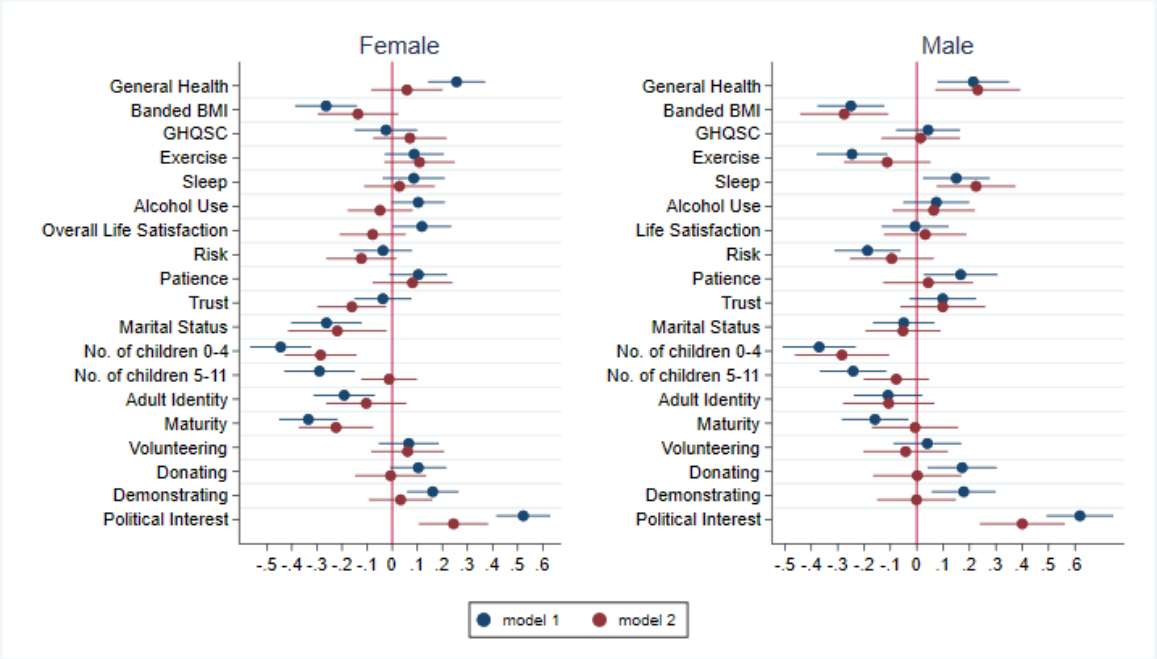


Figure B.4: Degree effects by Institution type (controlled for income)

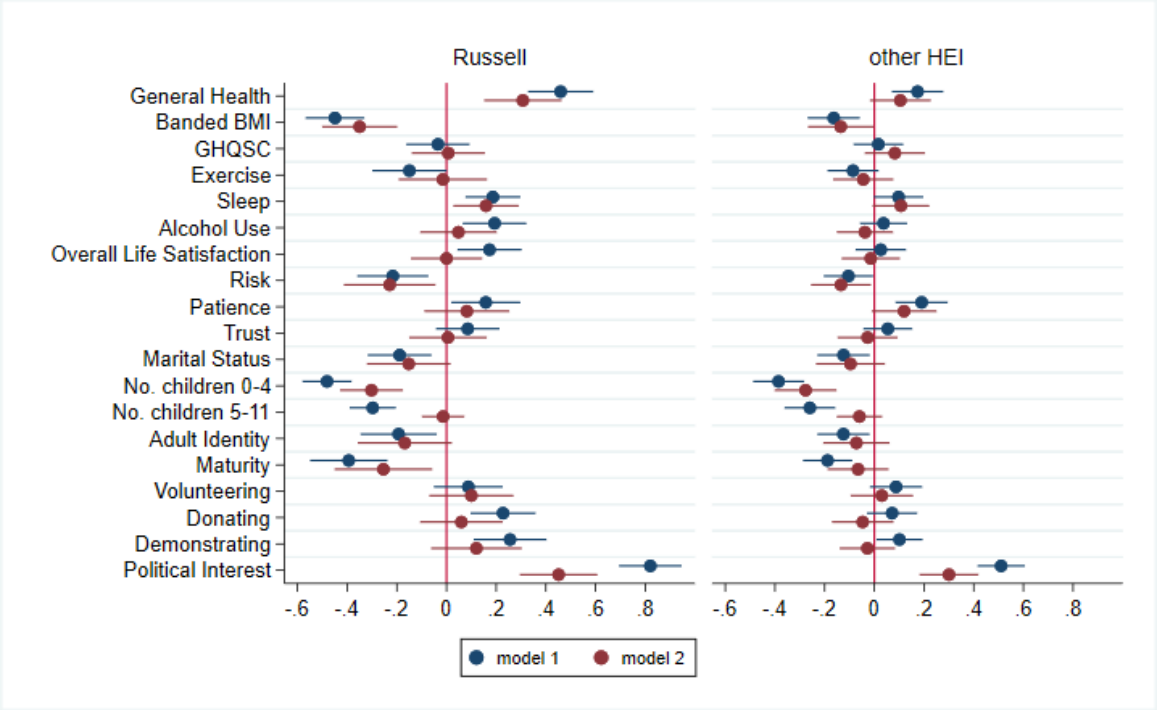


Figure B.5: Degree effects by Degree Subject (controlled for income)

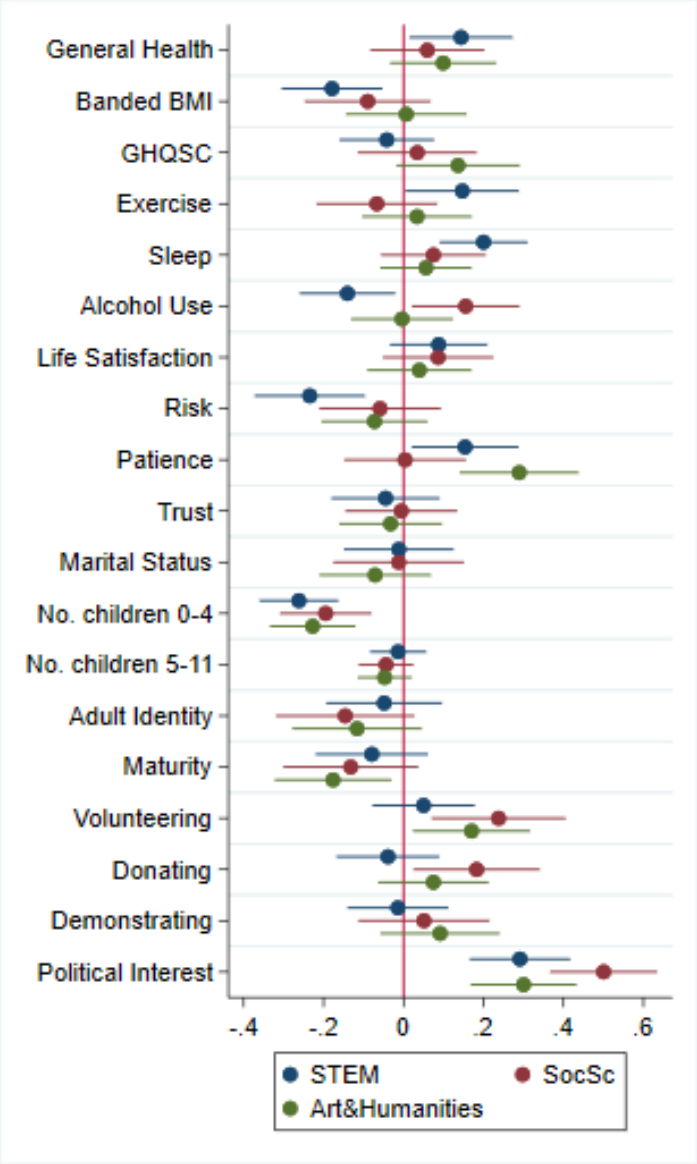


Figure B.6: Degree effecs by Subjects (controlled for income)

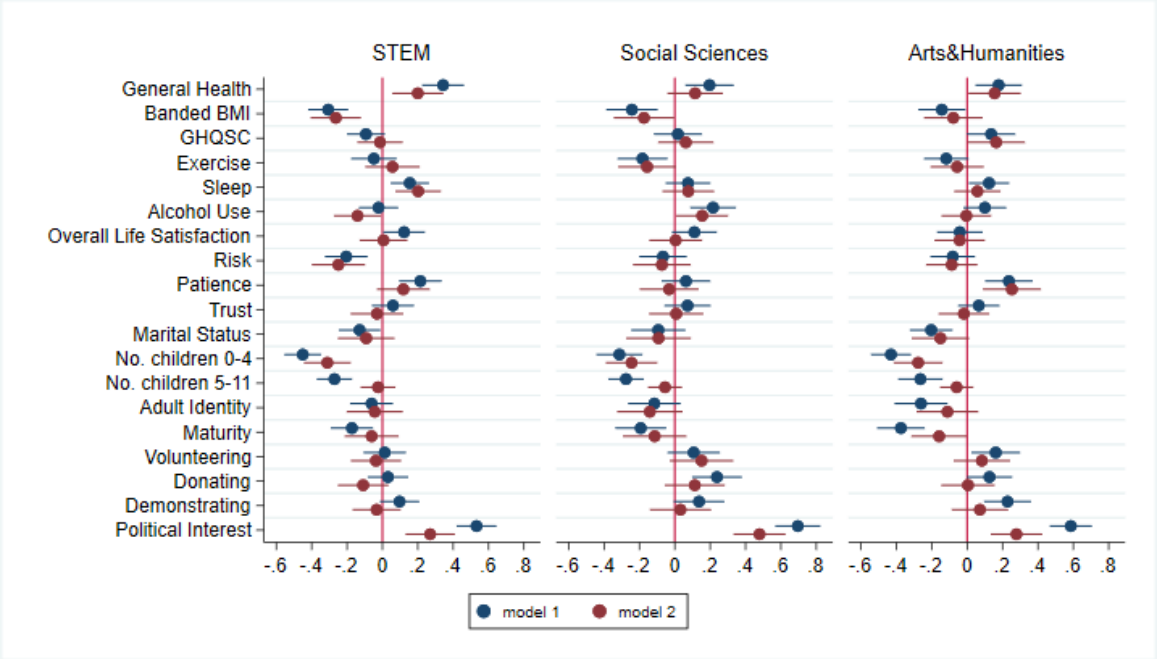


Figure B.7: Degree effects by Subject x Institution type (controlled for income)

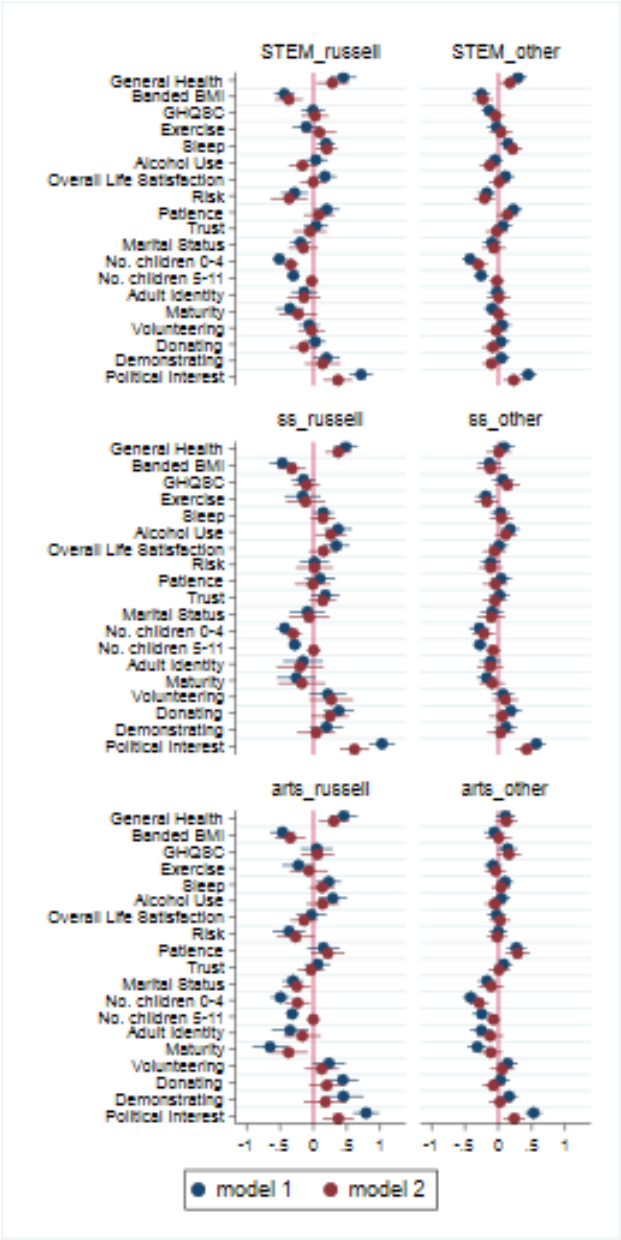
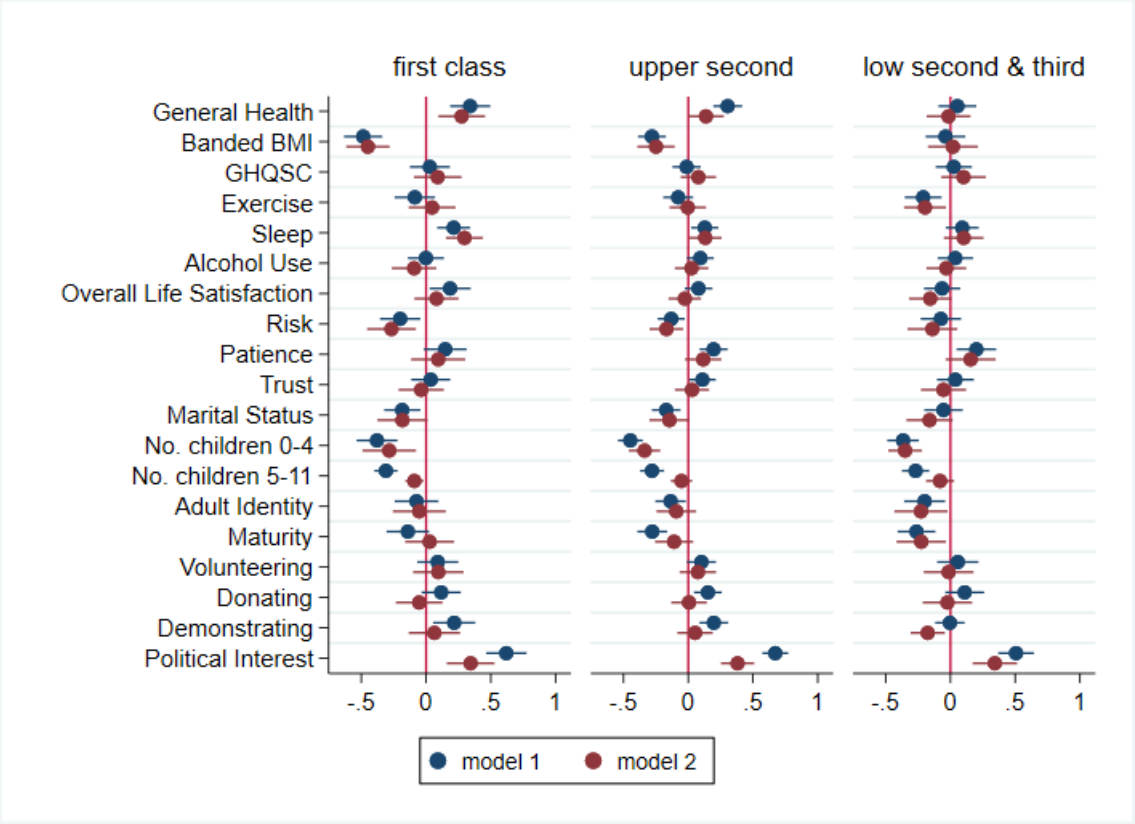


Figure B.9: Degree effects by Degree Subject x Institution type (controlled for income)

Figure B.8: Degree effects by classification



B.3 selected coefplots on restricted sample (2+ A levels)

Figure B.10: Coefplot of degree effects (pooled) on restricted sample (2+ A levels)

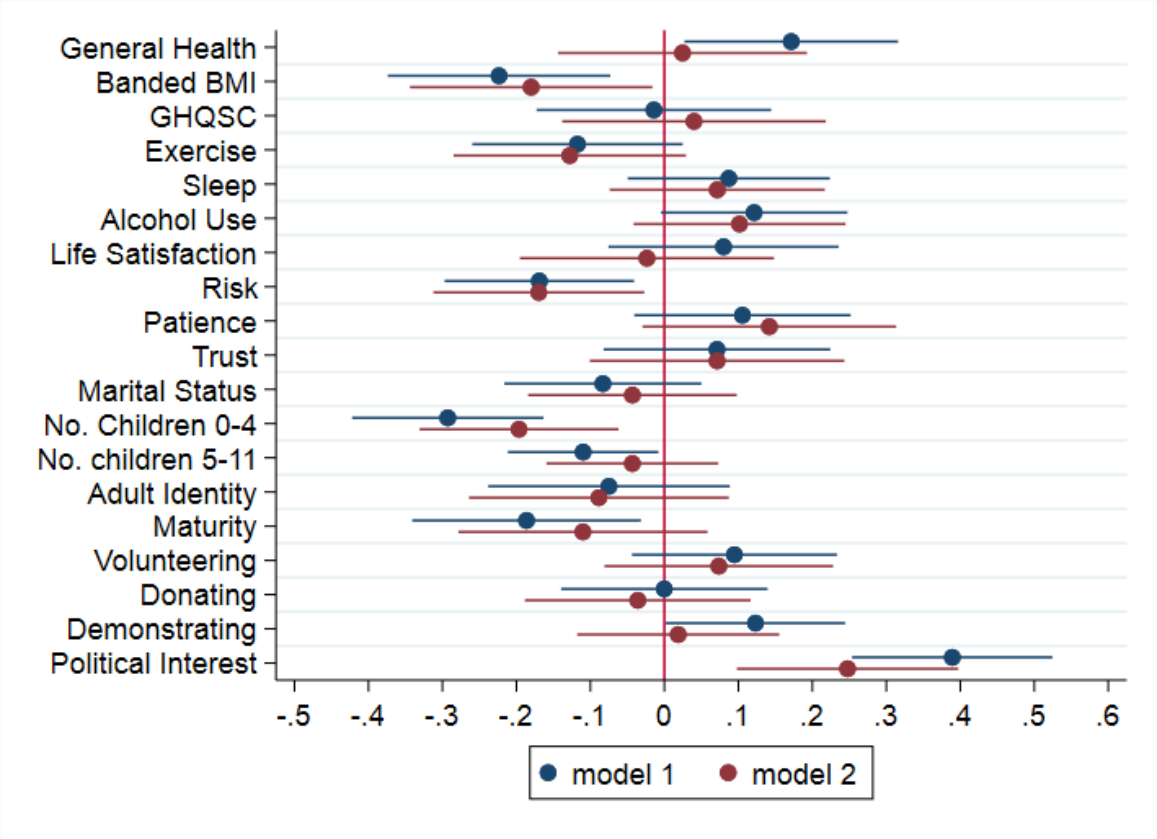


Figure B.11: Degree effects by Institution type (on restricted sample: 2+ A levels)

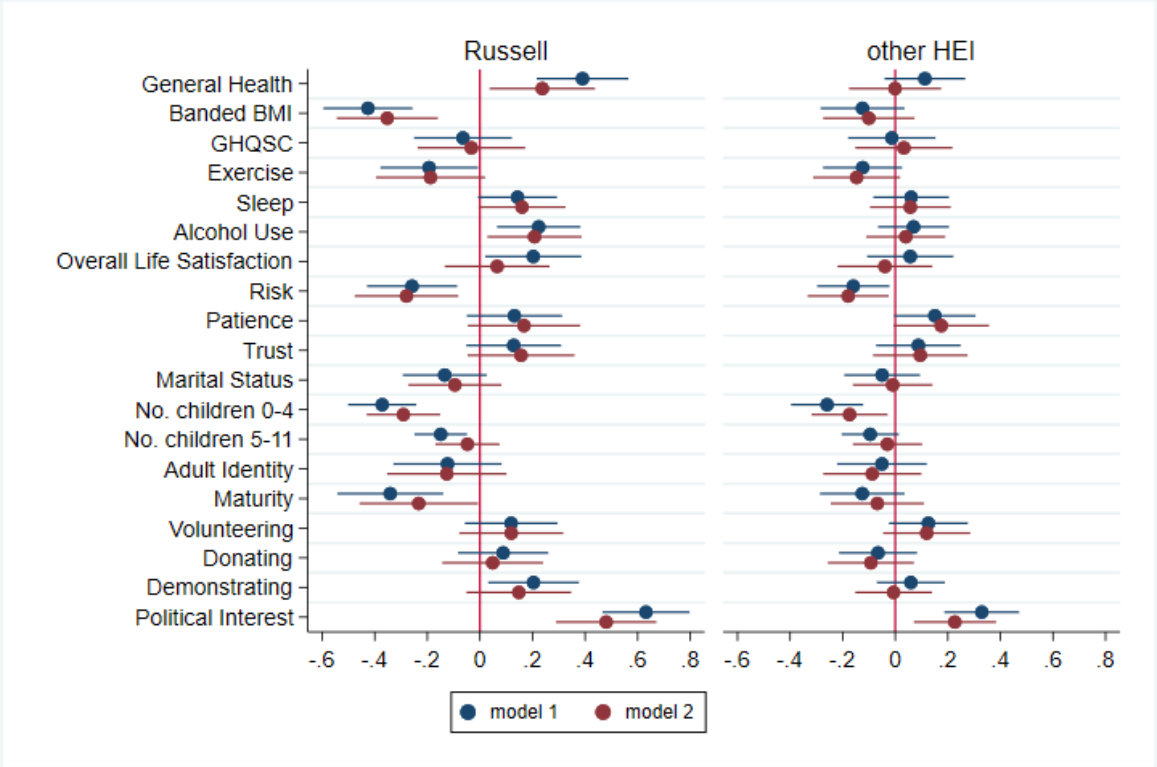
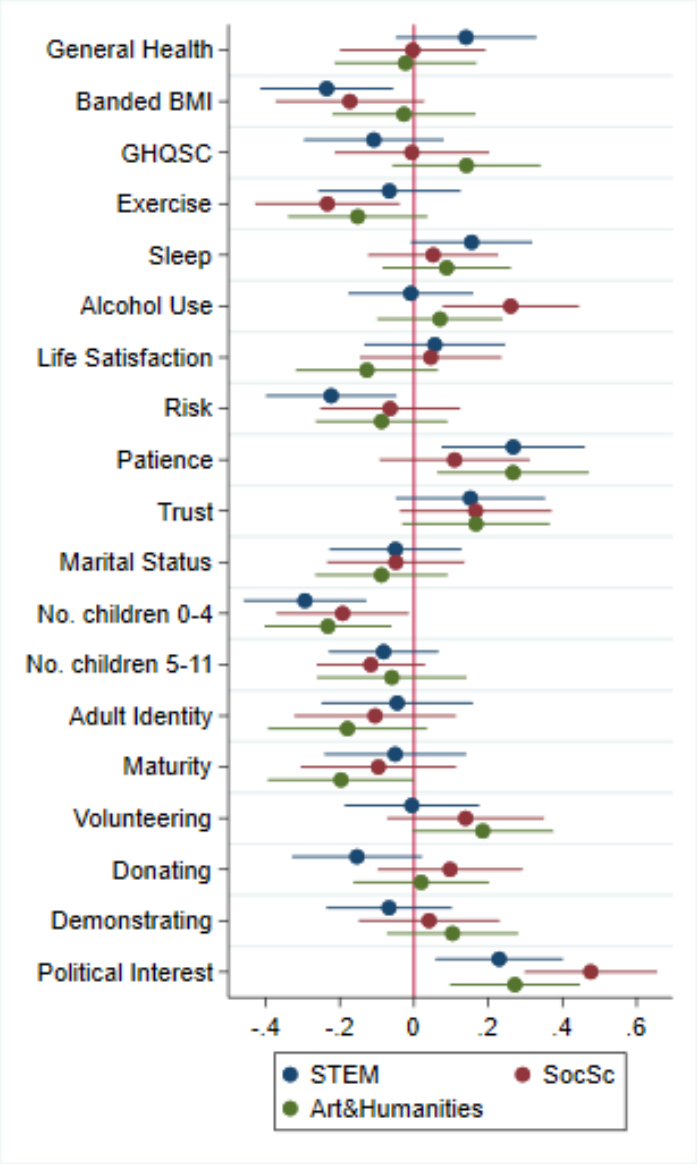


Figure B.12: Degree effects by Degree Subject (on restricted sample: 2+ A levels)



B.4 Oster's analysis on sensitivity to selection

Table B.20: bias-adjusted treatment estimates - health outcomes

	General Health		BMI		GHQSC		Exercise		Sleep		Alcohol Use		Life Satisfaction	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
original coefficient	0.236***	0.0996*	-0.260***	-0.206***	0.0147	0.0592	-0.0863*	-0.0686	0.120***	0.0917*	0.0886**	-0.0171	0.0510	-0.0112
	(0.0459)	(0.0517)	(0.0455)	(0.0527)	(0.0443)	(0.0517)	(0.0461)	(0.0524)	(0.0455)	(0.0517)	(0.0422)	(0.0485)	(0.0447)	(0.0509)
bias adj. beta (delta=1)	0.446	0.0085	-0.361	-0.196	0.0330	0.108	-0.108	-0.0642	0.125	0.0478	0.114*	-0.0631	-0.0036	-0.101
	(10.67)	(0.0992)	(2.304)	(0.185)	(0.657)	(0.113)	(0.0669)	(0.0807)	(2.031)	(0.140)	(0.0532)	(0.0691)	(0.0873)	(0.0816)
bias adj. beta (delta=2)	0.198	0.681	-0.0839	-0.152	0.0672	0.214	-0.144	-0.0552	0.148	0.386**	0.154	-0.161	0.424*	0.661
		(0.315)	(0.118)	(0.132)	(0.0929)	(0.260)	(0.176)	(0.147)	(0.0832)	(0.145)	(0.169)	(0.255)	(0.193)	(0.348)
delta for beta=0	0.940	1.067	1.061	1.926	-1.036	-2.470	-31.209	3.193	1.790	1.535	-17.89	-0.548	0.946	-0.160
	(0.496)	(2.013)	(4.852)	(1.925)	(69.212)	(278.96)	(300.039)	(97.51)	(245.02)	(3.748)	(126.68)	(9.431)	(2.052)	(4.493)
N	4089	3312	4089	3312	4089	3312	4089	3312	4089	3312	4089	3312	4089	3312

Table B.21: bias-adjusted treatment estimates - behavioral outcomes

	Risk		Patience		Trust		Marital Status		No. of children 0-4		No. of children 5-11	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
original coefficient	-0.113***	-0.154***	0.141***	0.0734	0.0370	-0.0371	-0.150***	-0.119**	-0.411***	-0.228***	-0.270***	-0.0975*
	(0.0439)	(0.0508)	(0.0470)	(0.0554)	(0.0438)	(0.0521)	(0.0463)	(0.0545)	(0.0476)	(0.0549)	(0.0483)	(0.0538)
bias adj. beta (delta=1)	-0.148*	-0.213**	0.0533	-0.0095	0.0422	-0.0785	-0.171	-0.133	-0.271	-0.0411	-0.250	0.0225
	(0.0613)	(0.0751)	(0.565)	(0.115)	(0.436)	(0.0855)	(21.71)	(0.162)	(2.904)	(0.110)	(0.516)	(0.0888)
bias adj. beta (delta=2)	-0.207	-0.397	0.278**	0.496*	0.0506	-0.176	-0.210	-0.163	-0.593***	-0.784*	-0.407**	-0.631*
	(0.220)	(0.257)	(0.0925)	(0.217)	(0.0792)	(0.195)	(0.145)	(0.147)	(0.155)	(0.316)	(0.125)	(0.301)
delta for beta=0	-10.424	-12.810	1.199	0.912	11.407	-1.531	5.203	4.319	1.185***	1.137	1.386**	0.846
	(1026.26)	(221.88)	(0.805)	(3.183)	(514.59)	(217.69)	(48.79)	(251.08)	(0.310)	(0.837)	(0.489)	(1.467)
N	4089	3312	4089	3312	4089	3312	4089	3312	4089	3312	4089	3312

Table B.22: bias-adjusted treatment estimates - social outcomes

	Adult Identity		Maturity		Volunteering		Donating		Demonstrating		Political Interest	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
original coefficient	-0.148***	-0.101*	-0.244***	-0.109**	0.0557	-0.000736	0.141***	0.0197	0.170***	0.0762*	0.573***	0.307***
	(0.0457)	(0.0540)	(0.0443)	(0.0517)	(0.0453)	(0.0517)	(0.0445)	(0.0493)	(0.0411)	(0.0459)	(0.0429)	(0.0485)
bias adj. beta (delta=1)	-0.165	-0.0697	-0.209	0.0195	-0.0064	-0.0709	0.0289	-0.128	0.171	0.0035	0.391*	-0.001
	(1.216)	(0.120)	(14.766)	(0.0959)	(0.128)	(0.0672)	(0.101)	(0.0936)	(2.338)	(0.0921)	(0.155)	(0.110)
bias adj. beta (delta=2)	0.0096	0.0482	-0.467***	-0.690*	0.331*	0.325	0.571*	0.643	0.193*	0.465*	1.024***	1.354***
	(0.103)	(0.142)	(0.127)	(0.336)	(0.150)	(0.175)	(0.225)	(0.353)	(0.0962)	(0.205)	(0.194)	(0.344)
delta for beta=0	2.114	1.865	1.580*	0.883	0.916	-0.0114	1.173	0.143	1.541	1.034	1.334***	0.999**
	(7.657)	(4.370)	(0.786)	(1.545)	(1.809)	(3.091)	(0.958)	(1.640)	(4.045)	(2.619))	(0.242)	(0.368)
N	4089	3312	4089	3312	4089	3312	4089	3312	4089	3312	4089	3312

Appendix C

Add. Material Chapter 4

C.1 Wellbeing measures by gender

Table C.1: OLS estimates - Life Satisfaction by gender

	Female				Male			
	(1) satis	(2) satis	(3) satis	(4) satis	(5) satis	(6) satis	(7) satis	(8) satis
qual_1		0.0877***		0.0158**			0.0448***	-0.0498***
		(0.00630)		(0.00686)			(0.00671)	(0.00692)
ln_grsswk			0.148***	0.143***		0.348***		0.362***
			(0.00542)	(0.00591)		(0.00786)		(0.00816)
_60s	-0.0542***	-0.0597***	-0.0754***	-0.0756***	-0.136***	-0.189***	-0.137***	-0.189***
	(0.0105)	(0.0105)	(0.0105)	(0.0105)	(0.0101)	(0.0102)	(0.0101)	(0.0102)
_70s	0.0477***	0.0302***	0.0242**	0.0219**	-0.0783***	-0.139***	-0.0844***	-0.134***
	(0.0104)	(0.0105)	(0.0104)	(0.0105)	(0.0103)	(0.0103)	(0.0103)	(0.0104)
_80s	0.221***	0.199***	0.206***	0.203***	0.0549***	0.0304***	0.0475***	0.0376***
	(0.0104)	(0.0106)	(0.0105)	(0.0106)	(0.0104)	(0.0104)	(0.0105)	(0.0104)
_90s	0.220***	0.201***	0.220***	0.216***	0.0465***	0.0929***	0.0400***	0.102***
	(0.0142)	(0.0143)	(0.0142)	(0.0143)	(0.0150)	(0.0149)	(0.0150)	(0.0150)
nonwhite	-0.240***	-0.248***	-0.240***	-0.242***	-0.0901***	-0.0309**	-0.0963***	-0.0216*
	(0.0131)	(0.0131)	(0.0131)	(0.0131)	(0.0127)	(0.0127)	(0.0128)	(0.0128)
north	0.00356	0.00409	0.00779	0.00774	-0.000566	0.0180*	-0.000353	0.0184*
	(0.00949)	(0.00948)	(0.00947)	(0.00947)	(0.00998)	(0.00992)	(0.00998)	(0.00992)
south	-0.0293***	-0.0371***	-0.0453***	-0.0462***	-0.0203**	-0.0496***	-0.0256***	-0.0448***
	(0.00925)	(0.00927)	(0.00926)	(0.00927)	(0.00954)	(0.00952)	(0.00958)	(0.00954)
wales	0.0378***	0.0353***	0.0393***	0.0388***	0.0325**	0.0523***	0.0320**	0.0537***
	(0.0120)	(0.0120)	(0.0120)	(0.0120)	(0.0129)	(0.0128)	(0.0129)	(0.0128)
scotland	0.0880***	0.0854***	0.0831***	0.0828***	0.111***	0.111***	0.109***	0.113***
	(0.0110)	(0.0110)	(0.0110)	(0.0110)	(0.0116)	(0.0115)	(0.0116)	(0.0115)
ireland	0.267***	0.266***	0.268***	0.268***	0.265***	0.289***	0.264***	0.291***
	(0.0230)	(0.0230)	(0.0230)	(0.0230)	(0.0256)	(0.0254)	(0.0256)	(0.0255)
N	255626	255626	255626	255626	204227	204227	204227	204227

C.1.1 Anxiousness

Table C.2: OLS estimates - Anxiousness by gender

	Female				Male			
	(1) anxious	(2) anxious	(3) anxious	(4) anxious	(5) anxious	(6) anxious	(7) anxious	(8) anxious
qual_1		0.182***		0.198***			0.254***	0.295***
		(0.0118)		(0.0128)			(0.0122)	(0.0126)
ln_grsswk			0.0313***	-0.0331***		-0.0770***		-0.157***
			(0.00969)	(0.0106)		(0.0130)		(0.0135)
_60s	-0.0297	-0.0411**	-0.0342*	-0.0374**	0.0775***	0.0893***	0.0682***	0.0907***
	(0.0181)	(0.0181)	(0.0182)	(0.0182)	(0.0176)	(0.0177)	(0.0176)	(0.0177)
_70s	-0.130***	-0.166***	-0.135***	-0.164***	0.0677***	0.0810***	0.0330*	0.0545***
	(0.0183)	(0.0185)	(0.0184)	(0.0185)	(0.0181)	(0.0182)	(0.0181)	(0.0182)
_80s	-0.178***	-0.224***	-0.181***	-0.225***	-0.0731***	-0.0676***	-0.115***	-0.110***
	(0.0187)	(0.0190)	(0.0187)	(0.0190)	(0.0184)	(0.0185)	(0.0185)	(0.0185)
_90s	-0.115***	-0.155***	-0.115***	-0.159***	-0.231***	-0.241***	-0.268***	-0.294***
	(0.0267)	(0.0268)	(0.0267)	(0.0268)	(0.0267)	(0.0267)	(0.0267)	(0.0267)
nonwhite	0.0190	0.00197	0.0188	0.000568	0.185***	0.172***	0.149***	0.117***
	(0.0217)	(0.0218)	(0.0217)	(0.0218)	(0.0210)	(0.0211)	(0.0211)	(0.0212)
north	0.0467***	0.0478***	0.0476***	0.0470***	0.0469***	0.0428**	0.0481***	0.0400**
	(0.0171)	(0.0171)	(0.0171)	(0.0171)	(0.0176)	(0.0176)	(0.0176)	(0.0176)
south	0.144***	0.128***	0.141***	0.130***	0.187***	0.194***	0.157***	0.166***
	(0.0168)	(0.0168)	(0.0168)	(0.0168)	(0.0170)	(0.0170)	(0.0170)	(0.0171)
wales	0.0114	0.00619	0.0117	0.00538	0.0325	0.0281	0.0296	0.0202
	(0.0217)	(0.0217)	(0.0217)	(0.0217)	(0.0227)	(0.0227)	(0.0227)	(0.0227)
scotland	-0.0965***	-0.102***	-0.0976***	-0.101***	-0.0876***	-0.0878***	-0.0941***	-0.0955***
	(0.0202)	(0.0202)	(0.0202)	(0.0202)	(0.0209)	(0.0209)	(0.0208)	(0.0208)
ireland	-0.199***	-0.201***	-0.199***	-0.201***	-0.160***	-0.165***	-0.168***	-0.180***
	(0.0429)	(0.0429)	(0.0429)	(0.0429)	(0.0462)	(0.0462)	(0.0463)	(0.0462)
N	255505	255505	255505	255505	204087	204087	204087	204087

Table C.3: OLS estimates - Happiness by gender

	Female				Male			
	(1) happy	(2) happy	(3) happy	(4) happy	(5) happy	(6) happy	(7) happy	(8) happy
qual_1		0.0769***		0.0550***			0.0218**	-0.0194**
		(0.00824)		(0.00901)			(0.00875)	(0.00907)
ln_grsswk			0.0614***	0.0435***		0.152***		0.157***
			(0.00691)	(0.00756)		(0.00972)		(0.0101)
_60s	-0.0864***	-0.0913***	-0.0952***	-0.0961***	-0.153***	-0.176***	-0.153***	-0.176***
	(0.0130)	(0.0130)	(0.0131)	(0.0131)	(0.0128)	(0.0129)	(0.0128)	(0.0129)
_70s	-0.0176	-0.0329**	-0.0274**	-0.0354***	-0.144***	-0.171***	-0.147***	-0.169***
	(0.0131)	(0.0132)	(0.0131)	(0.0132)	(0.0131)	(0.0132)	(0.0131)	(0.0132)
_80s	0.0508***	0.0312**	0.0445***	0.0324**	-0.0905***	-0.101***	-0.0940***	-0.0984***
	(0.0133)	(0.0135)	(0.0134)	(0.0135)	(0.0135)	(0.0135)	(0.0136)	(0.0136)
_90s	0.0228	0.00563	0.0227	0.0104	-0.0762***	-0.0559***	-0.0793***	-0.0524***
	(0.0191)	(0.0193)	(0.0191)	(0.0193)	(0.0202)	(0.0202)	(0.0202)	(0.0203)
nonwhite	-0.0280*	-0.0351**	-0.0282*	-0.0333**	0.164***	0.190***	0.161***	0.194***
	(0.0159)	(0.0160)	(0.0159)	(0.0159)	(0.0151)	(0.0151)	(0.0151)	(0.0152)
north	-0.0158	-0.0153	-0.0141	-0.0142	-0.0390***	-0.0309**	-0.0389***	-0.0307**
	(0.0123)	(0.0123)	(0.0123)	(0.0123)	(0.0129)	(0.0129)	(0.0129)	(0.0129)
south	-0.0124	-0.0193	-0.0190	-0.0220*	-0.0312**	-0.0439***	-0.0337***	-0.0421***
	(0.0120)	(0.0120)	(0.0120)	(0.0120)	(0.0124)	(0.0124)	(0.0124)	(0.0124)
wales	0.0418***	0.0397***	0.0425***	0.0407***	0.0224	0.0311*	0.0221	0.0316*
	(0.0154)	(0.0154)	(0.0154)	(0.0154)	(0.0167)	(0.0167)	(0.0167)	(0.0167)
scotland	0.0729***	0.0706***	0.0708***	0.0698***	0.0628***	0.0631***	0.0622***	0.0636***
	(0.0143)	(0.0143)	(0.0143)	(0.0143)	(0.0153)	(0.0153)	(0.0153)	(0.0153)
ireland	0.328***	0.327***	0.328***	0.327***	0.336***	0.347***	0.336***	0.348***
	(0.0297)	(0.0297)	(0.0297)	(0.0297)	(0.0319)	(0.0319)	(0.0319)	(0.0319)
N	255601	255601	255601	255601	204223	204223	204223	204223

Table C.4: OLS estimates - Things in life worthwhile by gender

	Female				Male			
	(1) worth	(2) worth	(3) worth	(4) worth	(5) worth	(6) worth	(7) worth	(8) worth
qual_1		0.110***		0.0804***			0.0718***	-0.000360
		(0.00593)		(0.00648)			(0.00668)	(0.00690)
ln_grsswk			0.0850***	0.0589***		0.276***		0.276***
			(0.00503)	(0.00549)		(0.00760)		(0.00788)
_60s	-0.108***	-0.115***	-0.120***	-0.121***	-0.151***	-0.194***	-0.154***	-0.194***
	(0.00929)	(0.00930)	(0.00933)	(0.00932)	(0.00956)	(0.00962)	(0.00956)	(0.00962)
_70s	-0.0541***	-0.0760***	-0.0676***	-0.0795***	-0.131***	-0.179***	-0.141***	-0.179***
	(0.00928)	(0.00936)	(0.00932)	(0.00937)	(0.00977)	(0.00986)	(0.00983)	(0.00989)
_80s	-0.0115	-0.0394***	-0.0201**	-0.0379***	-0.146***	-0.166***	-0.158***	-0.166***
	(0.00953)	(0.00966)	(0.00954)	(0.00965)	(0.0102)	(0.0102)	(0.0103)	(0.0102)
_90s	-0.104***	-0.129***	-0.104***	-0.122***	-0.224***	-0.188***	-0.235***	-0.187***
	(0.0140)	(0.0141)	(0.0140)	(0.0141)	(0.0159)	(0.0158)	(0.0159)	(0.0159)
nonwhite	-0.103***	-0.114***	-0.104***	-0.111***	0.0419***	0.0883***	0.0319***	0.0884***
	(0.0119)	(0.0119)	(0.0119)	(0.0119)	(0.0120)	(0.0119)	(0.0120)	(0.0120)
north	0.0394***	0.0401***	0.0419***	0.0416***	0.0261***	0.0408***	0.0264***	0.0408***
	(0.00880)	(0.00879)	(0.00879)	(0.00879)	(0.00975)	(0.00971)	(0.00975)	(0.00971)
south	-0.0409***	-0.0507***	-0.0501***	-0.0545***	-0.0336***	-0.0568***	-0.0421***	-0.0567***
	(0.00865)	(0.00867)	(0.00867)	(0.00867)	(0.00942)	(0.00941)	(0.00945)	(0.00943)
wales	0.0193*	0.0162	0.0202*	0.0177	0.0639***	0.0798***	0.0632***	0.0798***
	(0.0111)	(0.0111)	(0.0111)	(0.0111)	(0.0125)	(0.0124)	(0.0124)	(0.0124)
scotland	0.0604***	0.0571***	0.0576***	0.0561***	0.102***	0.103***	0.101***	0.103***
	(0.0102)	(0.0102)	(0.0102)	(0.0102)	(0.0113)	(0.0113)	(0.0113)	(0.0113)
ireland	0.273***	0.272***	0.273***	0.273***	0.277***	0.296***	0.275***	0.296***
	(0.0212)	(0.0212)	(0.0212)	(0.0212)	(0.0254)	(0.0253)	(0.0254)	(0.0253)
N	255324	255324	255324	255324	203899	203899	203899	203899

C.2 Wellbeing measures by subjects& gender

Table C.5: OLS estimates - Life satisfaction by subjects

	(1) satis	(2) satis	(3) satis	(4) satis
qual_1	0.0158**		-0.0498***	
	(0.00686)		(0.00692)	
stem		0.0727***		-0.0454***
		(0.00972)		(0.00920)
lem		0.0410		0.00578
		(0.0325)		(0.0322)
socsc		0.00978		-0.0155
		(0.0121)		(0.0132)
arts		0.0189*		-0.0996***
		(0.0105)		(0.0145)
ln_grsswk	0.143***	0.138***	0.362***	0.356***
	(0.00591)	(0.00574)	(0.00816)	(0.00807)
_60s	-0.0756***	-0.0764***	-0.189***	-0.189***
	(0.0105)	(0.0105)	(0.0102)	(0.0102)
_70s	0.0219**	0.0201*	-0.134***	-0.135***
	(0.0105)	(0.0105)	(0.0104)	(0.0104)
_80s	0.203***	0.200***	0.0376***	0.0363***
	(0.0106)	(0.0105)	(0.0104)	(0.0104)
_90s	0.216***	0.212***	0.102***	0.103***
	(0.0143)	(0.0143)	(0.0150)	(0.0150)
nonwhite	-0.242***	-0.241***	-0.0216*	-0.0318**
	(0.0131)	(0.0131)	(0.0128)	(0.0127)
north	0.00774	0.00709	0.0184*	0.0188*
	(0.00947)	(0.00947)	(0.00992)	(0.00992)
south	-0.0462***	-0.0460***	-0.0448***	-0.0472***
	(0.00927)	(0.00926)	(0.00954)	(0.00952)
wales	0.0388***	0.0375***	0.0537***	0.0540***
	(0.0120)	(0.0120)	(0.0128)	(0.0128)
scotland	0.0828***	0.0813***	0.113***	0.112***
	(0.0110)	(0.0110)	(0.0115)	(0.0115)
ireland	0.268***	0.268***	0.291***	0.289***
	(0.0230)	(0.0230)	(0.0255)	(0.0255)
N	255626	255626	204227	204227

Table C.6: OLS estimates - Anxiousness by subjects

	(1) anxious	(2) anxious	(3) anxious	(4) anxious
qual_1	0.198***		0.295***	
	(0.0128)		(0.0126)	
stem		0.0135		0.195***
		(0.0191)		(0.0175)
lem		0.216***		0.379***
		(0.0630)		(0.0639)
socsc		0.130***		0.233***
		(0.0238)		(0.0257)
arts		0.306***		0.437***
		(0.0205)		(0.0270)
ln_grsswk	-0.0331***	0.000362	-0.157***	-0.122***
	(0.0106)	(0.0103)	(0.0135)	(0.0134)
_60s	-0.0374**	-0.0355*	0.0907***	0.0867***
	(0.0182)	(0.0182)	(0.0177)	(0.0177)
_70s	-0.164***	-0.148***	0.0545***	0.0626***
	(0.0185)	(0.0184)	(0.0182)	(0.0182)
_80s	-0.225***	-0.204***	-0.110***	-0.0983***
	(0.0190)	(0.0189)	(0.0185)	(0.0185)
_90s	-0.159***	-0.145***	-0.294***	-0.292***
	(0.0268)	(0.0268)	(0.0267)	(0.0268)
nonwhite	0.000568	0.0262	0.117***	0.168***
	(0.0218)	(0.0217)	(0.0212)	(0.0212)
north	0.0470***	0.0465***	0.0400**	0.0382**
	(0.0171)	(0.0171)	(0.0176)	(0.0176)
south	0.130***	0.136***	0.166***	0.180***
	(0.0168)	(0.0168)	(0.0171)	(0.0170)
wales	0.00538	0.00759	0.0202	0.0197
	(0.0217)	(0.0217)	(0.0227)	(0.0227)
scotland	-0.101***	-0.0955***	-0.0955***	-0.0901***
	(0.0202)	(0.0202)	(0.0208)	(0.0208)
ireland	-0.201***	-0.193***	-0.180***	-0.168***
	(0.0429)	(0.0429)	(0.0462)	(0.0462)
N	255505	255505	204087	204087

Table C.7: OLS estimates - Happiness by subjects

	(1) happy	(2) happy	(3) happy	(4) happy
qual_1	0.0550***		-0.0194**	
	(0.00901)		(0.00907)	
stem		0.0686***		-0.0491***
		(0.0130)		(0.0123)
lem		0.0942**		0.105**
		(0.0426)		(0.0411)
socsc		0.0396**		-0.0185
		(0.0161)		(0.0176)
arts		0.0701***		-0.0327*
		(0.0138)		(0.0189)
ln_grsswk	0.0435***	0.0463***	0.157***	0.159***
	(0.00756)	(0.00732)	(0.0101)	(0.00998)
_60s	-0.0961***	-0.0965***	-0.176***	-0.175***
	(0.0131)	(0.0131)	(0.0129)	(0.0129)
_70s	-0.0354***	-0.0336**	-0.169***	-0.168***
	(0.0132)	(0.0132)	(0.0132)	(0.0132)
_80s	0.0324**	0.0344**	-0.0984***	-0.0970***
	(0.0135)	(0.0135)	(0.0136)	(0.0136)
_90s	0.0104	0.00946	-0.0524***	-0.0486**
	(0.0193)	(0.0193)	(0.0203)	(0.0203)
nonwhite	-0.0333**	-0.0280*	0.194***	0.191***
	(0.0159)	(0.0159)	(0.0152)	(0.0152)
north	-0.0142	-0.0150	-0.0307**	-0.0304**
	(0.0123)	(0.0123)	(0.0129)	(0.0129)
south	-0.0220*	-0.0206*	-0.0421***	-0.0426***
	(0.0120)	(0.0120)	(0.0124)	(0.0124)
wales	0.0407***	0.0401***	0.0316*	0.0322*
	(0.0154)	(0.0154)	(0.0167)	(0.0167)
scotland	0.0698***	0.0695***	0.0636***	0.0638***
	(0.0143)	(0.0144)	(0.0153)	(0.0153)
ireland	0.327***	0.329***	0.348***	0.348***
	(0.0297)	(0.0297)	(0.0319)	(0.0319)
N	255601	255601	204223	204223

Table C.8: OLS estimates - Things in life worthwhile by subjects

	(1) worth	(2) worth	(3) worth	(4) worth
qual_1	0.0804***		-0.000360	
	(0.00648)		(0.00690)	
stem		0.142***		-0.00449
		(0.00937)		(0.00934)
lem		0.0270		0.0431
		(0.0313)		(0.0330)
socsc		0.0404***		-0.0196
		(0.0116)		(0.0135)
arts		0.122***		0.0423***
		(0.0101)		(0.0152)
ln_grsswk	0.0589***	0.0594***	0.276***	0.277***
	(0.00549)	(0.00532)	(0.00788)	(0.00779)
_60s	-0.121***	-0.122***	-0.194***	-0.194***
	(0.00932)	(0.00933)	(0.00962)	(0.00962)
_70s	-0.0795***	-0.0784***	-0.179***	-0.179***
	(0.00937)	(0.00935)	(0.00989)	(0.00988)
_80s	-0.0379***	-0.0375***	-0.166***	-0.166***
	(0.00965)	(0.00961)	(0.0102)	(0.0102)
_90s	-0.122***	-0.127***	-0.187***	-0.188***
	(0.0141)	(0.0141)	(0.0159)	(0.0159)
nonwhite	-0.111***	-0.102***	0.0884***	0.0900***
	(0.0119)	(0.0119)	(0.0120)	(0.0120)
north	0.0416***	0.0405***	0.0408***	0.0407***
	(0.00879)	(0.00879)	(0.00971)	(0.00971)
south	-0.0545***	-0.0524***	-0.0567***	-0.0571***
	(0.00867)	(0.00867)	(0.00943)	(0.00942)
wales	0.0177	0.0162	0.0798***	0.0796***
	(0.0111)	(0.0111)	(0.0124)	(0.0124)
scotland	0.0561***	0.0549***	0.103***	0.104***
	(0.0102)	(0.0102)	(0.0113)	(0.0113)
ireland	0.273***	0.276***	0.296***	0.297***
	(0.0212)	(0.0212)	(0.0253)	(0.0253)
N	255324	255324	203899	203899

C.3 Oster by gender

Table C.9: OLS estimates & Oster test for all well-being measures - Females

	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
	satis	satis	anxious	anxious	happy	happy	worth	worth
_60s	-0.0597***	-0.0756***	-0.0411**	-0.0374**	-0.0913***	-0.0961***	-0.115***	-0.121***
	(0.0105)	(0.0105)	(0.0181)	(0.0182)	(0.0130)	(0.0131)	(0.00930)	(0.00932)
_70s	0.0302***	0.0219**	-0.166***	-0.164***	-0.0329**	-0.0354***	-0.0760***	-0.0795***
	(0.0105)	(0.0105)	(0.0185)	(0.0185)	(0.0132)	(0.0132)	(0.00936)	(0.00937)
_80s	0.199***	0.203***	-0.224***	-0.225***	0.0312**	0.0324**	-0.0394***	-0.0379***
	(0.0106)	(0.0106)	(0.0190)	(0.0190)	(0.0135)	(0.0135)	(0.00966)	(0.00965)
_90s	0.201***	0.216***	-0.155***	-0.159***	0.00563	0.0104	-0.129***	-0.122***
	(0.0143)	(0.0143)	(0.0268)	(0.0268)	(0.0193)	(0.0193)	(0.0141)	(0.0141)
nonwhite	-0.248***	-0.242***	0.00197	0.000568	-0.0351**	-0.0333**	-0.114***	-0.111***
	(0.0131)	(0.0131)	(0.0218)	(0.0218)	(0.0160)	(0.0159)	(0.0119)	(0.0119)
north	0.00409	0.00774	0.0478***	0.0470***	-0.0153	-0.0142	0.0401***	0.0416***
	(0.00948)	(0.00947)	(0.0171)	(0.0171)	(0.0123)	(0.0123)	(0.00879)	(0.00879)
south	-0.0371***	-0.0462***	0.128***	0.130***	-0.0193	-0.0220*	-0.0507***	-0.0545***
	(0.00927)	(0.00927)	(0.0168)	(0.0168)	(0.0120)	(0.0120)	(0.00867)	(0.00867)
wales	0.0353***	0.0388***	0.00619	0.00538	0.0397***	0.0407***	0.0162	0.0177
	(0.0120)	(0.0120)	(0.0217)	(0.0217)	(0.0154)	(0.0154)	(0.0111)	(0.0111)
scotland	0.0854***	0.0828***	-0.102***	-0.101***	0.0706***	0.0698***	0.0571***	0.0561***
	(0.0110)	(0.0110)	(0.0202)	(0.0202)	(0.0143)	(0.0143)	(0.0102)	(0.0102)
ireland	0.266***	0.268***	-0.201***	-0.201***	0.327***	0.327***	0.272***	0.273***
	(0.0230)	(0.0230)	(0.0429)	(0.0429)	(0.0297)	(0.0297)	(0.0212)	(0.0212)
qual_1	0.0877***	0.0158**	0.182***	0.198***	0.0769***	0.0550***	0.110***	0.0804***
	(0.00630)	(0.00686)	(0.0118)	(0.0128)	(0.00824)	(0.00901)	(0.00593)	(0.00648)
ln_grsswk		0.143***		-0.0331***		0.0435***		0.0589***
		(0.00591)		(0.0106)		(0.00756)		(0.00549)
Oster test								
bias adj. beta (delta=1)	0.0805***	-0.0210*	0.193***	0.220***	0.0742***	0.0419***	0.115***	0.0715***
	(0.00672)	(0.00942)	(0.0109)	(0.0121)	(0.00835)	(0.0115)	(0.00562)	(0.00814)
bias adj. beta (delta=2)	0.0731***	-0.0688***	0.204***	0.249***	0.0713***	0.0253	0.121***	0.0604***
	(0.00772)	(0.0178)	(0.0107)	(0.0308)	(0.00965)	(0.0193)	(0.00561)	(0.0118)
delta for beta=0	8.276***	0.445*	-9.583***	-92.889	11.449**	2.912	-17.031**	3.979***
	(8.276)	(0.209)	(2.462)	(637.497)	(4.387)	(1.620)	(5.464)	(0.935)
N	255626	255626	255505	255505	255601	255601	255324	255324

Table C.10: OLS estimates & Oster test for all well-being measures - Males

	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
	satis	satis	anxious	anxious	happy	happy	worth	worth
_60s	-0.137***	-0.189***	0.0682***	0.0907***	-0.153***	-0.176***	-0.154***	-0.194***
	(0.0101)	(0.0102)	(0.0176)	(0.0177)	(0.0128)	(0.0129)	(0.00956)	(0.00962)
_70s	-0.0844***	-0.134***	0.0330*	0.0545***	-0.147***	-0.169***	-0.141***	-0.179***
	(0.0103)	(0.0104)	(0.0181)	(0.0182)	(0.0131)	(0.0132)	(0.00983)	(0.00989)
_80s	0.0475***	0.0376***	-0.115***	-0.110***	-0.0940***	-0.0984***	-0.158***	-0.166***
	(0.0105)	(0.0104)	(0.0185)	(0.0185)	(0.0136)	(0.0136)	(0.0103)	(0.0102)
_90s	0.0400***	0.102***	-0.268***	-0.294***	-0.0793***	-0.0524***	-0.235***	-0.187***
	(0.0150)	(0.0150)	(0.0267)	(0.0267)	(0.0202)	(0.0203)	(0.0159)	(0.0159)
nonwhite	-0.0963***	-0.0216*	0.149***	0.117***	0.161***	0.194***	0.0319***	0.0884***
	(0.0128)	(0.0128)	(0.0211)	(0.0212)	(0.0151)	(0.0152)	(0.0120)	(0.0120)
north	-0.000353	0.0184*	0.0481***	0.0400**	-0.0389***	-0.0307**	0.0264***	0.0408***
	(0.00998)	(0.00992)	(0.0176)	(0.0176)	(0.0129)	(0.0129)	(0.00975)	(0.00971)
south	-0.0256***	-0.0448***	0.157***	0.166***	-0.0337***	-0.0421***	-0.0421***	-0.0567***
	(0.00958)	(0.00954)	(0.0170)	(0.0171)	(0.0124)	(0.0124)	(0.00945)	(0.00943)
wales	0.0320**	0.0537***	0.0296	0.0202	0.0221	0.0316*	0.0632***	0.0798***
	(0.0129)	(0.0128)	(0.0227)	(0.0227)	(0.0167)	(0.0167)	(0.0124)	(0.0124)
scotland	0.109***	0.113***	-0.0941***	-0.0955***	0.0622***	0.0636***	0.101***	0.103***
	(0.0116)	(0.0115)	(0.0208)	(0.0208)	(0.0153)	(0.0153)	(0.0113)	(0.0113)
ireland	0.264***	0.291***	-0.168***	-0.180***	0.336***	0.348***	0.275***	0.296***
	(0.0256)	(0.0255)	(0.0463)	(0.0462)	(0.0319)	(0.0319)	(0.0254)	(0.0253)
qual_1	0.0448***	-0.0498***	0.254***	0.295***	0.0218**	-0.0194**	0.0718***	-0.000360
	(0.00671)	(0.00692)	(0.0122)	(0.0126)	(0.00875)	(0.00907)	(0.00668)	(0.00690)
ln_grsswk		0.362***		-0.157***		0.157***		0.276***
		(0.00816)		(0.0135)		(0.0101)		(0.00788)
Oster test								
bias adj. beta (delta=1)	0.0457***	-0.0796***	0.247***	0.311***	0.0212*	-0.0328**	0.0783***	-0.0179*
	(0.00697)	(0.00809)	(0.0137)	(0.0124)	(0.00852)	(0.0101)	(0.00633)	(0.00776)
bias adj. beta (delta=2)	0.0467***	-0.113***	0.240***	0.330***	0.0207*	-0.0476***	0.0850***	-0.0372***
	(0.00740)	(0.0116)	(0.0151)	(0.0139)	(0.00912)	(0.0134)	(0.00660)	(0.00995)
delta for beta=0	-128.071	-1.637***	9.0197***	48.493	26.308	-1.477	-8.122***	0.0211
	(3330.518)	(0.349)	(1.526)	(221.931)	(2307.602)	(1.336)	(2.241)	(0.422)
N	204227	204227	204087	204087	204223	204223	203899	203899

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