Caught in the Cycle: Timing of Enrollment and Labor Market Performance of University Graduates*

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Abstract

We explore the labor market outcomes of cohorts who select into university at different points in the business cycle. We find robust evidence that cohorts of graduates who select into university during worse economic times have better average labor market outcomes than those who select during better times. This difference is not explained by differences in the economic conditions at the time of college graduation, by changes in the composition of the cohorts in terms of field of study, or by changes in selection into occupations or industries. Overall, our results suggest that worsening macroeconomic conditions improve selection of students into university, or induce otherwise similar students to exert more effort to improve their labor market outcomes after graduation. This is also supported by the fact that cohorts that enroll in adverse economic conditions exhibit better college performance in terms of degree class achievement.

Keywords: Business Cycle, Higher Education, Cohort Effects

JEL Classification: I23, J24, J31, E32

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1 Introduction

A rich line of research on cohort effects has focused on the role that the macroeconomic conditions prevailing at key moments in people's life play for their current and future economic achievements. This literature has highlighted how cohorts' average wages at entry are important predictors of later wages (Beaudry and DiNardo 1991; Baker et al. 1994; Gibbons and Waldman 2006; Hagedorn and Manovskii 2013); how unemployment spells affect earnings long after the spell is terminated (Arulampalam 2001); how cohorts experiencing high levels of unemployment when finishing compulsory schooling select to stay in education more frequently (Betts and McFarland 1995; Dellas and Sakellaris 2003; Clark 2011), and choose a different mix of university majors (Blom et al. 2015); and how cohorts who happen to graduate in a recession earn less when entering the labor market (Kahn 2010; Oreopoulos et al. 2012; Altonji et al. 2016; Liu et al. 2016) and suffer from slower career progressions (Kwon et al. 2010) than those who happen to graduate in periods of economic expansion. Overall, this literature finds robust evidence on the persistent effect of macroeconomic history on future cohort-level outcomes.

So far, the literature has not considered the potential link between macroeconomic conditions experienced at the time of college enrollment and future labor market outcomes. This paper fills this gap. Specifically, we test whether changes in college enrollment driven by the business cycle affect cohorts' returns to tertiary education investments. To our knowledge this is the first paper establishing this empirical link. In doing so, we reveal how cohort effects operate also via the decision of investing in specialized human capital accumulation, a surprisingly neglected channel given the exceptional importance of this decision for future economic outcomes, as a large body of literature on returns to education systematically shows.[1]

Macroeconomic conditions may impact college enrollment decisions in various ways. On the one hand, recessions lower wages and worsen job prospects, thus reducing the opportunity cost of education and making investment into further education more attractive. On the other hand, in the presence of credit constraints, adverse economic conditions may worsen students' ability to pay for college or force them to take jobs to support their recession-affected families. Previous empirical evidence on economic fluctuations and college enrollment suggests that the effect of lower opportunity cost of going to college dominates the income effect. In particular, Betts and McFarland (1995) find that 1% increases in the unemployment rates of recent high school graduates are associated with rises in full-time attendance of about 0.5% for community college students in the US. Dellas and Sakellaris (2003) find the same counter-cyclical behavior in a sample of 2 and 4 years US college students and a significant substitution between investment into human capital and competing labor

[1] See Card (1999) and Altonji et al. (2015) for a survey of this vast literature.

market opportunities over the business cycle.[2] The same pattern is encountered by Clark (2011) on a sample of UK students, while Johnson (2013), who focuses on post-college education, finds that overall graduate school enrollment is counter-cyclical for females and acyclical for males. Evidence in Barr and Turner (2015) shows that the Great Recession led to a large increase in college enrollment in the US.

Such business-cycle related expansions will have important implications in terms of selection and average cohort quality. Most economic models imply positive selection of individuals into higher education, suggesting lower ability of the marginal entrants. Carneiro et al. (2011) and Carneiro and Lee (2011) find that increases in college enrollment lead to a decline in the average quality of college graduates between 1960 and 2000 in the US. However, the implications of business-cycle driven changes in enrollment have not been directly studied so far.[3]

Our analysis relies on data from the UK Quarterly Labour Force Survey (QLFS). We focus our analysis solely on college graduates.[4] Our empirical approach compares wage outcomes across cohorts who enroll at different points in the business cycle. To avoid issues related to changes in female selection into the labor market, we focus our analysis on men. The key advantage of the QLFS is that it provides precise information on the timing of graduation, which allows us to obtain a fairly precise estimate of the point in time when an individual makes their college enrollment decision. This is in contrast to the majority of previous studies (e.g. Betts and McFarland 1995; Dellas and Sakellaris 2003; Blom et al. 2015) that impute the starting time of college based on information on the highest level of education completed and the individual's date of birth. This type of imputation requires the assumption that students make their college enrollment decisions exclusively at the usual age of high-school graduation, an assumption that our dataset contradicts for a non-negligible proportion of college graduates.

As mentioned, our objective is to determine whether cohort-level wage outcomes vary systematically according to the macroeconomic conditions that prevail at the time of enrollment, where cohorts are defined by year of college enrollment. As is well known, identification of cohort effects on wages is challenging, due to the fact that it is not possible to simultaneously control for age, calendar year and cohort in a fully flexible way. Our identification approach assumes a common age-wage profile across cohorts and controls for time effects through a full set of calendar year fixed effects. We isolate variation across cohorts that is systematically related to the business cycle

[2] See also Méndez and Sepúlveda (2012).

[3] To the best of our knowledge, the only exception is Alessandrini (2017), who focuses on the effect of business-cycle driven changes in enrollment composition for intergenerational mobility.

[4] Throughout the paper we follow the convention in the literature to refer to university as "college". The group that would normally be referred to as college graduates in the UK (those who completed A-levels) are referred to in this paper as "high-school" graduates. More details about the UK education system are provided below.

conditions at the time of enrollment, proxied by the average unemployment rate in the three years leading up to the individual's year of enrollment. To check the robustness of our results, we also control for trends in cohort effects, so that identification is obtained solely from business-cycle related deviations from these longer-run trends.

Our key finding is that cohorts of university graduates who enroll during periods of higher unemployment have higher average wages later in life (controlling for standard age-wage profiles, time effects, and long-term trends in cohort quality). A 3 percentage point increase in the unemployment rate at the time of enrollment (approximately one standard deviation in the sample), increases average cohort wages by around 2.5%. This result is not driven by differential selection into employment. Through a series of quantile regressions, we find that the positive effect on wages is experienced throughout the cohort's wage distribution, with particularly pronounced effects in the upper half of the distribution. Interestingly, our result remains robust when we focus only on individuals who made their enrollment decision directly after high school graduation. Even though the probability of enrolling into university directly after high-school (and completing a university degree) does not seem to be affected by business cycle conditions in our sample, the results suggest that the macroeconomic conditions may induce differential selection of different types of students.

We explore a number of potential mechanisms through which this wage differential may arise. First, we consider the impact of the economic conditions at the time of graduation. Previous research has produced well-documented evidence of the negative impact of economic conditions at the time of college graduation on wages. Kahn (2010) finds large, negative and persistent effects of graduating from college into recession on wages and occupational attainment of white male college graduates from 1979-1989 in the US and the results are confirmed in Altonji et al. (2016) who combine several data source with information on earnings and field of study for US college graduates graduating between 1974 and 2011. Oreopoulos et al. (2012), using 20 years of longitudinal data on a sample of Canadian college graduates, estimate that a typical recession, with a rise in unemployment rates by 5 percentage points, causes an initial loss in earnings of about 9 percent and the negative effect lasts up to 10 years after labor market entry. Liu et al. (2016) find the same effect for Norway and attribute it to a degraded quality of first job match in the labor market. Provided that the unemployment rate when entering college and the unemployment rate at the time of graduation are negatively correlated, the positive impact of the recession at the time of college entry on wages that we identify may simply reflect the positive consequences of the boom at the time of graduation. We find, however, that adding controls for the economic conditions at the time of graduation to our wage equations does not alter our results.

Second, as returns to college vary substantially across fields of study (Altonji et al.

2012; Lemieux 2014), we explore the possibility that changes in field selection account for our findings. Recent evidence by Blom et al. (2015) suggests that the business cycle impacts students' major choices in the US (the so called "allocative margin"). They find that during recessions individuals tend to choose majors with higher wages and better employment prospects.[5] The impact of the economic conditions when entering college on the choice of major is therefore a natural candidate to explain the better labor market outcomes of cohorts who enter college in a recession. In our UK data, we find mixed evidence for reshuffling towards higher-paying majors. In particular, we find that the share of students in Engineering fields significantly increases, but the share of students graduating from other high-paying fields such as Business Administration and Law decreases. Importantly, when controlling for the field of study composition in our wage regressions, we still find that cohorts who enroll during worse economic times perform significantly better ex-post, even conditional on their field of graduation. In fact, when running our wage estimations separately by field, we find increases in average cohort wages within a wide range of fields, including Engineering. This, surprisingly, suggests that these marginal students who shift towards Engineering when economic conditions worsen actually increase the average quality of the graduating cohorts from this field.

Next, we explore whether differential selection into occupations or industries can account for our documented wage differences. Controlling for this channel, as well as the varying returns within occupations or industries across time periods and across individuals with different fields of study, reduces our estimated effect slightly. However, important wage differences remain even within occupation-field-year or industry-field-year cells.

Finally, we explore whether cohorts who enroll during poorer economic conditions perform better in college by looking at the composition of degree classification, which is a function of students' Grade Point Average (GPA). We observe that cohorts who enroll during periods of higher unemployment graduate with a higher proportion of 'upper class' degrees (higher GPAs). Surprisingly, however, controlling for individuals' degree classification does not reduce the estimated effect of macroeconomic conditions at enrollment on wages. This suggest that cohorts who enroll during worse economic conditions perform better ex-post, both in terms of their grades, and in terms of their wages conditional on their academic achievement.

Our results consistently suggest that cohorts who enroll in university during worse economic conditions are of better quality ex-post. This finding is consistent with at least two broad interpretations. First, the ability composition of college cohorts can change during recessions. The ability level for the marginal student who selects into tertiary education following a hike in the unemployment rate is arguably different than the average student who would have attended college regardless. However, both

[5]See also Goulas and Megalokonomou (2015) and Bradley (2012).

multiple and single ability type models would predict a fall in average wages as cohort size expands. A different mechanism would have to be at play in order to rationalize the entry of higher quality marginal individuals. The second interpretation has to do with an increase in effort exerted, either at university or in the labor market, for the high unemployment cohorts. This interpretation is consistent with a social psychology hypothesis known as the impressionable years hypothesis (Krosnick and Alwin 1987). This hypothesis has already proven useful for explaining changing preferences for redistribution between cohorts (Giuliano and Spilimbergo 2014), how individuals form expectations about inflation (Malmendier and Nagel 2016) and how experiences of macroeconomic outcomes have long-term effects on risk attitudes (Malmendier and Nagel 2011). According to this hypothesis, core attitudes, beliefs, and values crystallize during early adulthood. Our conjecture is that individuals who are selecting into college education in a bad labor market are particularly susceptible to concerns regarding economic outcomes, display a different approach to their college education, or are particularly motivated to excel. The higher wages that we estimate for these cohorts would be consistent with this mechanism. Our data do not allow us to disentangle between these two competing interpretations and we leave this task to future research.

This paper adds to the general literature on cohort effects by highlighting a previously disregarded channel; to the related, and still embryonic, literature on allocative margin by estimating, for the first time, the effects of business cycles on type of major selected in the UK; lastly, to the extensive margin literature by underscoring the importance of including returning students when analyzing the influence of unemployment on tertiary education investment decisions.

The rest of the paper is organized as follows. Section 2 provides some background information on the UK higher education system and on the evolution of the unemployment rate over the last five decades. Section 3 describes our dataset, provides some context about the UK education system, and discusses identification of cohort effects in our setting. Section 4 describes our empirical approach and presents the key results in terms of wage outcomes across cohorts. Section 5 explores various potential mechanisms through which these cohort-level wage differences may arise. Finally, Section 6 presents the conclusions.

2 Background

2.1 Higher Education System in the U.K.

In this paper we concentrate our analysis on people whose highest educational achievement is an undergraduate degree.[6] The British educational system is divided into four stages: early years, primary, secondary and a dual post-secondary stage which includes Further Education (FE) and Higher Education (HE) where FE covers non-advanced and vocational education while Higher Education is the Tertiary academic education as commonly intended.

Students usually complete the first three stages before turning 16, which marks the end of compulsory education, by taking a General Certificate of Secondary Education (GCSE) examination.[7] The GCSE diploma is required to continue on to post-compulsory studies, which involve two years of education leading to a standardized school-leaving qualification called 'A-levels' (short for General Certificate of Education (GCE) Advanced level). A-levels take two years of prepaparation which is offered either at the same Secondary School where the students studied towards the GCSE degree or in dedicated high schools called 'Sixth Form' high schools. Each student can decide to take three to four A-levels in their subjects of choice. Most universities require three A-levels for admission. In this paper we use the term 'high-school graduates' when referring to those individuals who are awarded at least one A level, but do not pursue a degree in Higher Education.

The last stage of education is either FE or HE, we are interested in the latter only. HE is defined as courses that are of a standard that is higher than GCE A-level. Students normally enter Higher Education as undergraduates from age 18 onward and can study towards both vocational and academic qualifications. After three to five years of studies, depending on the subject chosen, students successfully carrying out their undergraduate studies are awarded a bachelor degree. These are the individuals that our analysis concentrates and, in this paper, following the convention in the literature, we refer to them as 'college graduates'.

Lastly, students completing a bachelor degree can apply for postgraduate and graduate courses which include Masters, typically taken in one year, and Doctorates, typically taken in three to four years. We exclude these postgraduates students from our analysis.

[6] This is often referred to as a *first* degree in the British Higher Education system

[7] In England, compulsory education or training has been extended to 18 for those born on or after 1 September 1997.

2.2 Unemployment rate in the UK

We use the national unemployment rate as our indicator of labor market conditions. In the UK, the unemployment rate is measured by the ONS,[8] and the survey-based series has only been available on a consistent basis since 1971. Since our data includes cohorts of university graduates who enrolled between the early 1960s and 2013 we resort to unemployment figures based on administrative sources, available since 1881 (Denman and McDonald 1996), for the years before 1971.

We consider the national unemployment rate to be the relevant indicator for our population of reference, which is very mobile especially in the UK context where local labor markets are often geographically adjacent. This indicator is also more readily available to the public and therefore more salient and more likely to be acted upon by families and individuals when choosing whether to enter college. Using the national rate does, however, reduce the variation in unemployment rates available for identification. Having access to more than 50 years of enrollment decisions and corresponding unemployment rates becomes extremely valuable, as it allows us to retain enough variation to identify our key parameters while relying on the most relevant labor market indicator.[9]

Figure 1 plots the UK national unemployment rate for the period 1958–2016. The Figure shows the well documented increase in unemployment in the 1970's and early 1980's and the negative impact of the economic recession of the early 1990's and the financial crisis of 2008–2009. It also shows that even during more recent periods of strong growth, the very low levels of unemployment that the UK enjoyed in the aftermath of WWII were never recovered. Our empirical strategy will control for long-run trends and exploit only business cycle variations in our different variables.

3 Data and Empirical Strategy

3.1 Data

Our analysis is based on the UK Quarterly Labour Force Survey (QLFS). The QLFS is a widely used survey covering 60,000 households living in the UK. It is managed by the Office of National Statistics (ONS) and is specifically designed to capture the

[8] See https://www.ons.gov.uk/employmentandlabourmarket/peoplenotinwork/unemployment, last accessed 31/07/2017

[9] In the literature, identification is often obtained from regional variation in unemployment rates, e.g. Kahn (2010); Oreopoulos et al. (2012); Liu et al. (2016); Betts and McFarland (1995); Clark (2011); Blom et al. (2015). Dellas and Sakellaris (2003) is an exception to this practice; similarly to us, the national unemployment rate is used in their paper.

labor market circumstances of the UK population. It has been conducted quarterly since 1992.

The QLFS presents several advantages for estimating our parameters of interest. In particular it records detailed information on educational attainments, labor market outcomes and several background variables for cohorts of university graduates starting in the early 1960s until the most recent years.

Schooling variables - Other than the highest level of education the LFS collects information on the year of graduation, the major studied in college and, since the last wave of 2005, two measures of educational performance: the number of GCSE exmas passed in high-school and the degree class achieved at the end of the university career.This feature of the data allows us to observe many cohorts of university graduates, our population of interest, their performance at key stages of their educational career and the exact moment at which their highest educational level was achieved. This is crucial for our purpose as it allows us to establish when the individual enrolled into tertiary education, which in turn allows us to infer the macroeconomic conditions that prevailed at the time of enrollment. This is in contrast to most other datasets which only record individuals' highest achieved education level, but not when they obtained this degree. Researchers who use such datasets and are interested in the impact of macroeconomic conditions at the time of college entry (or graduation) must make the assumption that individuals chose their degree at the standard age of high-school graduation (see e.g. Blom et al. 2015). Our dataset shows, however, that an important proportion of students enroll in university at later ages; hence this distinction is empirically important.

Ideally, we would like to have information on the year of enrollment rather than the year of graduation. Unfortunately this information is not directly available in the QLFS, so we impute the year of enrollment as the year of graduation minus three for all major categories excepts for graduates in Medicine for which the normal course of study takes five years. This procedure opens up some concerns of misclassification, as some students might exceed the normal length of their university course. If that is the case we would be assigning the wrong starting date and therefore the wrong unemployment rate, to the delayed students. To alleviate these concerns we compute the relevant unemployment rate at the time of enrollment as the average of the three years preceding the imputed year of enrollment.

Labor market outcomes - Other than information on education achievements and type of university degree, the QLFS contains a wide array of information on labor market experience and outcomes, such as wages, employment status, sector of employment, which are equally fundamental for our analysis, as well as some demographic information such as gender, nationality, place of residence and ethnic origin. In order to be consistent with our population of interest, we concentrate our analysis on 64 quarterly waves from 1998 to 2016, for which the key variables of interest are

available.

We limit our sample in several ways. First, we restrict our analysis to men only in order to avoid any issue of selection in the labor force which could be relevant especially for the older cohorts of women. Second, we select individuals between 25 and 65 years of age so that we exclude the economically inactive and those still in school. For most of the analysis, we focus on individuals whose highest educational achievement is a Bachelor's degree, and drop respondents with either a higher or a lower educational level. We also drop observations whose imputed year of enrollment in college is inconsistent (either later than 2017 or negative). Finally, we exclude university graduates whose stated age at university completion is less than 14 or more than 45.

After applying these rules, we are left with a sample of 253,828 college graduates. This is the 'full sample', which we use to estimate employment probabilities and field of study selection. Wage information is only available for a subset of the sample. The QLFS is designed as a short panel in which each household is maintained in the sample for five consecutive quarters. Information on wages is collected only in the first and last quarter. Our wage analysis focuses on individuals with relevant wage information who are working full time. This restricted 'earnings sample' includes 53,724 individuals. For our analysis that considers individuals' degree classifications, we must further restrict our sample to the 30,693 post-2005 observations.

Table 1 contains descriptive statistics for the full sample and the earnings sample in Panels A and B, respectively. The columns correspond to graduates by enrollment decade and for the entire sample. Overall the sample is predominantly white, but ethnic minorities increase throughout the period. Age at graduation is around 23 overall, but it has increased constantly for the last 50 years. Both high-school and university performance measured as the numer of GCSEs and the degree class achieved at graduation respectively, have increased through time and vidently, the majority of college graduates belongs to the highest high-school achievers. Wages for the early cohorts are higher as these cohorts are observed at later stages of their life cycle and therefore have, on average, more experience than the younger cohorts (something we control for in our wage regressions). It should also be noted that the majority of our graduates enrolled in the 1980s and 1990s.

The table also shows the composition across university majors. To categorize university majors we use the International Standard Classification of Education (ISCED) in its 2013 update. ISCED was developed by UNESCO to facilitate comparisons of educational statistics and indicators across countries on the basis of uniform and internationally agreed definitions. The descriptive statistics show that, through time, graduates in Engineering declined, perhaps due to the emergence of related degrees in Information and Communication Technologies, which in the later decades account for almost 10% of university degrees while they were absent for the first decade. It

is also worth noting the upsurge of graduates in Business and Law – from 10 to 21% in the 2000s– and the halving of graduates in Natural Sciences that went from 26 to 12% of all male university graduates. The other categories are fairly stable in their graduation numbers.

3.2 Identification of Cohort Effects

Individuals' labor market outcomes are typically modeled as determined by factors working through three different time dimensions: (i) current labor market situation, captured by calendar year, (ii) the time since an individual entered the labor market, captured by age or labor market experience, and (iii) the impact of cohort-specific factors, captured by cohort effects. As is well known, the three factors cannot be modeled at the same time in an entirely flexible way (by three sets of fixed effects) due to the direct relation between the three time dimensions.[10]

In our analysis, we are interested in how labor market outcomes vary across cohorts that enroll into college at different stages of the business cycle. We therefore focus on cohort effects where cohorts are defined by their year of college enrollment, and as mentioned above, restrict our sample to college graduates only. For simplicity, let us assume that everybody enters college at the age of 19 and graduates three years later. The observed labor market outcomes (say earnings) can be written in terms of the three dimensions as follows:[11]

$$w_{ict} = \sigma_c + \lambda_{t-c-3} + \tau_t, \tag{1}$$

where w_{ict} is the labor market outcome of individual i from cohort c observed in year t, τ_t captures the calendar year effect, λ_{t-c-3} captures the experience (age) effects and σ_c captures the cohort effect. As there is a linear dependence among the three sets of fixed effects, the equation cannot be estimated fully flexibly in this form.

As in the literature that studies the effect of economic conditions at the time of labor market entry, we are not interested in the long-term trends in cohort quality, but rather in their short-term fluctuations (i.e. in the non-linear component of the cohort effects around the long-term trend). Similar to Oreopoulos et al. (2012), our approach is to control for these long-term trends in cohort quality using a linear or

[10] Fixing two of the three dimensions determines the third one, e.g. the calendar year minus the number of years of experience is equal to the year when a cohort entered the labor market, which defines the cohort.

[11] The exposition is based on that in Kwon et al. (2010) (who study the impact of economic conditions at labor market entry on promotion and wages), but is adjusted for the purpose of our analysis.

quadratic trend.[12] As in Kwon et al. (2010), we also use fully flexible calendar year fixed effects to capture economic conditions at the time when wages are measured, and we approximate the effect of experience (age) using a quadratic functional form.[13]

In general, our estimation takes on the following form:

$$w_{ict} = \alpha + \beta U_c + \lambda_1 a_i + \lambda_2 a_i^2 + \delta c + \tau_t + \gamma x_{ict} + \epsilon_{ict}, \tag{2}$$

where w_{ict} is the labor market outcome of individual i from cohort c observed in year t, α is a constant term, $\lambda_1 a_i + \lambda_2 a_i^2$ is a quadratic function of age at which individual i is observed (where age proxies for labor market experience),[14] δc is the linear long-term trend in cohort quality,[15] τ_t captures the calendar year effect of the year in which individual i is observed, x_{ict} is the remaining set of individual-specific characteristics, ϵ_{ict} is a standard error term and, most importantly, β is the main effect of interest which captures the impact of the unemployment rate at the time of college enrollment (U_c). As mentioned above, this unemployment rate is measured as the average national unemployment rate in the three years leading to enrollment.

Our objective is therefore to explore to what extent the deviations in the cohort performance from the long-term linear (or quadratic) cohort trend can be explained by the economic conditions at the time of college entry. Our specification hinges on the following assumptions: We assume that (1) the unemployment rate at college entry affects only the short-run deviations from a long-term trend in cohort quality which evolves smoothly in a linear (or quadratic) fashion, and that (2) the age profile of labor market outcomes is constant across cohorts (an assumption that is widespread in any standard specification of the Mincerian wage equation). The identification of the impact of our main variable of interest therefore is obtained from the variation in labor market outcomes of college graduates from different cohorts that are observed in the same year but were exposed to different business cycle conditions at the time of college entry, after controlling for a common age-wage profile, and accounting for

[12] This is the approach taken by Oreopoulos et al. (2012) when estimating models using the national unemployment rate. Their main specification exploits regional variation in unemployment rates, which allows them to control for cohort trends at the national level in a more flexible manner.

[13] Kwon et al. (2010) also propose a specification where they identify the (short-term) fluctuations in the cohort outcomes by imposing a zero long-term trend in the cohort effects. This is done by dropping the first and the last cohort dummy from the regression. In an alternative specification, they control directly for the unemployment rate at entry without additional controls for cohort trends.

[14] We prefer to control for age, rather than years since graduation, since some graduates enroll at older ages and, for them, age would be more relevant than years since graduation as a measure of potential labor market experience. However, we have verified that our main results are robust to including a quadratic in years since graduation instead of age.

[15] We have also verified the robustness of our main results to including a quadratic trend in cohort quality.

the long-term trend in cohort quality.

4 Main Results

In order to analyze the variation in cohort quality across cohorts of university graduates who make their enrollment decisions at different points in the business cycle, we focus on wage outcomes among full-time college graduate males. We therefore estimate Equation (2) using log real weekly earnings as our dependent variable. The additional control variables included in x_{ict} are a race dummy, a dummy for foreign nationals, and a set of 19 region of residence dummies. In all cases observations are weighted using person weights provided in the dataset, and standard errors are clustered by year of enrollment.

We begin by showing a specification which does not control for the cohort trend (δc in Equation (2)). The results are shown in Column (1) of Table 2. The estimated coefficient on the unemployment rate is positive and statistically significant. The coefficient implies that cohorts that enrolled in times when the unemployment rate is 1p.p. higher have wages that are on average 0.8% higher, after controlling for age effects and calendar year effects. Put differently, a 3 p.p. increase in the unemployment rate at the time of enrollment (approximately one standard deviation in the sample), increases average cohort wages by around 2.5%. This suggests that these cohorts are on average of higher "quality".

The result in Column (1) may be confounding longer-term trends in the quality of cohorts of undergraduate degree holders. To account for these longer-term trends, in Column (2) we add the control for the linear trend in cohort wages as in Equation (2). Hence, identification of β in Column (2) is obtained solely from (business cycle-related) deviations from this trend across cohorts (within a calendar year, after controlling for common age-wage profiles). Even when allowing for these cohort trends, we find that cohorts that enrolled in times with worse economic conditions have statistically significant higher average wages. Column (3) verifies the robustness of our results to including a quadratic trend in cohort quality.[16] In the remaining specifications, we maintain a linear trend in cohort effects.

The average effect of unemployment at enrollment estimated in Columns (1) to (3) could be masking heterogeneity across cohorts according to their labor market experience. In particular, enrolling in times of high unemployment may generate an initial wage gap after graduation which may fade away over time. In Column (4) we add an interaction term between the unemployment rate at the time of enrollment

[16] We have further verified the robustness of our results to adding decade of enrollment dummies along with the linear trend in cohort-level wages. Results are available from the authors upon request.

and years since graduation. This allows us to distinguish between the short and long term effects of enrolling during times of high unemployment. We find that cohorts of graduates who enrolled during times of higher unemployment have a large initial wage advantage, which only slowly disappears with labor market experience. The rate of decline is quite slow, so we focus on the overall average effect in the remainder of the paper.

As discussed in further detail below, the composition of cohorts may vary both because of changes in the proportion of high school graduates who decide to enter directly into university, and because of changes in the enrollment decisions of returning students. If the proportion of returning students varies over the business cycle, and these students differ (relative to new high school graduates) in terms of their unobserved ability distribution, this might account for the wage differences that we have identified. In Column (5) we explore whether there is any evidence of changes in cohort quality among non-returning students; that is, we restrict the sample to individuals who enroll in university between the ages of 16 and 21. For this sample, we also find a statistically significant positive effect of the unemployment rate at enrollment. This implies that the average quality of graduates increases when economic conditions worsen, even among the set of graduates that enroll directly after high school completion.

One potential driver of the differences between cohorts could be selection into employment. If cohorts who enrolled during worse economic conditions have lower employment probabilities, it may be the case that the subset of full-time workers from these cohorts is more positively selected than among cohorts who enroll into university during better aggregate conditions. To check whether this is the case, in Column (6) we estimate a regression analogous to Column (2), but where the dependent variable is a dummy which is equal to one if the individual is in full-time employment. For this linear probability model estimation, we use the full sample of men, including those who are not working and, more importantly, those who are not part of the earnings survey sub-sample; hence we have a much larger sample size. The results show that there is no statistically significant relationship between aggregate conditions at the time of university enrollment and the probability of working full time. The coefficient is close to zero. Hence, it does not seem to be the case that the difference in cohort quality that we observe in Columns (1) to (5) is driven by differential selection into full-time employment.

In Table 3 we explore whether the positive wage effects that we find in Table 2 are concentrated in certain parts of the distribution. To do this, we run a set of quantile regressions analogous to Column (2) in Table 2. The results for each of the conditional deciles of the log real earnings distribution are presented in Table 3. The estimated coefficients are positive and statistically significant throughout the wage distribution. Thus, it seems that the whole distribution of earnings shifts up for cohorts who enroll

during worse economic conditions. The largest effects are found at the 70th and 80th percentiles of the distribution.

Overall, the results in this section show robust evidence that the average quality of cohorts of students who decide to enroll into university when aggregate economic conditions are poor is higher than that of cohorts who enroll during better economic conditions. The next section explores a series of potential mechanisms that could account for this result.

5 Mechanisms

In this section, we explore different mechanisms that might account for the differences in wages across cohorts selecting at different points in the business cycle documented above. First, we explore the evidence regarding changes in selection into college (at the extensive margin) over the business cycle. Next, we consider whether the wage result that we have identified is driven by variation in economic conditions at the time of *graduation*. We then consider whether the differences are due to changing selection into different fields of study or into different occupations or industries. Finally, we explore whether there is evidence that these cohorts do indeed have different average ability levels by analyzing variation in university performance, and whether this can account for the wage differentials that we observe.

5.1 Changes in Selection over the Business Cycle

We first explore how the probability of obtaining a bachelor degree changes over the business cycle. Previous literature (Betts and McFarland 1995; Dellas and Sakellaris 2003; Clark 2011) has shown that unfavorable labor market conditions may reduce the opportunity cost of postponing labor market entry and therefore encourage college enrollment. In our data we cannot directly test this hypothesis, as we are unable to directly observe enrollment decisions. Rather, we observe only ex-post graduation outcomes. We therefore test whether higher unemployment levels at the time of choice are correlated with the probability of *graduating* from college. If this probability fluctuates, one could expect cohort quality to vary due to changes in selection at the extensive margin.

It is important, at this point, to discuss some factors that complicate this type of analysis. The complication derives from the fact that entering the labor market is not an absorbing state. Students can enroll into college either immediately after high school graduation or years after it. For those individuals whose choice is made right after high school completion, or in the proximity of it, establishing which unemployment rates are relevant for their choice is straightforward. More complex is

the case of returning students. Returning students have the option to enroll every year following their high school graduation, but choose to wait. Establishing which unemployment rate is relevant for their choice is less clear-cut.

For this reason we have adopted a two step approach to the estimation of the effect of unemployment rate on graduating cohort size. In the first, we consider only individuals who never enroll, at least in our sample, or who enroll into college between the ages of 18 and 20,[17] and estimate whether the probability of college graduation for individuals who happen to finish high school in bad times decreases. In the second, we consider how the probability of being a late enroller – defined as someone who starts tertiary education at age 21 or later – is affected by the contemporaneous unemployment rate.

Taken together, these two pieces of evidence provide information on how the size of university student cohorts changes over the business cycle due to both the effect of high school students entering university and workers leaving the workforce to invest in their human capital.

In the first step we focus on the non-returning students only and estimate a Linear Probability Model (LPM) for the effect of unemployment on college enrollment taking the form:

$$E_{ic} = \alpha + \beta U_{c,18} + \delta_1 c_{18} + \delta_2 c_{18}^2 + \epsilon_{ic}, \tag{3}$$

where $E_{ic} = 1$ if individual i from cohort c is a college graduate, $U_{c,18}$ is the average national unemployment rate for the three years prior to the individual turning 18, c_{18} and c_{18}^2 are quadratic cohort trends for the year in which the individual turns 18 (which capture aggregate trends in college enrollment) and ϵ_{ic} is the usual error term. As mentioned above, we do not have retrospective information on enrollment, as this is not recorded in the QLFS. What we know is whether an individual graduated from university, and when. Hence, to be precise, what we estimate is the joint probability of enrolling *and* graduating from college. As our unit of analysis when studying labor market outcomes are *graduating* cohorts and we are interested in understanding what happens to their size, this distinction is not crucial for our purposes.

For this set of regression we augment our 'schooling' sample by including 378,544 full time working men who are high school graduates and exclude 43,718 university graduates who are late enrollers and are analyzed separately. For these set of regressions we do not restrict our sample to full time working men and include 22,745 part-time workers.

Column (1) in Table 4 includes a linear trend in cohort quality only and shows

[17] This group of college graduates constitutes the majority in our sample: 78.6% of college graduates enroll within two years of high school graduation.

that when unemployment grows, the joint probability of enrolling and graduating from college decreases slightly. The effect is significant at the 5% level, but it disappears in Column (2) when we include a quadratic term in cohort quality. Here the national unemployment rate at age 18 has no statistically significant effect on the joint probability. This is an interesting results, as it suggests that additional enrollment among new high-school graduates that occurs during times of poor economic conditions may not actually lead to additional graduates due to a potential increase in the drop-out rate. Alternatively, it may be the case that universities are constrained and cannot easily expand their admission levels even if they receive more applications. An increase in applications may change universities' selection criteria. Hence, although the probability of graduating from university is not affected by unemployment at age 18, there may still be changes in the composition of college graduates, as we discuss further below when considering labor market outcomes.

Next, we explore the possibility that graduating cohorts expand by attracting more returning students. We do so by estimating a LPM for the probability of late enrollment, defined as enrolling in university at least three years after high school graduation. The LPM takes the following form:

$$LE_{ic} = \alpha + \beta U_c + \delta_1 c + \delta_2 c^2 + \epsilon_{ic}, \tag{4}$$

where $LE_{ic} = 1$ if individual i enrolls into college late, U_c is the average national unemployment rate for the three years prior to the individual enrolling into college, c and c^2 are quadratic cohort trends, where cohorts are defined here by the year of *enrollment* (rather than by the year when individuals turn 18), and ϵ_{ic} is the usual error term. The last two columns of Table 4 show that the probability of being a returning student increases when we include a linear trend for cohort quality as shown in Column (3), but, once again, it shows no statistically significant relationship to the unemployment rate at choice when a quadratic term is chosen.

When considered jointly, the overall effect for the two channels discussed (i.e. graduation rates of new high school graduates and returning students) on the size of graduating cohorts, point towards no extensive margin differences between cohorts selecting at different moments of the cycle. At first pass this apparent lack of selection at the extensive margin might seem to imply that there should be no difference in terms of the unobserved ability distribution of cohorts enrolling at different points in the cycle. Most single-dimensional and multidimensional (*à la* Roy) models would only allow for changes in cohort composition if there are changes in the extensive margin. It would seem that some other type of unobserved phenomena would have to be at play to account for the wage results discussed above.

5.2 Economic conditions at time of graduation

There is strong evidence in the literature that economic conditions at the time of graduation have large and long-lasting effects on labor market outcomes for university graduates (Kahn 2010; Oreopoulos et al. 2012; Altonji et al. 2015; Liu et al. 2016). Our key result regarding differences in average cohort-level wages could potentially be driven by the fact that cohorts that enroll in bad times tend to graduate in good times, and hence avoid these negative graduation effects.

To explore this possibility, we expand our regression by adding controls for economic conditions at the time of graduation, and their interaction with time since graduation (as in Kahn 2010). Identification of our coefficient of interest is still possible given that unemployment at time of enrollment and unemployment at time of graduation are not perfectly correlated. The results are presented in Column (1) of Table 5. As in Kahn (2010), we find that the unemployment rate at the time of graduation has a negative and statistically significant effect on wages, and this wage penalty is slowly eroded as years since graduation increase. However, controlling for this pattern has very little impact on our effect of interest. Hence, we can conclude that, even conditional on economic conditions at graduation, cohorts that enroll at times when unemployment is higher have higher average wages.

5.3 Major choice

There is also recent evidence in the literature suggesting that economic conditions at the time of enrollment have an impact on students' field of study preferences and choices (Bradley 2012; Goulas and Megalokonomou 2015; Blom et al. 2015). It is also well known that earnings vary substantially across majors (e.g. Altonji et al. 2012; Lemieux 2014). Therefore, a potential explanation for the earnings differences that we have documented would be that students who enroll when economic conditions are poorer tend to select into higher paying majors, thus increasing average earnings at the cohort level.

To explore evidence for this mechanism, we proceed in two parts. First, we analyze whether we observe changes in field of study choices over the business cycle in our dataset. To the best of our knowledge, this is the first paper to explore the effects of the business cycle on the composition of majors in the UK. Then, we return to our wage regression to determine whether changes in the field of study composition across cohorts can account for the differences in earnings.

To determine whether the composition of fields of study varies according to the business cycle, we estimate a series of linear probability models of students' major choices. The models are estimated separately for each major category. In our baseline specification we control for ethnicity, nationality and a quadratic time trend across

cohorts. The simple linear regression that we estimate is:

$$y_{im} = \alpha_m + \beta_m U_c + \delta_{1,m} c + \delta_{2,m} c^2 + \gamma_m x_i + \epsilon_{im}, \tag{5}$$

where $y_{im} = 1$ if individual i selects major m and 0 otherwise. α_m is a major specific constant, c and c^2 are quadratic cohort trends with coefficients that are allowed to vary across majors, and x_i is the vector of covariates. β_m is the major specific coefficient on the three year average of the unemployment rate at the time of choice. ϵ_{im} is a standard error term.

We present the results in graphical format in Figure 2. The impact of the unemployment rate at time of enrollment is significantly different from zero at the 1% level for two out of nine categories, with estimated changes in probabilities varying between negative 0.03% and positive 0.08%.

Our estimates suggest that in periods of higher unemployment more students select into Engineering and out of Education, Business, Social Sciences and Information and Communication Technologies. These effects are small though. Our estimates imply that a 5% movement in the national unemployment rate – a historical swing, only experienced twice in the last 55 years in the UK – would increase graduation rates in Engineering, the most responsive category, by 4%, and decrease graduation in Education degrees by 1.5%.

To give a full sense of the size of this effect we can consider the enrollment numbers for the year 2015 provided by the British Universities and Colleges Admissions Service (UCAS).[18] Our estimated elasticity implies an inflow of about 2,000 graduates in the Engineering and Architecture category as a consequence of a hike of the hypothesized proportions in the unemployment rate.

From this we conclude that even though some reshuffling between majors occurs in bad versus good times, these changes are of modest proportions.[19] Moreover, although Engineering – which is clearly a high-paying field – grows in recessions, other high-paying fields such as Law and Business Administration tend to shrink. It is also not obvious that marginal students who change their field of study decisions due to the business cycle would earn wages that are similar to the average wages in their new field of choice, given that they might not be as well matched.

To determine whether changes in the field of study composition explain the dif-

[18] https://www.ucas.com/corporate/data-and-analysis/ucas-undergraduate-releases/ucas-undergraduate-end-cycle-data-resources/applications-and-acceptances-types-higher-education-course-2016 accessed 18/08/2017.

[19] This contrasts with the results for the US in Blom et al. (2015), and may be due to the fact that selection of majors is more rigid in the UK system, where students' choices are more limited by their course of study during their A-levels. It may also reflect less flexibility at the departmental level to change enrollment as a response to changes in application volumes.

ferences in wages across cohorts, we return to the wage regression from Table 2 and replace the simple calendar year fixed effects with fully interacted field of study-calendar year fixed effects. This controls for the return to different fields at each point in time at which earnings are observed. To the extent that the effect that we were finding was due to differences in field of study composition and the different rewards across fields, these new fixed effects should eliminate our effect.

The results are displayed in Column (2) of Table 5. Interestingly, adding these field-specific calendar year fixed effects does not eliminate our result of interest. Compared to the estimated effect of the unemployment rate in Column (2) of Table 2, the coefficient falls by a little over 10%, suggesting that the effect of changes in the major composition on average cohort wages is relatively small.

In order to further investigate this effect, Table 6 shows the results of the effect of unemployment at enrollment on wages by field. The results in Column (1) are analogous to the results from Column (1) in Table 2, but all variables are fully interacted with field dummies (except the race, nationality and region of residence dummies). The results show that, within all fields, cohorts that select in a recession earn higher wages: The point estimates are always positive, although not always statistically significant. Interestingly, the results are statistically significant in a subset of high-paying fields, including Natural Sciences, Mathematics and Statistics, and most notably, Engineering. This implies that the average quality of the cohorts selecting into these highly remunerated fields actually increases when aggregate economic conditions deteriorate. Again, this contrasts with economic intuition which would suggest that a field like Engineering would attract lower quality marginal students as it tends to expand as a reaction to worsening aggregate economic conditions.

Column (2) controls for an *overall* (linear) trend in cohort quality. This would capture any general cohort trend that is common across fields, for example, because of changes in the selection of college-goers in general. Adding this control does not alter the results much. Column (3) replaces the general cohort trend with field-specific (linear) trends in cohort quality. Once again, the results are robust and actually become even stronger.

In Column (4) we add a full set of cohort dummies. In this case, the effect of unemployment on overall cohort quality is no longer identified; this is absorbed by the cohort dummies. Instead, what we can still identify is the effect of unemployment on *relative* wages across fields. We use Health and Welfare as our base category. The results show relative increases in wages in the same fields as identified in the previous columns. This once again suggests differential positive selection among college-goers towards these higher-paying fields.

Finally, Column (5) controls for field-specific effects of economic conditions at the time of graduation (i.e. field-specific impacts of unemployment at graduation, and

field-specific interactions of this unemployment rate with years since graduation), along with an overall (linear) trend in cohort quality. Our results remain robust.

Overall, the results provide robust evidence that the increase in wages observed for cohorts who select into college during worse economic conditions is *not* driven by reallocation across fields of study. Instead, there appears to be an improvement in cohort quality within many fields, particularly so within high-paying fields such as Natural Sciences, Mathematics and Statistics, and Engineering.

5.4 Occupation and industry sorting

The wage differential that we have found for cohorts who enroll in university during worse macroeconomic conditions could be to some extent driven by differential sorting into higher paying occupations or industries. For example, Liu et al. (2016) show that the business cycle has important implications for the quality of graduates' initial industry match, and this can explain some of the persistent earnings losses from graduating in a recession.

Here we explore the extent to which differences in the occupation and industry composition of different cohorts can explain the wage differences that we have identified. We do this by adding a set of controls for occupations and industries and determining the extent to which the coefficient on the unemployment at enrollment is reduced.

In Column (3) of Table 5 we add a set of nine broad occupation dummies, interacted with calendar year. This accounts for variation in the return to different occupations over time.[20] The coefficient on unemployment at enrollment is still statistically significant, implying that cohorts who enroll into university during periods of higher unemployment have higher wages, even within occupations. The slight reduction in the magnitude implies that only a small part of the cohort-level wage differences are due to differences in selection into different occupations.

As Liu et al. (2016) emphasize, an important determinant of wages is the quality of the job match with respect to an individual's field of study. In other words, occupational wage premia may differ significantly across individuals with different types of degrees. In order to account for this, in Column (4) of Table 5 we further interact our occupation-calendar year dummies with the full set of field of study indicators. Any remaining effect of unemployment at enrollment would capture cohort-level differences within occupation-field-calendar year cells. The results in Column (4) show that this coefficient does not fall much relative to the baseline estimate in Column (2)

[20]Having these occupation-time interactions also implies that we do not need to be concerned about changes in the occupational coding schemes over time, given that identification is solely within occupation-year cells.

of Table 2. Hence, the majority of the wage variation that we identify occurs within occupation-field-calendar year cells.

Columns (5) and (6) of Table 5 repeat the analysis using ten broad industry categories instead of the occupation groups. The results are similar with regards to industry sorting.

5.5 Educational performance over the business cycle

The results from the previous subsections rule out the possibility that the observed increase in wages for cohorts who select into college during worse economic conditions is driven by economic conditions at graduation, or by reallocation across fields of study. They are also not fully explained by differential sorting into occupations or industries, even conditional on field of study. This suggests two possible explanations for our results: either poor economic conditions may actually induce *positive* selection into college, or, at constant or negative levels of self-selection, cohorts entering tertiary education in a trough might increase effort, compensating for their worse average quality, and improving their labor market outcomes.

In this subsection we explore competing evidence for these two possible explanations by considering the empirical link between unemployment rate at the time of college enrollment and two different measures of educational performance: the GCSE score[21], an *ex-ante* measure of performance providing us with an indication of the average ability level for cohorts entering at different stages of the cycle; and the degree class achieved at the end of tertiary education which measures the *ex-post* cohort quality.

As explained in section 2.1, the GCSE exam marks the end of compulsory education in the U.K. and it is normally taken at age 16, two years prior entering university. The LFS measures whether the respondent has one to two, three to four, five to seven or more than eight GCSEs at a grade of C, the passing grade, or above. This allows us to construct a ordered categorical variable capturing the prior educational achievement and serving as a proxy for the individual academic ability before entering university.

By estimating the effect of the average unemployment at entry on the probability of belonging to the highest GCSE scoring group, we test whether our positive wage effect can be explained by high achievers going to college more frequently during

[21] A variable recording the number of A-levels, another measure a pre-university achievements, is also available in the LFS, but it has very limited granularity only recording whether the individual has zero or one of more A-levels. Given that a key prerequisite for university admission is the number of A-levels, this variable presents almost no variation in our particular sample. For this reason, we believe that the GCSE score is a more robust measure of prior educational attainment.

recessions. Therefore, in Table 7 we presents the estimated coefficients for an ordered probit model in which the dependent variable is the GCSE scoring group to which the individual belongs to in ascending order. The estimates in column (1) control for the usual race and foreign born dummies and for a linear trend in cohort quality and they show that cohorts going to college in high unemployment years have *lower* average GCSE scores than those going in boom periods. The relationship is significant at the 5% level. In column (2) we replace the linear cohort trend with decade dummies. In this specification the relationship is still negative, but, even if close to, it ceases being significant at conventional levels.

Our results, to the very least, show no support for an explanation of high wages driven by positive selection, measured by *ex-ante* achievements, during recessions.

Once established the absence of positive selection during troughs in our data, we analyze how cohorts entering college at different stages of the economic cycle perform in their university studies. We do so by looking at the degree class that students graduate in. Students at British universities are classified according to five possible degree classes at graduation which, in descending order, are: first-class, second-class upper division, second-class lower division, third class, and ordinary degree otherwise called a "pass". Which degree is awarded depends on the weighted average of the marks obtained during the course of study, with a higher weight assigned to marks obtained in the later years. Therefore the degree class is a function of students Grade Point Average (GPA).

For this analysis, our outcome variable is the degree class achieved at graduation while the variable of interest is, as before, the unemployment rate when selecting into university. This effect is estimated from the following linear model:

$$D_i = \alpha + \beta U_c + \delta_1 c + \delta_2 c^2 + \gamma a_i + \psi_m + \psi_m \times c + \nu_i + \nu_i \times c + \epsilon_i, \tag{6}$$

in which D_i indicates the degree class for individual i, α is a constant, U_c is the average unemployment rate in the three years preceding enrollment, c and c^2 are quadratic cohort trends, a_i is the age at which the student graduated, ψ_m is a college major fixed effect, ν_i is a GCSE score group fixed effects and ϵ_i the usual error term. The quadratic cohort trends are meant to capture overall trends in the quality of university students and/or in "grade inflation" patterns. The major dummies capture fixed differences in the grade distribution across majors. The GCSE dummies capture the impact of high school on college achievements. As discussed above, some students return to university at older ages. Since older students might be more mature and/or motivated to pursue their studies we control for age at graduation to capture this effect. We allow for different trends between fields either for cohort qualities or leniency in grading by including an interaction term between field of study and cohort trend.

Table 8 presents OLS estimates of the linear model just described, weighted by person weights and with standard errors clustered at the cohort level. Each column shows different specifications for the model described in Equation (6). Column (1) does not control either for age at graduation or for field of study and shows that a 1 percentage point increase in the average unemployment level at the time of college entry increases the graduation mark by .01 on a 5 point scale. This might confound the effect that a more mature cohort might have a higher average performance. In Column (2) we control for age at graduation and our coefficient of interest remains unaltered. Since individuals who decide to enroll into college in times of higher unemployment might select majors where higher grades are easier to achieve, in Column (3) we control for field fixed effects. Adding field fixed effects has no impact on our main coefficient. In Column (4) we introduce a full set of field specific trends in cohort effects allowing for cohort effects and major fixed effects to vary with time. Again, the coefficient of interest remains positive and significant, if only slightly reduced. Finally, in Column (5) we estimate the full model specified in equation 6 by including a full set of high school score dummies and their interaction with the cohort effects allowing also for the impact of GCSE score on degree class to vary with time. Controlling for *ex-ante* achievement measures increases the positive *ex-post* achievement gap in favor of high unemployment cohorts. This is coherent with the negative correlation between unemployment levels and high school achievements estimated in our probit model presented in Table 7.

The favorable wage effect of selecting in periods of high unemployment that we encounter has at least two competing explanations: either high ability students choose to enter directly into the labor market when economic conditions are strong, and instead decide to go into further education when aggregate conditions deteriorate. Alternatively, the ex-ante distribution of ability among college-goers might not be changing over the business cycle, but the economic conditions might affect the effort they exert during their studies, leading to ability differences arising ex-post.

Overall, the combined evidence of *ex-ante* and *ex-post* achievement it is not suggestive of an improvement in the innate quality of the cohorts that select into university in a recession (and complete their degrees), to the contrary, it suggests that high unemployment encourages lower ability individuals to pursue a university degree. The evidence presented in this section seems to point towards an increase in effort already during tertiary education studies when economic conditions are bad translating in higher marks.

Does the increased university achievement account for the wage variation across cohorts documented in the previous tables? To determine this, we estimate our wage regressions once again, but adding controls for individuals' degree classifications. Given that the degree classification information is only available for a subset of recent years, we first present our baseline estimates using the same specification as before,

but restricting the sample to individuals for whom we have non-missing information on degree classification. The results are presented in Column (1) of Table 9. The results for this sub-sample are similar to those for the baseline sample.

In Column (2) we add controls for degree classification, in the form of a full set of degree class fixed effects. The estimated coefficient on the unemployment rate at enrollment does not change significantly in magnitude and if anything becomes larger. In Column (3) we replace the simple degree class fixed effects with fully interacted degree class and calendar year fixed effects. This allows the return to different degree classes to vary over time. Our coefficient of interest remains robust. Finally, in Column (4) we control jointly for degree classification and re-shuffling of individuals across fields by including field-specific calendar year fixed effects along with the degree classification fixed effects. Again, our estimated coefficient of interest remains robust.

This implies that, surprisingly, the increased attainment in terms of degree classification does not account for the wage differences across cohorts either. Even conditional on degree class, students who enroll into university during times of higher unemployment still earn higher wages. Therefore, higher wages for these cohorts would have to be explained by unobservable skills not captured by observed academic ability. This unobservable skill would need to explain both higher wages and higher educational achievements for cohorts of individuals whose academic performance in earlier years is at best equal, and possibly worse, than that of cohorts enrolling in periods of economic expansion.

6 Conclusions

In the UK, graduation rates do not seem to vary systematically according to economic conditions at the time of college enrollment. Economic intuition would suggest little variation in the average quality of cohorts that select into university during worse economic conditions. Contrary to this intuition, we find robust evidence that cohorts who select during worse times earn higher wages. This wage difference is not explained by changing selection into employment, by differences in the economic conditions at the time of graduation, or by changes in the selection of fields of study or occupations or industries among university graduates. Instead, we find evidence that suggests that there is a genuine improvement in the quality of the cohorts selecting into university during adverse macroeconomic times. This is reflected both in better university degree attainment and in higher wages conditional on GPA.

The reasons why the quality of university goers increases during recessions merits further investigation. It may be the case that some students with high unobserved ability choose to enter directly into the labor market after high school when economic conditions are strong (or enroll in college but drop out before graduation). If

conditions deteriorate, they select into college and complete their degree, improving the average quality of the cohort. This is puzzling given that most economic models think of college-goers as being positively selected in terms of unobserved ability (regardless of the phase of the business cycle), and this explanation would require an improvement in selection into college during economic downturns. Alternatively, it may be the case that the average unobserved ability does not vary so much across cohorts selecting at different points in the cycle, but experiencing poor macroeconomic conditions induces college-goers to exert more effort during their studies and hence, although perhaps not different in terms of quality ex-ante, they turn out to be of higher quality ex-post. We do find evidence that poorer ex-ante educational achievement translate in superior performance at university level. Our composite evidence would be consistent with the impressionable years hypothesis from social psychology, which has been validated using economic data in other contexts. Unfortunately, our data do not allow us to test this hypothesis directly. Devising empirical strategies to identify these different channels would be a promising avenue for future research.

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Figure 1: UK Unemployment rate 1958-2016

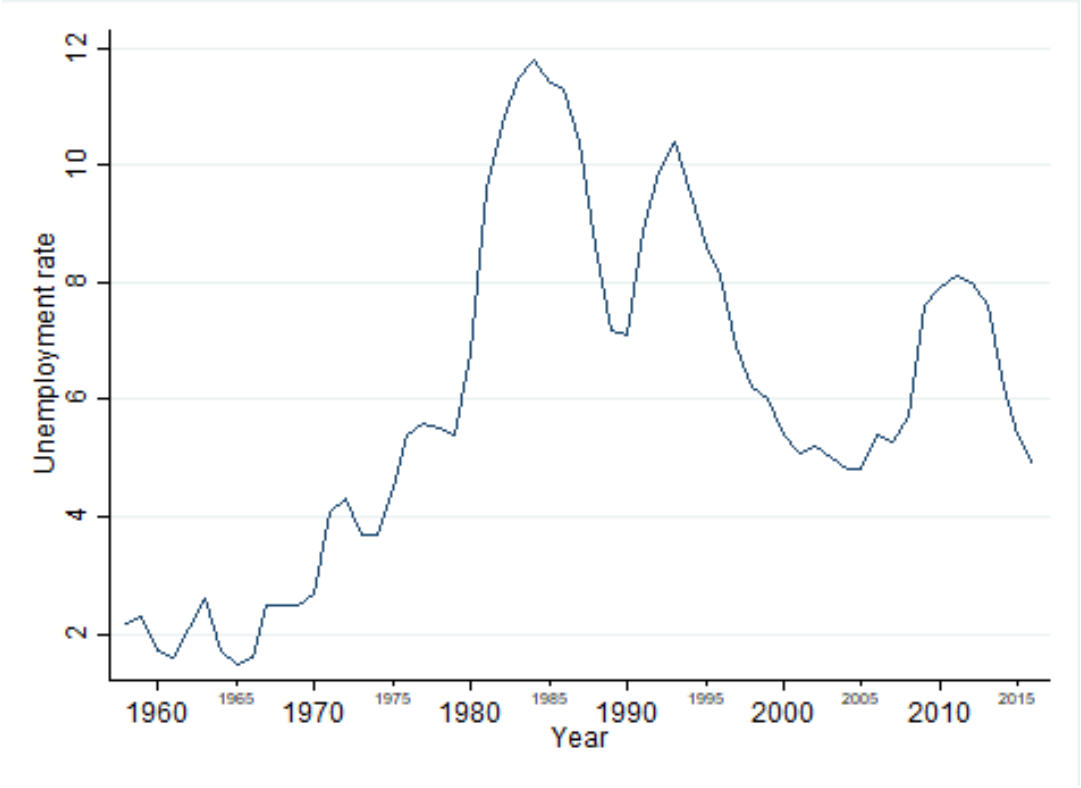
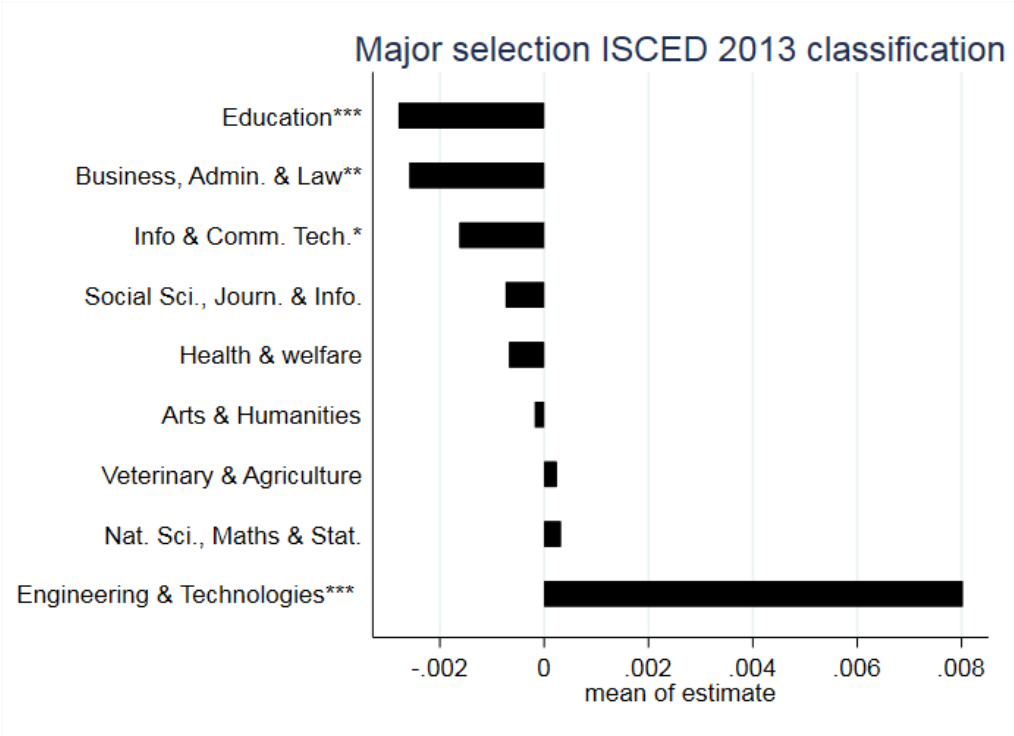


Figure 2: Change in major selection probabilities



***, ** and * denote statistical significance at the one, five and ten percent levels, respectively. Regressions include a quadratic in cohort trend. All regressions are weighted using person weights from the LFS. Standard errors are clustered by year of enrollment .

Table 1: Descriptive Statistics UK QLFS: Full Sample

	Enrollment Decade						
	1960s	1970s	1980s	1990s	2000s	2010s	Total
Panel A: *Full sample*							
White	0.97	0.94	0.92	0.88	0.84	0.81	0.90
	(0.18)	(0.23)	(0.28)	(0.32)	(0.36)	(0.40)	(0.29)
Foreign	0.10	0.09	0.11	0.13	0.11	0.09	0.11
	(0.29)	(0.29)	(0.31)	(0.33)	(0.31)	(0.29)	(0.31)
Age at graduation	21.98	22.42	23.03	24.23	24.87	27.14	23.51
	(1.59)	(2.54)	(3.73)	(5.01)	(5.77)	(6.78)	(4.37)
Unemp. at enr.	2.05	4.34	9.76	8.46	5.33	7.07	7.12
	(0.28)	(0.92)	(1.80)	(1.09)	(0.36)	(0.00)	(2.76)
GCSE score:							
1 to 2	0.01	0.01	0.01	0.03	0.02	0.04	0.02
	(0.11)	(0.10)	(0.12)	(0.16)	(0.15)	(0.20)	(0.14)
3 to 4	0.04	0.03	0.04	0.06	0.05	0.04	0.05
	(0.19)	(0.18)	(0.20)	(0.23)	(0.22)	(0.21)	(0.21)
5 to 7	0.33	0.31	0.27	0.28	0.22	0.26	0.27
	(0.47)	(0.46)	(0.45)	(0.45)	(0.41)	(0.44)	(0.45)
≥ 8	0.61	0.65	0.67	0.64	0.71	0.65	0.66
	(0.49)	(0.48)	(0.47)	(0.48)	(0.45)	(0.48)	(0.47)
Degree class	3.16	3.17	3.34	3.49	3.60	3.74	3.41
	(1.20)	(1.15)	(1.08)	(0.96)	(0.97)	(0.95)	(1.05)
University major:							
Health & Welfare	0.06	0.06	0.05	0.05	0.06	0.08	0.05
	(0.24)	(0.24)	(0.21)	(0.21)	(0.23)	(0.27)	(0.22)
Soc. Sci., Journ. and Info.	0.11	0.11	0.11	0.11	0.12	0.13	0.11
	(0.31)	(0.32)	(0.31)	(0.31)	(0.32)	(0.34)	(0.31)
Business, Admin. & Law	0.10	0.14	0.16	0.21	0.21	0.19	0.18
	(0.30)	(0.35)	(0.37)	(0.41)	(0.41)	(0.39)	(0.38)
Arts & Humanities	0.16	0.15	0.15	0.15	0.16	0.17	0.15
	(0.36)	(0.35)	(0.35)	(0.36)	(0.37)	(0.37)	(0.36)
Education	0.02	0.04	0.02	0.02	0.02	0.02	0.02
	(0.14)	(0.19)	(0.13)	(0.12)	(0.14)	(0.13)	(0.14)
Nat. Sci., Maths & Stat.	0.25	0.23	0.21	0.18	0.16	0.15	0.20
	(0.43)	(0.42)	(0.40)	(0.38)	(0.37)	(0.36)	(0.40)
Veterinary & Agriculture	0.02	0.02	0.02	0.01	0.01	0.02	0.02
	(0.14)	(0.14)	(0.13)	(0.12)	(0.12)	(0.13)	(0.13)
Info & Comm. Tech.	0.01	0.02	0.05	0.08	0.10	0.07	0.06
	(0.08)	(0.15)	(0.22)	(0.27)	(0.30)	(0.25)	(0.23)
Engineering & Techn.	0.28	0.23	0.24	0.20	0.15	0.17	0.22
	(0.45)	(0.42)	(0.43)	(0.40)	(0.36)	(0.38)	(0.41)
Observations	16,838	44,115	59,885	78,390	31,050	778	231,056
Panel B: *Earnings sample*							
Log real earnings	6.81	6.83	6.79	6.58	6.36	6.15	6.66
	(0.52)	(0.52)	(0.51)	(0.49)	(0.45)	(0.42)	(0.52)
Observations	2,894	9,365	14,405	19,553	7,359	148	53,724

Note: Standard deviations in parenthesis.

Table 2: Labor Market Outcomes and Economic Conditions at Time of College Enrollment

	Log real earnings					FT Employment
	(1)	(2)	(3)	(4)	(5)	(6)
Unemp at enrollment	0.0081	0.0117	0.0061	0.0290	0.0120	0.0006
	(.0023)***	(.0013)***	(.0019)***	(.0050)***	(.0016)***	(.0010)
Unemp at enrollment				-0.0009		
* Years since graduation				(.0002)***		
Age, age squared	Yes	Yes	Yes	Yes	Yes	Yes
Calendar Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Trend in cohort effect		Linear	Quadratic	Linear	Linear	Linear
Sample	Earnings	Earnings	Earnings	Earnings	Restricted	Full
R^2	0.1814	0.2102	0.2106	0.2111	0.2253	0.1573
N	53,724	53,724	53,724	53,724	43,542	253,828

Note: ***, ** and * denote statistical significance at the one, five and ten percent levels, respectively. All regressions include a race dummy, a dummy for foreign nationals, and 19 region of residence dummies. All regressions are weighted using person weights from the LFS. Standard errors are clustered by year of enrollment. Columns (1) to (4) use all observations for full-time workers with non-missing earnings data. Column (5) restricts the sample to individuals who enroll in university between the ages of 16 to 21. Column (6) uses the full sample (including those that are not part of the earnings survey and those not working full time)

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Table 3: Quantile Regressions of Log Real Earnings on Economic Conditions at Time of College Enrollment

	Quantile								
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Unemp at enrollment	0.0039	0.0086	0.0117	0.0127	0.0127	0.0130	0.0154	0.0167	0.0126
	(.0001)***	(.0001)***	(.0000)***	(.0000)***	(.0000)***	(.0000)***	(.0000)***	(.0000)***	(.0000)***
Age, age squared	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Calendar Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Trend in cohort effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R^2	0.0806	0.1141	0.1306	0.1384	0.1421	0.1440	0.1482	0.1563	0.1662
N	53,724	53,724	53,724	53,724	53,724	53,724	53,724	53,724	53,724

Note: ***, ** and * denote statistical significance at the one, five and ten percent levels, respectively. All regressions include a race dummy, a dummy for foreign nationals, and 19 region of residence dummies. All regressions are weighted using person weights from the LFS.

Table 4: Effect of unemployment on enrollment and graduation probabilities

	(1)	(2)	(3)	(4)
Unemp. at enrollment	-0.004	0.001	0.003	0.003
	(0.002)**	(0.003)	(0.001)**	(0.002)
Trend in cohort effect	Linear	Quadratic	Linear	Quadratic
R^2	0.089	0.089	0.040	0.040
N	618,072	618,072	253,828	253,828

Note: ***, ** and * denote statistical significance at the one, five and ten percent levels, respectively. All regressions include a race dummy, a dummy for foreign nationals, and 19 region of residence dummies. All regressions are weighted using person weights from the LFS. Standard errors are clustered by year of enrollment.

Table 5: Mechanisms

	(1)	(2)	(3)	(4)	(5)	(6)
Unemp at enrollment	0.0089	0.0104	0.0093	0.0080	0.0092	0.0086
	(.0025)***	(.0012)***	(.0012)***	(.0012)***	(.0012)***	(.0011)***
Unemp at graduation	-0.0370					
	(.0047)***					
Unemp at graduation	0.0020					
$*$ Years since graduation	(.0002)***					
Age, age squared	Yes	Yes	Yes	Yes	Yes	Yes
Trend in cohort effect		Yes	Yes	Yes	Yes	Yes
Calendar year FE	Yes					
Field-specific year FE		Yes				
Occ-specific year FE			Yes			
Occ-field-specific year FE				Yes		
Ind-specific year FE					Yes	
Ind-field-specific year FE						Yes
R^2	0.1958	0.2434	0.3132	0.3521	0.2469	0.2959
N	53,724	53,724	53,705	53,705	53,687	53,687

Note: ***, ** and * denote statistical significance at the one, five and ten percent levels, respectively. The dependent variable is log real earnings. All regressions include a race dummy, a dummy for foreign nationals, and 19 region of residence dummies. All regressions are weighted using person weights from the LFS. Standard errors are clustered by year of enrollment.

Table 6: Wage Regressions by Field of Study

	(1)	(2)	(3)	(4)	(5)
Field-specific Coeff on Unemp at Enrollment					
Health & Welfare	0.0027	-0.0004	-0.0014	Base	-0.0018
Social Sciences, Journalism & Info	0.0001	0.0048	0.0055*	0.0051	0.0018
Business, Admin & Law	0.0070*	0.0081**	0.0080**	0.0088	0.0051
Arts & Humanities	0.0016	0.0068***	0.0079***	0.0076	0.0048
Education	0.0038	0.0122***	0.0091**	0.0127*	0.0132***
Nat Sci, Math & Stat	0.0090***	0.0153***	0.0156***	0.0157***	0.0118***
Veterinary & Agriculture	0.0145	0.0174*	0.0175*	0.0174	0.0151
Info & Comm Tech	0.0254***	0.0204***	0.0201***	0.0219***	0.0226***
Engineering & Technologies	0.0077***	0.0110***	0.0101***	0.0117*	0.0079**
Field-specific age profile (quadratic)	Yes	Yes	Yes	Yes	Yes
Field-specific calendar Year FE	Yes	Yes	Yes	Yes	Yes
Overall trend in cohort effect		Yes			
Field-specific trend in cohort effect			Yes		
Cohort dummies				Yes	
Field-specific scarring effects					Yes
R^2	0.2152	0.2457	0.2469	0.2476	0.2321
N	53,724	53,724	53,724	53,724	53,724

Note: ***, ** and * denote statistical significance at the one, five and ten percent levels, respectively. The dependent variable is log real earnings. All regressions include a race dummy, a dummy for foreign nationals, and 19 region of residence dummies. All regressions are weighted using person weights from the LFS. Standard errors are clustered by year of enrollment.

Table 7: Ordered probit for GCSE score over the business cycle

	(1)	(2)
Unemp. at enrollment	-0.014	-0.015
	(0.006)**	(0.009)
Trend in cohort effect	Linear	Decade dummies
N	148,298	148,298

Note: ***, ** and * denote statistical significance at the one, five and ten percent levels, respectively. The dependent variable is the number of GCSE passed with a score of C or more. All regressions include a race dummy and a dummy for foreign nationals. All regressions are weighted using person weights from the LFS. Standard errors are clustered by year of enrollment. In all columns, the sample is restricted to individuals with information on their GCSE score. This information is only collected starting in the final wave of 2005.

Table 8: Effect of labor market conditions at enrollment on degree class

	(1)	(2)	(3)	(4)	(5)
Unemp. at enrollment	0.011	0.012	0.011	0.011	0.014
	(0.004)***	(0.004)***	(0.004)***	(0.003)***	(0.004)***
Quadratic trend in cohort effect	Yes	Yes	Yes	Yes	Yes
Age at enrollment		Yes	Yes	Yes	Yes
University major dummies			Yes	Yes	Yes
Field specific trend in cohort effect				Yes	Yes
GCSE-specific trend in cohort effect					Yes
R^2	0.025	0.026	0.040	0.042	0.053
N	151,363	151,363	151,363	151,363	136,077

Note: ***, ** and * denote statistical significance at the one, five and ten percent levels, respectively. The dependent variable is university degree class. All regressions include a race dummy and a dummy for foreign nationals. All regressions are weighted using person weights from the LFS. Standard errors are clustered by year of enrollment. In columns (1) to (4), the sample is restricted to individuals with information on their degree classification. In column (5) the sample is restricted to individuals with information on their GCSE score. This information are collected starting in the final wave of 2005.

Table 9: Degree class and wages

	(1)	(2)	(3)	(4)
Unemp at enrollment	0.0080	0.0086	0.0087	0.0080
	(.0020)***	(.0021)***	(.0021)***	(.0020)***
First Class		0.1495		0.1673
		(.0140)***		(.0139)***
Upper Second Class		0.0712		0.1063
		(.0135)***		(.0128)***
Lower Second Class		-0.0243		0.0077
		(.0146)		(.0144)
Third Class		-0.0829		-0.0606
		(.0191)***		(.0182)***
Age, age squared	Yes	Yes	Yes	Yes
Calendar year FE	Yes	Yes		
Trend in cohort effect	Yes	Yes	Yes	Yes
Degree class-specific calendar year FE			Yes	
Field-specific calendar year FE				Yes
R^2	0.2160	0.2300	0.2315	0.2611
N	30,693	30,693	30,693	30,693

Note: ***, ** and * denote statistical significance at the one, five and ten percent levels, respectively. The dependent variable is log real earnings. All regressions include a race dummy, a dummy for foreign nationals, and 19 region of residence dummies. All regressions are weighted using person weights from the LFS. Standard errors are clustered by year of enrollment. In all columns, the sample is restricted to individuals with information on their degree classification. This information is only collected starting in the final wave of 2005.