Cashier or Consultant? Entry Labor Market Conditions, Field of Study, and Career Success[1]

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Abstract

We analyze labor market outcomes of U.S. college graduates from the classes of 1976 to 2011, as a function of the economic conditions they graduated into. We categorize college majors by average economic outcomes and skill level of the major, predominantly the average earnings premium, and measure a range of labor market outcomes over the first 13 years after college graduation. We have three main findings. First, poor labor market conditions disrupt early careers. For the average major, a large recession at time of graduation reduces earnings and wages by roughly 11% and 3% (respectively) in the first year, and reduces the probability of full-time employment by 0.095. Effects on earnings and full-time employment fade out over the first 7 years of a career, while the wage effects persist. There is a small positive effect on the probability of obtaining an advanced degree. Second, for the period as a whole, these effects are differential across college majors. High-earning majors are somewhat sheltered when graduating into a recession relative to the average major, experiencing significantly smaller disadvantages in most labor market outcomes measured. As a result, the initial earnings and wage gaps across college majors widen by 33% and 8%, respectively, for those graduating into a large recession. Most of these effects fade out over the first 7 years, but impacts on wages and a measure of occupational match quality persist. Higher paying majors are also slightly less likely to obtain an advanced degree when graduating into a recession.

Our third set of results focuses on a recent period that includes the Great Recession. Early impacts on earnings are double what we would have expected given past patterns and the size of the recession, in part because of a large increase in the cyclical sensitivity of demand for college graduates. The effects are also dispersed much more evenly across college majors than those of prior recessions.

1 Introduction

The impact of the Great Recession was widespread, with unemployment rates doubling for nearly all subgroups of the population. Recent college graduates, whose unemployment rate increased from 9% in 2007 to a peak of 17.6% in 2009, were no exception.[1] Research on previous recessions suggests this group will experience significant earnings losses over their careers, relative to their luckier counterparts who graduated just before or just after the recession.[2] Research also suggests that college graduates face sizable earnings differences depending on their field of study.[3] A natural question then is how these returns will interact with the business cycle; who bears the brunt of the entry-conditions effect on earnings? Does an engineering student retain his or her roughly 75% earnings advantage above an education major, or even widen it when graduating into a recession? Or, does the general lack of opportunity compress these earnings differences?

College majors differ widely in the skill requirements of their degree and subsequent jobs. For example, Turner and Bowen (1999) show substantial variation in average SAT scores across college major and Arcidiacono (2004) shows that the ordering of majors by earnings is very similar to the ordering by relative SAT math score. It is also likely that training opportunities and skill appreciation will be more important for career paths in some majors than in others. Though the literature on the career effects of entry conditions is sparse on underlying mechanisms, Kahn (2010) suggests that human capital disparities are a likely driver. Consistent with this notion, effects are typically worse for higher human capital individuals for whom post-schooling skill accumulation is likely more important. For example, college graduates face larger, more persistent impacts than do high school graduates; white men experience worse wage outcomes than women and minorities.[4] We might therefore expect higher-skilled majors, where training opportunities could be more important, to bear larger costs when entry conditions are worse.

However, students in more skilled majors have better labor market opportunities, regardless of the business cycle they graduate into. We might then think that higher-skilled graduates can more easily weather a recession, downgrading into lower-skilled jobs if necessary, and crowding out their counterparts in other majors. They may also have the tools to recover more quickly from a poor initial job placement. Oreopoulos, von Wachter and Heisz

[1] These numbers are obtained from the School Enrollment Supplement to the Current Population Survey and are based on recent college graduates aged 20 to 29 who completed a bachelor's degree in the calendar year of the survey.

[2] Kahn (2010) estimates that white men graduating in the worst part of the 1981-82 recession earned over 20% less, relative to those graduating in nearby peaks, and these effects persisted for 15-20 years. Oreopoulos, von Wachter and Heisz (2012) find somewhat similar effects on men in Canada over a twenty-year period, though magnitudes and persistence are weaker.

[3] For example, Altonji, Blom and Meghir (2012) show that earnings differences across college majors can be as large as the overall college-high school premium. See their paper for a survey of the literature on the returns to college major.

[4] See Kondo (2008) and Hershbein (2012).

(2012) find that higher-skilled graduates who enter the labor market in a recession catch up more quickly than their lower-skilled counterparts. They argue this is because the returns to on-the-job search will be higher for this group, so they search with more intensity.

In this paper, we analyze short- and medium-term career outcomes of college graduates as a function of economic conditions at graduation and college major. The data requirements are formidable. We combine seven data sets with information on earnings and field of study for U.S. college graduates graduating between 1976 and 2011. Our pooled data yields coverage of multiple business cycles and larger sample sizes than the typical cohort-based analyses in this literature. We categorize our roughly 50 college majors by indicators of skill in these majors, particularly the average earnings premium in the major. We use the data to measure the impacts of graduating in times of higher unemployment across these skill groups for a range of labor market outcomes over the first 13 years of a career.

We address three main questions. First, what is the effect of graduating into a recession for the average college major? Second, how does this effect vary across college major? Third, have the answers to these questions changed in the Great Recession? Consistent with the previous literature, we find that graduating from college in times of higher unemployment is associated with significant earnings losses for the average major. Initial earnings decline by roughly 11% in response to a four percentage point increase in the unemployment rate (the increase seen in a large recession) at college graduation, and the effects partially persist for the first several years of a career, averaging to a roughly 3% earnings loss per year over the first 10 years. This result is consistent with that found in Oreopoulos et al. (2012) and a bit smaller and less persistent than that found by Kahn (2010).

We then examine the channels through which recessions affect labor market outcomes, focusing on employment, full-time status, wage rates, and occupational attainment. We find no evidence that the graduating unemployment rate impacts the probability of being employed. We were somewhat surprised by this finding but it may reflect the overall high likelihood that the average college graduate is employed. However, we do find substantial differences in the probability of working full-time; workers graduating into a large recession are 0.095 less likely to be working full time in their first year out of college, though this effect does not persist past the first three years after graduation. Furthermore, when we restrict the sample to full-time workers, the negative earnings effects of graduating in a recession are about half as large. Thus some of the earnings losses are accounted for by more time spent out of full-time employment. However, we also find sizable negative impacts of graduating into a large recession on wage rates, on the order of a roughly 3% wage loss, which persist for the entire potential experience window studied. We find no significant impacts on occupational attainment. Graduates in worse economies end up in similar occupations in terms of average returns and relative to what is typical for their major. Taken together, these results suggest the negative earnings impact of graduating in a recession is driven by a combination of impacts on hours and on earning power. More specifically, the initial effect on earnings seems mostly driven by effects on being in full-time employment, while the persistence is driven mostly by effects on wage rates.[5]

Regarding the second question, we find that the effects of labor market entry conditions are differential across college major. Typically high-earning majors are somewhat sheltered from the negative effects of graduating into a recession. They therefore increase their earnings advantage by almost a third when graduating into a large recession, and this effect persists for 6 years into a career. Our point estimates suggest that a major whose typical earnings are at least 1.4 standard deviations above the mean (such as finance, economics and some types of engineers) suffer no significant earnings losses when graduating into a period of high unemployment, while majors who typically earn 2 standard deviations below the mean (music and speech/drama, and philosophy and religion) experience double the earnings losses of the average major when graduating into a recession.

We find that the differential earnings effect across college major is due to a combination of differential effects on wages, employment, occupational attainment, and hours. The initial advantage enjoyed by high-earning majors graduating into a recession is reduced by almost half when we restrict to full-time workers, suggesting a roughly equal role for employment/hours and earning power. Indeed, we find significant differential effects on the probability of employment and full-time employment, as well as on wage rates, all favoring higher-skilled majors. High-earning majors increase their wage advantage by 8% when graduating into a large recession, and this effect is quite persistent. Occupations also seem to be an important margin for the differential effects. Higher earning majors are differentially more likely to be in higher paying occupations and they are more likely to find a job in the "typical" occupations associated with their major, relative to low-earning majors.[6]

Educational attainment might also be impacted by labor market entry conditions because they change the opportunity cost of remaining in school. Most research has focused on the impact of local labor market conditions on high school completion and college enrollment, and surprisingly little attention has been paid to the graduate school decision.[7] We examine the probability of attaining an advanced degree and find small positive effects for those graduating into a recession that are muted for higher-skilled majors, consistent with the relative changes in opportunity costs. This represents the broadest evidence to date on the subject of graduate educational attainment.

[5] It is possible that those graduating into a recession compensate for their persistently lower wage rates by working longer hours once the economy has recovered. This would explain the shorter persistence of the earnings effect. Unfortunately, we cannot measure hours consistently across data sets.

[6] Liu, Salvanes, and Sorensen (2012) analyze the effects of graduating from college into a recession in Norway and find initial impacts on wage rates as well as persistent impacts on unemployment. They show that an important channel through which these effects operate is the ability to find work in a high-paying industry. Similarly, Oyer (2006) and (2008) find persistent earnings losses for MBA's and economics PhD's graduating into recessions, and attribute much of these effects to initial industry placement.

[7] Exceptions include Kahn (2010) on educational attainment, and Bedard and Herman (2008) and Johnson (2013) on enrollment. See, for example, Card and Lemieux (2001) for more on high school graduation and college attendance as a function of local labor market conditions.

It is possible that the relative advantage of higher-skilled majors graduating into a recession is driven by a differential cyclicality in their labor demand.[8] To examine this mechanism, we construct and analyze the cyclicality of a major-specific graduation unemployment rate; this is the first such analysis to our knowledge. We use annual Current Population Survey data and the industry-occupation distribution for each major from a subset of our data to construct the unemployment rate in the industry-occupation cells that a given major tends to enter into. We indeed find a negative correlation between skill level and cyclicality of the major-specific unemployment rate, but it is small. A one standard deviation increase in skill level of the major reduces its cyclicality by only 9%, relative to the average major. Furthermore, directly controlling for the major-specific unemployment rate does not change our primary coefficients of interest, although these rates are imprecise.

The business cycle could also differentially impact majors if some majors typically enter into a narrower set of occupations. If some sectors are more impacted than others by a recession, then some jobs will be relatively more difficult to obtain when graduating into a recession. Majors who typically enter into a broader set of jobs should be somewhat sheltered, in expectation, from these effects. To investigate this issue, we construct an occupation-concentration measure for each major, defined as the share of workers from a given major working in the 5 most common occupations for that major, and estimate the differential impact of entry conditions across major concentration. Indeed, we find majors that feed into a more concentrated set of occupations do in fact fare worse when graduating into a recession relative to those who typically move to a more diverse set of jobs. However, the concentration measure is only weakly correlated with the earnings return to a major, so it does not help us account for the differential effects described above.

The final set of results concerns those who graduated into the Great Recession. First, we present evidence that 2004-2011 graduates, a period that included the Great Recession, saw much larger per-unit impacts of the aggregate unemployment rate on earnings – more than double the size of the earlier period. We document that these changes are associated with a large increase in the cyclicality of demand for college graduates. Second, the relative advantage of high-skilled majors graduating into a recession has largely disappeared. This may be due in part to an increase in cyclicality of demand for high-skilled majors relative to the average major, although this is probably only part of the story. Therefore, the 2004-2011 period is harsher overall on recent graduates, double what we would have expected given the size of the aggregate unemployment rate increase, but these effects are more evenly distributed across college major.

Our work is most closely related to Oreopoulos et al. (2012), who use Canadian university-employer-employee matched data to study the earnings effects of graduating in times of higher unemployment, and how these effects vary with the skill level of the graduate. They

[8] Such a mechanism is consistent with the literature on cyclical upgrading, which finds that employment in higher paying industries is more cyclical than that in lower paying industries (Bils and McLaughlin 2001).

find smaller and less persistent effects for workers who went to better schools, majored in more difficult subjects, and received better grades. They find this group is able to catch up more quickly through upgrading on firm quality. Our result that higher-skilled majors fare relatively better when graduating into a worse economy is entirely consistent with their work. We offer the first results on this question for the United States across a long time horizon with large sample sizes. We also show our results are robust to a number of different college major categorizations. In addition, we can measure a number of other outcomes, such as employment, wages and occupational and educational attainment, that were unavailable in the administrative data set used by Oreopoulos et al. (2012). Though we cannot measure firm quality in our data, we use occupation earnings differentials and the propensity to be in a popular occupation given one's major to assess the quality of jobs workers enter into over the business cycle and across college major.

This paper proceeds as follows. Section 2 discusses mechanisms through which bad labor market conditions at the time of graduation could have persistent impacts on a career and why these impacts might differ across college major. We discuss our data sources and some measurement issues in section 3 before describing methodology in section 4. Section 5 presents our core results on earnings, wages, employment, and occupational and educational attainment for the average major. Section 6 examines differential effects across major. Section 7 consider effects of recessions on graduate education. Section 8 examines effects of labor market conditions at graduation in recent years, including the Great Recession. Section 9 concludes.

2 Mechanisms

In this section, we explore potential mechanisms through which labor market entry conditions could impact workers' careers and why we might expect these impacts to be differential across college major.

The literature on entry conditions suggests that those graduating into recessions will start in lower level jobs and spend more time in unemployment (Devereux 2002).[9] We might think that a typically highly mobile young worker (Topel and Ward 1992) could recover from this setback, if slightly more gradually in the face of search frictions. Even this will result in differential speed of recovery if some workers exert a greater search intensity than others. Shimer (2004) points out that the expected return to job search will positively impact search intensity, and Oreopoulos et al. (2012) hypothesize that differential search intensity is driving their result that higher-skilled majors catch up relatively quickly when graduating into a recession. Furthermore, Wozniak (2010) finds that the geographic location choices of college

[9] One motivation for the former effect is found in the cyclical upgrading literature (e.g., Bils and McLaughlin 2001), which finds that higher paying industries are more sensitive to the business cycle. Matches occurring in a recession are therefore likely to be found in lower paying industries and individuals must work their way up as the economy recovers.

graduates are more sensitive to local labor conditions than are those of high school graduates. This suggests that higher-skilled workers are more adaptable to unlucky conditions, perhaps because they exert greater search effort. A pure search theoretic framework will predict a sluggish recovery that is in direct proportion to the inhibiting effects of search costs. If search costs are small then we should not see lasting labor market effects to graduating into a recession, but we might see differential effects across groups based on their expected returns to search or adaptability. In particular, this mechanism would suggest that higher-skilled majors with greater adaptability and likely greater returns to search will fare relatively better when graduating into a recession.

However, a number of factors suggest poor entry conditions will result in a longer setback. A poor early start could put college graduates in jobs with fewer training and promotion opportunities, resulting in a lasting disadvantage.[10] This disadvantage could easily be differential across college majors if graduates in some majors suffer greater mismatch between their degree and the opportunities for advancement in their starting jobs when graduating into a recession. We might think that for higher-skilled majors, post-schooling human capital accumulation is more important, suggesting they would suffer more from these effects. But this is actually an open question. Furthermore, time spent in unemployment or underemployment could be more damaging to some majors if skill depreciation is more rapid or ports of entry are more important. For example, Oyer (2006 and 2008) finds long-term earnings losses for economics Ph.D.'s and MBA's (respectively) graduating into worse economies, and these effects operate almost entirely through initial industry placement (entry into an academic job or the finance industry, respectively). Liu et al. (2012) find for college graduates in Norway that graduating into a recession substantially decreases the likelihood of working in a high-paying industry.

Individuals that choose majors that lead into a more concentrated set of occupations will likely be more at risk of experiencing negative consequences due to mismatch and skill depreciation associated with graduating into a recession. For example, accounting majors may only have a narrow range of occupations they can go into that take advantage of their skill set. If a couple of these occupations are severely impacted by the recession, an accounting major will be out of luck. In contrast, a major that typically sends students to a more diverse set of jobs, such as communications, could very well have an easier time weathering the recession, because a sectoral shock impacting any given occupation will be less damaging.[11] Furthermore, recessions will differ in the type of sectoral shocks experienced. This means some recessions will hit college graduates harder than others and these impacts will be differential across degree type. For example, the 2001 recession was driven in part

[10] For example, Gibbons and Waldman (2006) derive a model with task-specific human capital. Workers entering firms in worse economies start out in lower levels and aherefore never accumulate as much task-specific human capital in the more important jobs.

[11] By our measure, accounting is one of the most concentrated majors, while communications is among the least concentrated. See table 2 for a complete listing of majors.

by the "dot com" bust. This shock to the information technology sector likely resulted in larger impacts to college graduates overall and to those coming from technical majors more specifically.

A poor early start due to a recession also results in a murkier signal of worker quality, because perspective employers cannot update as much based on the worker's first job. This could then inhibit the assortative matching process that should occur as firms learn about worker quality (Gibbons, Katz, Lemieux, and Parent 2005), leaving unlucky recent graduates lagging behind. Finally, a series of papers finding evidence of persistent firm-level entry cohort effects (e.g., Baker, Gibbs, and Holmstrom 1994, and Beaudry and DiNardo 1991) suggest a role for contracting rigidities, such as wage insurance or bargaining based on outside options and imperfect mobility. We have only limited ability to consider these more contract theoretic explanations, due to data limitations, though we do find them interesting.

In sum, then, we would expect persistent career effects of graduating into a recession if search costs are very high or if training and promotion opportunities become limited after a poor early start. These effects might differ across college majors, but the direction of these effects is unclear. We speculate that higher-skilled majors may be better able to adapt to a poor early start through greater job search intensity, but also may be more damaged by a lack of human capital advancement opportunities and even experience worse impacts on skill depreciation. We do not have a strong prior about the relative effects of contracting rigidities on high skilled majors.

Finally, in this section we would like to discuss the interpretation of our results and whether they can be seen as uncovering a causal relationship between economic conditions and labor market outcomes and the interaction with college major. The impact of entry economic conditions on labor market outcomes is arguably exogenous since it is unlikely that students optimally time their graduation date (see Kahn 2010 for more on this).[12] However, choice of college major is certainly correlated with the ability to succeed in the labor market (see Altonji (1993) and Arcidiacono (2004), among others). In that sense, our paper simply reports heterogeneity in the effect of entry conditions across an observable characteristic. We do not wish to attribute a causal relationship between major choice and the ability to weather an economic downturn, but we think in a descriptive sense, any heterogeneity we find is quite interesting in its own right. A larger problem for our interpretation would be if students choose their college major in response to the business cycle, since this would yield differential selection into some college majors over the business cycle. Blom (2012) does find that students' major choices respond to aggregate economic conditions at age 20; she finds that students shift to higher-return majors when economic conditions are worse. Thus we might worry that unobserved ability within college major varies over the business cycle. This suggests that, if anything, high-return majors are more negatively selected when graduating

[12]Kahn (2010) corrects for any endogeneity in timing by instrumenting for graduation year with birth year. That she obtains similar results to the OLS somewhat alleviates this concern.

into a recession than into a boom, working against our finding that high return majors fare relatively better. A counter-cyclical increase in the relative supply of high return majors would also bias our estimates down. Furthermore, the correlation between the national unemployment rate at age 20 and at age 22 (when the modal student graduates) is 0.37 over our sample period. This implies that there is still substantial independent variation in graduation conditions, even controlling for earlier conditions.

3 Standard Sample Characteristics

3.1 Data Sources

In order to estimate the short- and medium-term effects of initial economic conditions on labor market outcomes across college major, with coverage over several national expansions and contractions, we pool multiple data sources: two National Longitudinal Surveys of Youth (the NLSY79 and NLSY97), the National Survey of College Graduates for 1993 (NSCG93) and 2003 (NSCG03), the Baccalaureate and Beyond 1993 (BB93) and 2008 (BB08), the National Longitudinal Study 1972 (NLS72), the Survey of Income and Program Participation (SIPP) 1984 through 2008 panels, and the American Community Survey (ACS) from 2009-2011.[13]

These surveys are chosen because they contain information on both college major and labor market outcomes.[14] To better align the length of time individuals can be observed post-college graduation across data sets, we restrict attention to workers between ages 22 and 35 and those who are between 0 and 13 years out of college. We also exclude workers who graduated before age 20 or after age 24 (roughly 3% of the sample, mostly from late graduates).[15] The pooled data meeting these criteria contain college graduates who graduated from college between 1976 and 2011 with an unbalanced panel of labor market outcomes measured from 1977 to 2011.[16] Appendix table 1 reports this coverage by survey.

[13]We do not use the 1985 SIPP panel, which does not have college major information, or the 1989 SIPP panel, which was abandoned and did not produce enough follow-up waves to be useable.

[14]The Current Population Survey March Supplement (March CPS) does not contain information on college major, but does have annual earnings and educational attainment for large sample sizes over a long time period. Thus we can use this survey to help identify the main effect of graduating into a recession, though not the differential effects across college major. When we do, we find effects similar to those from our pooled data sets. A second disadvantage of the March CPS, shared with the ACS, is that it does not provide information about graduation year. We have therefore chosen to remain consistent across analyses and only include data sets with information on college major. See the data appendix for more detail on the March CPS analysis.

[15]In all surveys but the ACS and the NLS72, we can determine the exact year of college graduation. For the ACS we take advantage of quarter of birth information to impute graduation year as the year an individual was likely age 22 in May of that year, the most common graduation age in the other data sets. In the NLS72, we infer the year of graduation from questions in each wave about years of college completed. If no other information is available, we assign graduation year as the first year in which a respondent says he or she has at least four years of college.

[16]Though we also have data on college graduates from 1971-75, the samples are small in those years, and

We provide a description of each survey and details of specific variable creation in the data appendix.

The goal in this paper is to estimate the impacts of entry conditions on subsequent labor market outcomes. We use the census division unemployment rate for the year in which the worker graduated from college as an indicator of entry conditions, hereafter U_c. The subscript c stands for the college graduation cohort which we define as a division-graduation year.[17] The unemployment rate is highly visible and is the most commonly-used measure of economic conditions in prior work. In particular, Kahn (2010) and Oreopoulos et al. (2012) show that both the national and local-level unemployment rates at time of college graduation have strong relationships with subsequent labor market outcomes. While the national economy is likely the most relevant for college graduates, a more local indicator provides useful variation to supplement the time series. On the downside, using a local unemployment rate introduces noise generated by our inability to pinpoint location of college graduation in some surveys.[18] When location is unavailable, we instead impute with current location of residence. Balancing these tensions, we compromise with the 9 census divisions as the geographic level of analysis. This takes advantage of spatial variation over time in entry conditions but does not generate as much additional noise as imputing state of college graduation – even if workers move across state lines after college, they are less likely to move across divisions.[19] Results are fully robust to instead using national, regional, or state-level unemployment rates, though estimates are somewhat less precise, especially in the case of the national rate.

To provide a sense of sample coverage, appendix table 2 presents counts of the number of observations in the pooled sample by U_c and years since graduation (hereafter potential experience). We have substantial sample sizes at both low and high levels of unemployment. However, the pooled data are heavily skewed towards low unemployment rates. This is because the ACS is much larger than the other data sets and its graduates tend to be from low unemployment years (with the exception of the most recent graduates from these surveys, who graduated into the Great Recession). This feature of our data leads us to employ a two-step estimation procedure that will allow us to put equal weight on each cohort-potential experience cell. We describe this procedure in more detail in section 4. While the nature of labor market shocks surely varies over time, it is interesting to characterize the overall impact of graduating into a period of high unemployment across the long time period spanned by our data sets. Estimates from an unweighted sample would instead primarily reflect the recent period. In section 8, we discuss how the effects of entry conditions differed in the

are therefore lost when we apply cell-size restrictions, described below.

[17] We use annual measures from the Bureau of Labor Statistics to reduce noise in the measure itself and because we cannot determine month of graduation in most data sets.

[18] The NSCG93 and the BB surveys have state of college graduation, while state of residence in the college graduation year is typically available in the NLS72, NLSY79, and NLSY97.

[19] Also, state-level information is not available in the NSCG03, so we can only disaggregate to division in these data.

years surrounding the Great Recession.

3.2 Labor Market Outcome Measures

In the subsequent sections, we measure the impacts of U_c on earnings, wage rates, employment, full-time employment, and occupational attainment. We describe specific variable creation in the data appendix. We pay particular attention to defining these variables as consistently as possible across surveys. However, because differences in definitions naturally arise across surveys, we always include survey fixed effects in the regression analysis.[20]

The earnings sample is restricted to non-enrolled workers earning at least $500 (in 2006 dollars) for the previous calendar year or 12-month period.[21] We exclude enrolled workers since any income they earn is less likely to be indicative of earning power, and more likely reflects part-time work while in school. We therefore also exclude earnings in the year of college graduation since this could partially reflect income while still in school. Results are fairly similar when we include the enrolled workers and/or include observations in the year of graduation, though early impacts of U_c on earnings are larger in magnitude.

We maintain the same sample restrictions for wages and occupation outcomes (described in more detail in section 5.2).[22] For analysis of employment and full-time employment (working at least 35 hours per week), we typically use variables that reflect employment status at a point in time.[23] In the employment analyses, we naturally include those who have no income for the year, but still exclude workers who are enrolled in school.

In table 1 we report weighted summary statistics, calculated by assigning equal weight to each cohort-potential experience cell. This most closely represents the weighting for the two-step estimation procedure described below. Panel A summarizes variables for the earnings sample, while panel B reports means of the dependent variables for the corresponding samples in each analysis. Average annual earnings in our data is about $45,500 in 2006 dollars. The average graduation year is 1990 and the average year of an earnings observation is 1997. As noted above, the pooled sample yields substantial variation in the unemployment rate at time of graduation. The national rate ranges from 4.0% to 9.7%, and the divisional rate ranges from 2.8% to 12.5%. In the full sample, 89% were employed and 77% were employed full time.

[20] Specifically, we treat the NLSY79, NLSY97, NSCG93, NSCG03, BB93, BB08, NLS72, early SIPP (panels 1984-1993), later SIPP (panels 1996-2008), and the ACS (waves 2009-2011) as separate surveys and control for survey fixed effects in all pooled regressions. See the data appendix for more detail.

[21] In the NSCG and BB93 samples, only annual salary in the current job is available. To reduce the influence of high-earning outliers, we top code annual earnings at $400,000.

[22] Wages are further restricted to be greater than $0 and are bottom- and top-coded to be between $5 and $250 per hour.

[23] The exception is the SIPP, which gives monthly measures of employment and full-time status. Because our analysis is at the annual level, we measure employment and full-time status as a fraction – e.g., months employed divided by 12 – in the SIPP.

3.3 Characteristics of College Majors

A primary goal of this paper is to estimate the differential effects of labor market conditions across college majors. In most data sets, we can easily classify college major into a set of 51 categories commonly used by the Department of Education.[24] In principle, we could estimate a separate U_c effect for each of the 51 major categories, but that quickly becomes intractable. Instead we categorize majors along a number of continuous dimensions and report how these measures interact with entry conditions.

Our preferred measure is the earnings return to the major. We estimate earnings returns on a sample of older workers (age 36 to 59) with at least a college degree who report being employed full time at the survey date in the pooled data (excluding SIPP). The age restriction excludes the regression sample used to estimate the effect of entry conditions on labor market outcomes, reducing any simultaneity concerns. We regress log earnings on worker characteristics, as well as survey, year, and major fixed effects.[25] We obtain the major fixed effects, merge them into the pooled regression sample (used to estimate the entry conditions effects), and standardize them to be mean zero and standard deviation one.[26] We denote these standardized fixed effects as β^{major}.

Table 2 reports the values of β^{major} for each of the 51 Department of Education major categories, sorted by β^{major}.[27] Chemical and electrical engineering, economics, and finance have the highest earnings returns, while philosophy and religion, several arts fields, and library science and non-secondary education have the lowest. The table also reports a number of other major characteristics, which we discuss later.

4 Econometric Model and Methods

To estimate the effect of the unemployment rate at graduation on labor market outcomes, and how this varies across college majors, we use the following specification.

$$\begin{aligned} Y_{ict} = {} & \beta_1 X_{it} + \beta_2 U_c + \beta_3 U_c PE_{it} + \beta_4 U_c PE_{it}^2 + \beta_6 \beta_i^{major} PE_{it} \\ & + \beta_7 \beta_i^{major} U_c + \beta_8 \beta_i^{major} U_c PE_{it} + \delta_t + \gamma_{major} + \epsilon_{ict} \end{aligned} \tag{1}$$

[24] The exception is the SIPP, which has one classification of 20 categories in panels 1984-1993 and another with 18 categories from 1994-2008. We explain how we use and combine these categories below.

[25] The worker characteristics controlled for in this regression are gender, race, and region dummies, and a cubic in potential experience.

[26] For the SIPP, which contains two separate major classifications, we estimate a similar log earnings regression in each of these samples (the early panels from 1984-1993 and the later panels from 1996-2008) and obtain major fixed effects for the SIPP categories. We merge these into the main regression sample as well and include them in the standardization. In the SIPP regressions as well as in the pooled one, psychology is the excluded major category. Note that the age and education sample restrictions are identical to those for the pooled sample, but in SIPP the full-time restriction is imposed by retaining only those who were employed full-time in at least three-quarters of the survey months that year.

[27] Values for the two SIPP classifications can be found in appendix tables 3a and 3b.

In equation (1), Y_{ict} is a labor market outcome measured in year t, for an individual i, in college graduation cohort c (division-graduation year). X_{it} is a set of control variables, including a quadratic in PE_{it} (potential experience).[28] We define PE_{it} as the number of years since college graduation minus 1, rather than actual labor market experience, which could be endogenously related to U_c and is not observed in most of our data sets. We subtract 1 so that interaction terms involving PE_{it} are 0 in the year after graduation, yielding a more natural interpretation for the main effects (the effect in the first year after graduation). δ_t is a fixed effect for the year when the outcome variable was measured to control for current demand conditions and secular changes over the long time period analyzed.[29]

U_c measures labor market entry conditions, defined as the deviation of the division unemployment rate from the sample (national) mean of 5.8% in the year of college graduation. The coefficient β_2 on U_c measures the impact of entry conditions on initial labor market outcomes (the year following graduation). Since β^{major} is standardized to be mean 0, the main effect of U_c is the impact for the average major. To measure the persistence of this impact, we interact U_c with a quadratic in potential experience. Results on persistence are not at all sensitive to the functional form of the potential experience interactions. (Results are robust to only including a linear interaction, and to controlling for potential experience with 3-year buckets and allowing these to interact with U_c.)

β^{major} is the earnings return to a given major. We control for the main effect of β^{major} with major fixed effects (γ_{major}) in our preferred specifications, and allow for a separate experience profile in β^{major} by including $\beta_i^{major} PE_{it}$. The coefficient β_7 measures the differential impact of entry conditions across college major on initial labor market outcomes. We include the three way interaction $\beta_i^{major} U_c PE_{it}$ to allow the differential effect to vary with experience. Again results are not sensitive to the functional form of the persistence term. (We could instead include a quadratic interaction or control for potential experience with 3-year buckets and allow these to interact with $\beta^{major} U_c$, and obtain similar results.) In some specifications we replace β^{major} with other major characteristics of interest, described later.

Note that the interpretation of the parameters is affected by the fact that entry division unemployment rates are positively correlated with the unemployment rates at 1 ($\rho = 0.85$) and 2 ($\rho = 0.57$) years experience, so a worker leaving school in a recession is likely to

[28] The controls included in X_{it} are survey fixed effects, a quadratic in potential experience, gender, race, gender interacted with race and potential experience, division of graduation/residence fixed effects, and the current division unemployment rate. As we describe below some of these will enter into the first step regression while others enter into the second step.

[29] Results are robust to a number of additional control variables. Specifically, the inclusion of survey-graduation year fixed effects and survey-potential experience interactions, and β^{major} interacted with a cubic time trend do not change the point estimates and actually improve precision. The survey interactions are useful since outcome measures vary slightly across surveys. The time trend in β^{major} controls for differences in the return to skills over time. Results are also robust to educational attainment controls, though we prefer to omit these since they could be endogenously related to labor market entry conditions. Instead we examine educational attainment as an outcome in section 7.

experience more than just one bad year of labor market conditions. Since we do not control for unemployment rates between the time of graduation and t, the terms involving U_c absorb the effects of variation in labor market conditions between c and t, conditional on the year dummies for t.[30]

4.1 Two-Step Estimation Procedure

In practice, we cannot obtain the average effect of U_c over the entire sample period from estimating the regression model in equation (1) on the pooled data. These data are not balanced across time or across experience levels and are instead heavily skewed towards recent cohorts.[31] We would instead like to weight the data more equally across years; this is especially important if these effects change over time.

One way to estimate average effects over the time period we study is to weight each cohort-potential experience cell equally. However, this method is accompanied by a large loss in efficiency, since it upweights noisy small cells and downweights precisely estimated large cells. There is no way around some degree of inefficiency if we want equal weighting. However, we attempt to retain some of the precision given in the larger cells through a two-step estimation procedure.

We first estimate a regression of a labor market outcome on the control variables, weighting observations with survey weights (to take full advantage of the extra precision from larger data sets). We then collapse residuals to the major-cohort-potential experience cell (we denote this *mcp*-level, where m is major, c is division-graduation year, and p is potential experience) and use these in a second step regression to estimate the coefficients of interest.[32][33] In this second step regression, we weight the data so that the distribution of observations across college majors, m, in a given *cp*-cell, matches the empirical distribution, but each *cp*-cell gets the same weight.[34]

Since the unit of observation in the second step is at the *mcp*-level, we are naturally worried that some cells made up of very few observations will have too large an influence.

[30] Oreopoulos et al. (2012) exclude year dummies from their main analysis, in which case U_c captures association between U_c and labor market conditions between labor market entry and t. They also attempt to isolate the partial effect of U_c by controlling for the values of unemployment during the years between labor market entry and t.

[31] As noted in the data section, this is due to the large sample sizes in the ACS.

[32] We treat the early and late SIPP major categories as separate majors from the 51 Department of Education categories. This gives us a total of 89 majors.

[33] In the first step regression, we include survey fixed effects, gender, race, gender interacted with race, and gender interacted with potential experience. The second step includes survey, year, and division fixed effects, the current division unemployment rate, a quadratic in potential experience, controls for major (either a major characteristic of interest such as β^{major} or major fixed effects), the major characteristic interacted with PE, and the key explanatory variables (U_c and a quadratic interaction with PE, U_c times the major characteristics and $U_c \cdot PE$ times the major characteristic). Because values in the second step are collapsed to the *mcp*-level, fixed effects actually reflect shares within each cell.

[34] Specifically, we weight the second-step regression by the number of observations in the *mcp*-cell divided by the number of observations in the *cp*-cell.

We address this concern in two ways. First, we drop all observations from graduation year-potential experience cells with fewer than 100 earnings observations to eliminate the influence of the smallest cells.[35] Second, we trim the *mcp*-cell fixed effects from the first stage regression to eliminate extreme outliers.[36] We then estimate the second-step regression described above.

In practice, we vary the control variables in the second-step regression depending on the parameters of interest, balancing concern for bias against concern for sampling error. The choice of controls drives the choice of how to cluster when estimating standard errors. When estimating the coefficients β_2, β_3, and β_4 on U_c, U_cPE and U_cPE^2, we exclude graduation year fixed effects. The exclusion allows both national and division-specific time series variation to contribute to identification of these parameters. Using the national variation reduces sampling error and reduces possible downward bias if division-specific variation in labor market conditions matters less for college graduates than national variation. On the other hand, unobserved trends in graduation year cohort characteristics could potentially affect the estimates.[37] The standard errors for β_2, β_3, and β_4 are clustered by cohort (division-graduation year), the level of variation underlying U_c.

For the parameters β_7 and β_8 governing the differential effects of U_c across β^{major}, time series variation is less important because of the variation in β^{major}, so we include graduation year fixed effects. We also include major fixed effects. Given the two sets of fixed effects, we prefer to use robust standard errors that simply account for heteroskedasticity. Standard error estimates are typically larger when we instead cluster at the major-cohort level, but conclusions about statistical significance remain the same in most cases. For example, in the earnings regression, the standard error for the coefficient on $U_c\beta^{major}$ is about a third larger when clustering at the major-cohort level.

5 The Effects of Graduating in Times of High Unemployment

We use annual earnings as our primary outcome measure because it incorporates impacts on both earning power and the ability to obtain work hours. We discuss these results in section 5.1. In section 5.2, we then investigate the degree to which impacts on employment and hours, wage rates, and occupational attainment can account for the earnings effects.

[35] This restriction removes about 25,000 person-year observations, or 4.4% of our pooled, unweighted data, mostly from the early waves of the SIPP.

[36] We regress the *mcp*-cell fixed effects on survey and year fixed effects, a quadratic in PE, β^{major}, and $\beta^{major} * PE$ and trim based on the residuals. We drop cells whose residuals are in the top and bottom 2%. Trimming eliminates 0.75% of the unweighted pooled sample. It does not change the point estimates, but improves precision considerably.

[37] In practice, when we use only the divisional variation by including graduation year fixed effects, the coefficient on U_c is quite similar.

5.1 Earnings

Table 3 reports regressions from the second step of the estimation procedure for log annual earnings. The number of observations for these regressions is the number of *mcp*-cells remaining after the cell size and outlier restrictions. The first two columns are targeted at understanding the main effect of labor market entry conditions (U_c) on future earnings; the other columns will be discussed later. Column 1 omits major fixed effects and instead includes the main effect of β^{major}, while column 2, our preferred specification, is based on the equation (1). The standard errors in the first two columns are clustered at the cohort (division-graduation year) level.

Column 1 shows that annual earnings fall by 0.0277 (with a standard error of 0.0053) log points in response to a one percentage point (ppt) increase in U_c. This effect is significant at the 1% level. The coefficient on U_c, as well as the interactions with potential experience and its square are almost identical in column 2, where we add major fixed effects.

For easier interpretation of these estimates, we calculate the impact of a 4 ppt increase in U_c, the approximate shift of U_c in the large 1981-82 and 2007-09 recessions, on log earnings for workers at various experience levels.[38] Column 1 of table 4 presents these estimates using the coefficients reported in table 3, column 2. The first row of table 4 displays the average impact across the first 10 years of experience.[39] Graduating into a large recession results in a roughly 3% earnings loss per year over the first 10 years of a career. The subsequent rows fit the experience profile starting with a large 0.11 log point earnings loss in the first year out of school. This effect halves in magnitude after 3 years experience, but remains significant at the 1% level. It declines to an insignificant zero by year 7.[40]

These earnings effects are quite consistent with Oreopoulos et al. (2012), who exploit national and regional variation in labor market conditions in Canada over a 20-year period. They find a 1 ppt increase in the national unemployment rate at college graduation reduces earnings by roughly 2% in the first year (or by 8% for a large recession) and this effect fades away over the next 5 years. In contrast, Kahn (2010) finds an initial decline in pay rates of more than 20% for white males who graduated in the worst part of the 1981-82 recession compared to those who graduated in the nearby booms; these effects diminish over time but remain significant well past 10 years out of college. We later discuss heterogeneity in the impact of entry conditions on labor market outcomes across recessions.

From now on, we report results for other dependent variables and samples using the format in table 4 for easier interpretation. The underlying regressions are all as specified

[38] One should keep in mind that since the model is linear in U_c and the parameters are identified by variation associated with booms as well as recessions, our estimates equally apply to a 4 ppt shift from a large boom to an average economy and can be used to characterize the advantage of graduating in a boom.

[39] We fit an unweighted average across the first 10 years to avoid impacts of sample composition.

[40] Though not reported here, we have also estimated the effects separately for men and women and find that the two groups experience remarkably similar earnings losses when graduating into a recession. These results are available upon request.

in column 2 of table 3, except we either replace the dependent variable or alter the sample restrictions. The key regression results are summarized in web appendix tables 1-6.

5.2 Mechanisms

The remainder of table 4 gives guidance as to whether these earnings effects are driven by differences in time spent working, wage rates, occupational attainment, or some combination. Column 2 restricts the sample to full-time workers, retaining 85% of the earnings sample. Effects are roughly half the magnitude of those in column 1 and somewhat less significant, statistically. In the full-time sample, those graduating into a large recession still lose 0.046 (0.0186) in log earnings in the first year out of school and 0.017 (0.0094) on average over their first 10 years. Columns 1 and 2 together suggest the ability to find full-time work may be impaired when graduating into a recession.

We next analyze the probability of employment and full-time employment directly and present the results in columns 3 and 4, respectively (we do not have consistent data on annual work hours). Surprisingly, column 3 shows that the probability of being employed is not impacted by labor market entry conditions. The point estimates of graduating into a large recession are very close to 0 for every experience level. Given the standard errors, we can rule out effects outside the range of roughly ± 0.01 with at least 90% confidence, quite small compared to the 0.89 mean probability of employment in this sample.

In contrast, column 4 shows sizable effects on the probability of full-time employment. In the first year out of school, a worker who graduated into a large recession is 0.0947 (0.0128) less likely to be in full-time employment, statistically significant at the 1% level. Compared to the mean probability of full-time employment for this sample, 0.77, this effect is quite substantial. The effect dissipates quickly, falling to less than a third its size by 3 years out. On average across the first 10 years of a career, the effect of graduating into a large recession on the probability of full-time employment (row 1) is close to 0.

Thus, outside of the first few years after graduation, we find almost no effect on employment and hours. This is perhaps not surprising, given our sample is made up of college graduates – a group very likely to be in full-time employment. However, the effects on full-time employment in the first few years are large enough to sizably impact earnings. In our data, the gap in average earnings of full- and part-time workers is more than 1.0 log point. A reduction in full-time employment of the size we estimate (0.0947) could account for more than 100% of the substantial losses in first-year earnings for the full sample, which are more than double the losses estimated from the sample restricted to full-time workers.

To better understand effects on earning power, we next examine wage rates, defined to be a rate of pay, rather than realized earnings which would be impacted directly by labor supply. Column 5 shows that workers who graduate into a large recession earn roughly 3% lower wages on average over the first 10 years of a career. This effect is quite similar across years of experience and does not dissipate. Though not shown here, impacts are very similar when we restrict the sample to full-time workers. These effects are quite a bit smaller in magnitude than those found by Kahn (2010), who also studies wage rates, but just as persistent. Interestingly then, while we find no lingering effects on total earnings 7 and 10 years after graduation, effects on wage rates persist. The results are consistent with evidence in studies that can distinguish wage rates, employment, and work hours that employment and work hours recover fairly quickly following a layoff but wage losses persist.[41] It is possible that workers who graduate into a recession compensate for lost earnings by increasing hours later in their careers. Unfortunately we cannot measure hours consistently across our data sets and therefore cannot analyze this margin directly. However, the estimated positive effect of U_c on full-time employment in year 7 is suggestive of such an effect.[42]

As discussed in section 2, wage rates can be impacted for a number of reasons. Early difficulty finding full-time employment could impact human capital or a worker's ability to signal his or her quality. Also, workers graduating into recessions may place into lower-level jobs or suffer from early mismatch. Both of these effects could negatively impact early wages and, to the extent that there is path dependence, reduce long-term wages. Though we cannot measure the causal impact of early hours on future wage rates, we can explore occupational attainment. We exploit two occupation measures. First, to understand impacts on overall job quality, we categorize occupations by average earnings return.[43] Second, to better understand mismatch, we use an indicator for whether a worker is in an occupation typical of that major. In practice we define "typical" as being in one of the top 5 occupations for the major, but results are quite robust to varying the number of "top" occupations included. We hereafter denote this measure $Top5$.[44]

Results are reported in columns 6 and 7 of table 4. In column 6, the point estimate of the effect of graduating into a large recession on occupation quality (average log earnings return to the occupation) in the first year out is -0.01 (0.008) but is not significant. These coefficients are easily interpreted since the occupation earnings return is in log earnings units. Thus the -0.01 effect is about one tenth of the effect on earnings and about a third of the effect on wage rates, where one would expect impacts on occupation quality to be

[41] See for example, Stevens (1997) and Altonji, Smith and Vidangos (2013).

[42] The size of the difference in the recession effects on earnings and wages may be understated due to the fact that for the NSCG and BB93 samples we have to use current annual salary as both our earnings and wage measures.

[43] Using just ACS data for full-time, non-enrolled workers aged 25-59, earning at least $500, we regress log earnings on worker characteristics (race, education, and a cubic in potential experience) and occupation fixed effects (using 1990 3-digit Census codes). We use these occupation fixed effects as our measure of occupation quality. We use the large ACS samples, rather than the pooled data set, to obtain more precise estimates. Thus occupation quality is the average earnings return to the occupation from 2009-2011.

[44] This variable is defined on the same sample as the occupation earnings return measure, except we restrict attention to college graduates. The top 5 occupations for a given major are invariant to potential experience. That is, we classify the top 5 occupations for the whole sample period. See Altonji et al. (2012) for evidence on the distribution of similar measures of occupation concentration across college major by years of potential experience.

concentrated. Given the standard error, we cannot rule out an effect as large as -0.024 with 90% confidence. The effects die out at a rate more similar to earnings than wage rates and are quite small for experienced workers. For the average effect over the first 10 years of a career, we can rule out effects as large as -0.01 with 90% confidence.[45]

We find similar results for match quality (column 7). Again, our measure of match quality is $Top5$, an indicator for whether worker's occupation is one of the 5 most common ones for his or her major. The sample mean of this variable is 0.40. In the first year out, workers graduating into a large recession are 0.0256 (0.0155) less likely to be in a popular occupation, but this effect is only significant at the 10% level and quickly loses significance. The average effect over 10 years is insignificant, but the 90% confidence interval includes magnitudes as large as a 0.03 decline in this probability, sizable relative to the sample mean. In thinking about the extent to which entry conditions might influence earnings through $Top5$, it is important to know the association between $Top5$ and log earnings, conditional on the major. We are not aware of prior evidence on this. We therefore augment the log earnings regression reported in column 3 of table 3 (which includes major and graduation year fixed effects) with controls for $Top5$ and its interaction with potential experience. The coefficient on $Top5$ is 0.16 (0.016) and the coefficient on $Top5 \cdot PE$ is -0.0048 (0.0023). Thus, there is a substantial monetary return to obtaining an occupation that is typical for one's major that slowly declines with time in the labor market. However, the point estimate of the effect of U_c on $Top5$ in the first year and the upper bound of the 90% confidence band indicate that increased mismatch can account for only a small part of negative effect of U_c on earnings.

5.3 Summary of the Effects of Graduating in a Recession for the Average Major

In this section, we have provided evidence that graduating into a large recession results in modest, negative earnings effects that persist for several years after graduation. These effects are accounted for by a reduced probability of finding full-time employment in the first few years and a persistent impact on wage rates. Though we do not find significant effects on occupational attainment, those estimates are quite noisy; we cannot rule out that large differences in occupation and match quality account for some of the impact on wages, particularly in the early years of a career.

[45] We have also defined occupation quality as the log hourly wage return to the occupation (rather than the log earnings return) and obtained extremely similar results.

6 Differential Effects Across College Major

In this section we analyze whether the effects of graduating into a recession differ across college major, and if so, why. For the most part, we use the earnings return to the major, β^{major}, to characterize college majors. We begin with earnings, followed by an analysis of employment and hours, wage rates, and occupational attainment as potential mechanisms to account for the earnings results. We then investigate whether differential cyclicality of labor demand across college majors can account for the differential earnings effects. Finally, we explore alternative characteristics of college major.

6.1 Earnings

Table 3 also summarizes regression results on the interaction effects between β^{major}, the earnings return to the major, and the graduating unemployment rate (U_c). The third column, our preferred specification, includes graduation year fixed effects as well as major fixed effects and reports heteroskedasticity robust standard errors. Column 4 reports a more conservative set of standard errors that are clustered by major-division-graduation year.

Higher return majors are somewhat sheltered from the economy relative to those in lower return majors. Column 3, row 6 of this table reports estimates of β_7 (from equation 1), the coefficient on the interaction term $\beta^{major}U_c$. Since β^{major} has a standard deviation of 1 and a mean of 0, this is the difference between a major that is one standard deviation above the mean of β^{major} and an average major in the earnings response to a 1 ppt increase in U_c. The point estimate is 0.0135 (0.0027) log points, which is is statistically significant at the 1% level and large enough to offset about half of the main effect of U_c on the average major (row 1). Another useful benchmark for the magnitude of this effect is the main effect of β^{major} on log earnings (column 1), which is about 0.17 (0.007) log points. Each percentage point increase in U_c widens the initial earnings gap between a one standard deviation higher β^{major} and the average major by an additional 12.5%. This effect declines with potential experience; the estimate of β_8, the coefficient on $\beta^{major} \cdot U_c \cdot PE_{it}$ is -0.0020 (0.0004).

To more easily interpret the magnitudes and their persistence over time, we fit the differential impact between a high return major ($\beta^{major} = 1$) and an average major ($\beta^{major} = 0$) of graduating into a large recession. By large recession, we continue to mean a 4 ppt increase in U_c above the sample mean. We will often use the term "differential effect" of a large recession, which corresponds to the values of $\beta_7 \cdot 4 + \beta_8 PE_{it} \cdot 4$ for the specified value of PE_{it}, based on estimates from column 3 of table 3. Table 5, column 1, Panel B reports the estimates averaged across 10 years of experience, followed by the estimates for 1, 3, 7, and 10 years experience. In panel A, we report the main effect of β^{major} as well the coefficient on its interaction with potential experience from the regression specification in column 1 of table 3, as a benchmark.

On average over the first 10 years of a career, high return majors majors lose 0.0179

(0.0063) log points less in earnings, relative to the average major graduating into a large recession. This is a substantial offset to the 0.0311 loss experienced by the average major (see table 4, column 1). In the first year after graduation, the loss is 0.054 (0.011) less for a high return major. Relative to the main effect of β^{major} (a 0.17 earnings return for a one standard deviation larger value), graduating into a large recession widens the earnings advantage of a high-return major by an additional third. Over time, the differential impacts of graduating into a recession do diminish, becoming insignificant by 7 years out.[46]

These results are in line with Oreopoulos et al. (2012), who also find that higher-skilled graduates face smaller, less persistent earnings losses when graduating into a recession. In fact, our point estimates imply that a major with at least a 1.4 standard deviation larger β^{major} (e.g., finance, economics, and some types of engineers) will not experience a significant earnings loss, even in the first year out of school.

6.2 Mechanisms

We again wish to determine whether the differential earnings impacts across college major operate through employment, hours, wage rates, occupational attainment, or some combination. Columns 2-7 of table 5 report the differential impact of graduating into a large recession for a high return major, compared to an average major, on earnings of full-time workers and on other outcomes. They are calculated from regression specifications similar to those reported for log earnings in column 3 of table 3, but with different dependent variables or samples.[47]

Column 2 of table 5 presents differential earnings impacts restricting the sample to full-time workers. Except in the first few years, this sample produces results quite similar to the overall earnings estimates. The initial differential effect when restricting to full-time (row 2 of panel B) is smaller, but slightly more persistent than for the full sample, remaining important and statistically significant well past 7 years out and only reaching 0 by 10 years out. This leaves the average differential effect over the first ten years nearly identical to that in the full sample. The similarity across columns 1 and 2 suggests a large role for wage rates and only a limited scope for employment and hours as the source of the high β^{major} advantage in a recession. However, we next examine each of these directly and find that this is not the case.

Column 3 presents results on the probability of being employed. Panel A provides the main effect of β^{major} on the probability of being employed and the coefficient on $\beta^{major}PE_{it}$ (obtained from a similar regression specification to that underlying column 1 in table 3, which excludes major fixed effects – see column 1 of web appendix table 2). These estimates are only

[46] We have also estimated these effects separately for men and women and found that the differential impacts of graduating into a recession are similar but a bit larger for women than for men.

[47] These results are generated from the same regressions that underlie columns 2-7 of table 4 and are summarized in web appendix tables 1-6. Detailed regression results are available upon request.

0.0034 and 0.0005, respectively, indicating that there is essentially no employment advantage to being in a higher-skilled major in a normal economy. Interestingly though, an employment advantage does arise when graduating into a recession. From panel B, graduating into a large recession increases the employment advantage of high-skilled majors by 0.0118 (0.0049) in the first year after graduation, and the effect remains significant through the first 3 years out of school. This advantage could be important in accounting for the differential earnings impacts, especially in the first few years.

Column 4 shows that the impact of graduating into a large recession on the probability of obtaining full-time employment is less negative for high paying majors. These effects are both larger in magnitude and more persistent than the differential impacts on employment. The differential effect 1 year after graduation is a 0.02 (0.0079) increase in the probability of full-time employment. Thus the main effect of U_c (from table 4) is reduced in magnitude by 22% for a one standard deviation higher β^{major}. This offset is also large relative to the main effect of β^{major} on full-time employment, which is 0.037 (column 4, panel A, row 1). Furthermore, the effect persists and is statistically significant at even 7 years out. Thus, the differential impact of graduating into a large recession on job-finding capability can partially explain why the earnings of high return majors decline less.

At the same time, given that even full-time workers experience large earnings differentials across college major (column 2), we would also expect a large role for wage rates. Column 5 presents the wage results and shows modest impacts that are marginally significant. Over 10 years, the average differential effect on wages is 0.0099 (0.0054) log point. Effects of this magnitude persist for most of the first 10 years of a career. This offsets roughly a third of the negative wage effect of graduating into a large recession (the main effect of U_c in column 5, table 4). The effect of -0.011 (0.0095) in the first year out of school also widens the initial wage gap across college majors by about 8% (using the main effect of 0.138 reported in panel A). Thus the differential impact on wages is nontrivial; the average effect across 10 years experience is roughly half that of the differential earnings effect (column 1). Though not shown here, magnitudes increase when we restrict the sample to full-time earners.

Columns 6 and 7 present results on occupational attainment. Though we found little evidence that graduating into a recession impacts occupation for the average major (table 4, columns 6 and 7), we do find large differential effects across major. First from column 6, higher β^{major} majors are differentially in higher quality occupations when they graduate into a large recession. Panel B shows that graduating into a large recession widens the occupational earnings advantage of higher return majors by 0.017 (0.0051) log points in the first year and by 0.007 (0.003) on average over the first 10 years of a career, significant at the 1% and 5% levels, respectively. Thus a substantial part of the earnings and wage effects could be driven by lower β^{major} workers finding lower quality jobs.[48]

[48]Our estimates imply that most of the earnings differential across college majors can be accounted for by differences in occupation quality. From panel A, a one standard deviation increase in β^{major} is associated

Furthermore, majors with a low β^{major} are, based on our measure, relatively more likely to be mismatched when graduating into a large recession. Column 7 presents results on whether a worker is in one of the top 5 most common occupations for his or her major ($Top5 = 1$). While there is no particular pattern across β^{major} in this outcome (panel A), there are differential effects when graduating into a large recession (panel B). A high β^{major} is on average 0.0095 (0.0055) more likely to be in a common occupation; this effect is small in magnitude and insignificant in the first year out of school, but grows as workers gain experience, persisting for the entire time period studied. Thus, relative to lower return majors, high return majors seem to have an easier time "staying on track" when graduating into a recession. Staying on track does not necessarily mean higher earnings, since some majors may lead to occupations that pay little but have favorable non-pecuniary attributes. However, on average $Top5$ has a substantial positive association with log earnings conditional on the major (see above). Given this fact, the results suggest that in a large recession, low β^{major} graduates are less successful in obtaining the types of jobs they had in mind when they chose their major, and likely experience earnings losses as a result.

On balance, the evidence reported in table 5 suggests that the milder effect of a recession on the earnings of high return majors is driven by both the wage rate margin and the employment and hours margin, with part of the differential effect on wage rates possibly driven by occupational attainment. The larger differential earnings effect in the first year out of school seems to be attributable to the differential employment and hours effects, but persistent differential effects on occupational attainment and wages are important throughout.

6.3 Robustness to Alternative Measures of College Major Skill Level

The results on college major are robust to a number of different measures of the skill level of the major. Though we focus on the earnings return (β^{major}) for most of our analysis, we also find similar results when using the average SAT math score in the major, as well as an SAT-ACT composite score.[49] In addition, we have explored robustness to a proxy measure for the skill level required in the occupations a major typically enters into, using O*NET task data on critical thinking and problem solving.[50] Results are also largely consistent here.

with a 0.168 increase in log earnings (column 1, panel A), as well as an increase in occupational quality of 0.146 log earnings points (column 6, panel A). Taken at face value these estimates suggest that 83% of the earnings return to college major are associated with access to higher-paying occupations, but this is an overstatement because we did not control for college major when estimating the occupation fixed effects. Using the 171 major categories available in the ACS in a log wage equation, Altonji et al. (2012) report that among men the standard deviation of college major coefficients falls from 0.177 to 0.098 when detailed occupation controls are added. The corresponding values for women are 0.146 and 0.074.

[49] We construct average test scores for the 51 Department of Education major classifications using both BB panels. For the SIPP we generate a crosswalk between the Department of Education majors and the SIPP majors based on the names of the majors. The mappings are reported in appendix tables 4a and 4b.

[50] Via principal components analysis, we obtain the primary factor from a set of O*NET measures associated with critical thinking and problem solving. This measure is highly correlated with earnings. We aggregate these to the major level by taking a weighted average across 3-digit 1990 Census occupations using

Average SAT math score and occupation skill measure are reported in table 2, by major. As can be seen, both measures are highly correlated with β^{major}. Therefore it is unsurprising that these measures produce similar results, but it is comforting that the results are not particularly sensitive to the way we define β^{major}.[51]

6.4 Differences in Demand Cyclicality Across College Major

In this section so far, we have shown that high-skilled majors are somewhat sheltered from the negative effects of graduating into a recession, relative to lower-skilled majors. A potential explanation for this finding is that labor demand for high-skilled majors is less sensitive to the business cycle. This could, in particular, explain why high-skilled majors are relatively more likely to be in a typical occupation for their field of study when graduating into a recession.

We develop two time-varying measures of major-specific labor demand conditions: the major-specific unemployment rate (U_c^{major}) and the major-specific annual employment growth rate (the first difference in the log of employment in the major).[52] We obtain industry-occupation-specific annual unemployment rates and employment levels using the Current Population Survey March Supplement, then aggregate these to the major level using a mapping between major and occupation-industry based on our pooled sample for workers age 26-59.[53][54] Averages for U_c^{major} are reported in table 2. The higher-skilled majors (those with higher β^{major} and test scores) tend to have lower unemployment rates. This illustrates the problem that unemployment rates reflect both labor demand and adaptability. The controls for major fixed effects in our regressions remove these permanent differences across majors,

employment shares within a major from the ACS (for workers aged 36-59) as the weights.

[51] Appendix tables 5 and 6 report results using SAT Math and the occupation skill measure, respectively, and are analogous to table 5.

[52] Major-specific unemployment rates are a function of both major-specific labor demand and the adaptability of workers in the major (i.e., the ability to find a job). Ideally we would use a measure that only includes the former effect, since the latter is more related to major ability. The growth in the log of employment is less affected by this problem but the link between the change in employment and the level of employment demand may be more tenuous, which is why we prefer the unemployment rate. We do not use employment levels because the link between this measure and the aggregate unemployment rate is highly sensitive to how we detrend it.

[53] Major-specific employment is the weighted sum of employment in all occupation-industry cells, using the shares from the major-occupation-industry mapping as weights, while the major-specific unemployment rate is a weighted average of occupation-industry-specific unemployment rates. We define the latter as the number of unemployed people who report that their most recent job was in a given occupation-industry cell divided by this plus employment in the occupation-industry cell. We use 3-digit 1990 Census occupations and 12 "major" industry categories also based on 1990 Census codes.

[54] The major to occupation-industry cell mapping is generated for the 51 Department of Education major categories using just the ACS and NSCG samples (the largest of our data sets) and thus excludes the SIPP. In the case of SIPP, we use the previously-mentioned cross-walk (reported in appendix tables 4a and 4b). The demand measure for each SIPP category is the weighted average of the demand measures for the constituent Department of Education majors. The weights are based on the shares of each component Department of Education major category in our pooled data set, with SIPP excluded. The mapping and weights are computed at the national level rather than the divisional level.

but the importance of ability differences could easily vary over the business cycle. In contrast the employment growth rates are uncorrelated with β^{major} (not shown), but these measures are problematic for other reasons described above.

We now investigate the relationship between U_c^{major} and aggregate economic conditions, and whether the relationship is differential across β^{major}. Column 1 of table 6 reports regressions of the divisional value of U_c^{major} on the divisional value of U_c, β^{major}, and $\beta^{major} * U_c$, over the time period 1971-2012, where an observation is a major-division-year. We control for a cubic time trend. The coefficient on U_c is 0.25 (0.0043), which says that the unemployment rate for college graduates fluctuates only about one fourth as widely as that of the whole labor market. The coefficient on β^{major} is small and negative; higher-skilled majors are less likely to be unemployed. The interaction term of -0.023 (0.003) indicates that when aggregate unemployment rises, labor demand conditions deteriorate relatively less for higher-earning majors.[55] Columns 2-4 will be discussed later. Column 5 reports estimates defining U_c and U_c^{major} at the national level (an observation is a major-year). The coefficient on β^{major} is larger, 0.51, likely reflecting the fact that the national market is more relevant for college graduates than the divisional, but the coefficient on $\beta^{major} * U_c$ is again very small relative to main effect. We obtain similar results when using the major-specific employment growth rate, rather than U_c^{major}.

The fact that demand for high-skilled majors is less sensitive to the business cycle could help account for the widening earnings advantage of high-skilled majors in recessions compared to booms. However, given the very small magnitude of the interaction effect on major-specific unemployment (-0.023), relative to the overall impact of the unemployment rate (0.25), one would not expect the measure to explain much of the earnings differentials. This is exactly what we find. Specifically, adding controls for U_c^{major} and its interaction with potential experience to the earnings regressions reported in table 3 has almost no effect on the coefficients on $\beta^{major} \cdot U_c$ and $\beta^{major} \cdot U_c \cdot PE$ that govern differential effects of entry conditions across β^{major} (results not reported). The same is true when the analysis is performed defining cohorts and U_c at the graduation year-national level. Therefore, this particular measure of major-cyclicality cannot account for our earnings findings. Nor does it change the results for the other labor market outcomes. However, as we have noted, major specific unemployment rates are difficult to interpret since they also reflect the ability of workers to find jobs outside their usual occupation paths in a difficult economy. It is reassuring that we obtain similar results when we instead use the employment growth rate in the major, even though sampling error in both measures may reduce their usefulness as control variables.

In summary, we have no evidence that differential labor demand conditions are driving the differential effects of U_c across β^{major} for the full sample period, although we would not

[55] The negative interaction term could also reflect the possibility that higher earning majors are more versatile and are better able to avoid unemployment in the face of given change in demand. That is, even the small coefficient we obtain might overstate the magnitude of degree of difference across β^{major} in the cyclicality of demand.

rule out a small role given the problems with our major-specific demand measures.

6.5 Occupational Concentration of Majors

Another way of characterizing college majors that is not necessarily reflective of skill, but could be particularly relevant over the business cycle, is by the degree of occupational concentration. Some majors typically enter into a narrower set of occupations than others. These majors could thus be more prone to sectoral shocks, since they have a less diverse set of options. We next explore whether the effects of graduating into a recession are differential across the occupational concentration of the major.

We define the major-concentration measure as the share of graduates within a major who are in the top 5 occupations for that major.[56] For easier interpretation of the regression results, we standardize this measure to be mean 0, standard deviation 1.[57] Table 2 summarizes this measure for each major category, and shows it is fairly uncorrelated with β^{major}. Nursing, computer programming, and civil engineering have the highest occupation concentration levels, while environmental studies, film and other arts, and other social sciences have the lowest.[58]

Table 7 summarizes regression results in a similar format to table 5 except here we replace β^{major} with the concentration measure. Column 1 shows impacts on earnings. First note from panel A that there is an earnings return to being in a concentrated major. A one standard-deviation higher concentration is associated with a 0.051 (0.008) earnings gain, though most of this earnings return dissipates over the first decade of a career. Panel B shows that majors with a more concentrated set of occupations fare worse when graduating into a recession, relative to those who typically move to a more diverse set of jobs. They earn 0.027 log points less in the first year after graduation, eliminating about half of the earnings advantage reported in panel A. This is interesting and intuitive since majors in a more concentrated set of occupations may be more likely to suffer from unemployment or mismatch when graduating into a recession. We examine these effects directly next.

Column 3 shows that more concentrated majors have a slight disadvantage in finding employment when graduating into a recession. Magnitudes are fairly small relative to the sample mean employment of 89%. However, the magnitude is not small compared to the positive main effect of concentration on employment (panel A). Graduating into a large recession more than fully offsets the employment advantage of highly concentrated majors. Thus in some sense, the employment effects are sizable.

We do not find any differential impact on the probability of full-time employment (column

[56] Our results are robust to varying the number of "top" occupations from 3 to 7. We have also experimented with a Herfindahl index of occupation concentration, which yields qualitatively similar results.

[57] The major-concentration measure is created for each of the 51 Department of Education major categories. For the SIPP we use the crosswalks defined in appendix tables 4a and 4b.

[58] Altonji et al. (2012) characterize majors by this concentration measure and also show that the degree to which majors are concentrated in a specific set of occupations declines with potential experience.

4) and therefore unsurprisingly find that most of the earnings effect persists in the full-time sample (column 2) and that wage rates are highly impacted (column 5). One reason for large impacts on wage rates could be that majors with high occupation concentration are more prone to mismatch. Indeed, this is exactly what we find in column 7, which presents results for the probability of being in a popular occupation given one's major ($Top5$) as the outcome. By definition, highly concentrated majors are substantially more likely to be in one of the top 5 occupations for their major (0.15 from panel A). This gap is reduced by 9% when graduating into a large recession. Furthermore, the effect persists as workers gain experience, even increasing in magnitude.

In summary, majors with a more concentrated set of occupations do have more difficulty finding employment initially, and are increasingly likely to be mismatched as they gain work experience, relative to less concentrated majors graduating into a large recession. These combine to produce large, persistent impacts on wages.

We have examined whether the occupational concentration of a major is in part responsible for the positive coefficient on $\beta^{major}U_c$ in the earnings regression. However, as noted above, concentration is only weakly correlated with β^{major}. Therefore adding major concentration and its interaction with U_c and $U_c \cdot PE$ as control variables does not reduce the coefficients on $\beta^{major}U_c$ and $\beta^{major} \cdot U_c \cdot PE$.

7 The Response of Graduate Education

Faced with a weak labor market and a low opportunity cost, students who graduate into a bad economy may choose to enroll in graduate school. Whether labor market conditions impact graduate educational attainment has received little attention in the past, but is important for understanding both schooling decisions and the broader consequences of entry conditions.[59] Furthermore, differences in educational attainment could affect earnings outcomes by altering the composition of recent college graduates in the labor force across the business cycle. And, if many students graduating into a recession are induced to obtain further schooling, they could eventually out-earn their counterparts who graduated in better times.

Ideally, we would analyze enrollment among young workers and completed educational attainment among older workers as a function of U_c and its interaction with β^{major}. However, our pooled data are not well-suited to this exercise since we do not have a balanced panel of observations across experience and graduating unemployment rates. In contrast to the labor market outcomes analyzed thus far, the timing in which education variables are measured

[59] Kahn (2010) shows that students graduating in the worst part of the 1981 recession obtain an additional year of graduate school, on average, relative to those graduating in the best times. Bedard and Herman (2008) examine the impact of state-level economic conditions on graduate enrollment for a sample of science and engineering majors and find counter-cyclical enrollment for males in Ph.D. programs, pro-cyclical enrollment for males in Master's programs, and largely acyclical enrollment for women. Johnson (2013) finds for a more representative sample of college graduates that graduate enrollment is counter-cyclical for women and acyclical for men.

matters in a way that cannot be accounted for with a smooth control for potential experience. Instead, we make use of the wide range of cohorts in the ACS.[60] Focusing on just the ACS has the added advantage that educational attainment of all cohorts can be observed with similar, large, sample sizes and measured in a consistent way.[61]

In this analysis, the dependent variable is an indicator for whether the individual has an advanced degree at the time of the ACS wave (2009-2011).[62] We restrict the sample to non-enrolled workers with at least 5 years of potential experience whose implied college graduation date falls between 1976 and 2006. We estimate regressions similar to the specification presented in table 3, based on equation (1), and including graduation year fixed effects.[63]

Table 8 reports regression results. Column 1 excludes major fixed effects to instead provide an estimate of the impact of β^{major} on educational attainment, while column 2 controls for major fixed effects. Column 3 additionally controls for β^{major} interacted with a cubic time trend, to take account of the fact that the returns to education and the composition of college majors are changing over this time period. Both columns cluster standard errors by cohort (division-graduation year), though statistical significance is similar for other treatments. We find that those who graduate at times of higher unemployment are slightly more likely to attain an advanced degree. From column 2, a 1 ppt increase in U_c is associated with a 0.014 increased probability of holding an advanced degree. This effect is tiny compared to the sample mean of 0.35, but is statistically significant at the 5% level.

We find that the effects are also differential across college major. Those with a one standard deviation higher β^{major} become slightly less likely to hold a higher degree when graduating into a bad economy. The coefficient of -0.0023 implies a reduced probability that is double the magnitude of the main effect of U_c and is significant at the 1% level. It is also relatively large compared to the main effect of β^{major} (0.0122 from column 1). Thus graduating into a large recession (4 ppt higher U_c) reduces the educational attainment advantage of high β^{major} majors by roughly three-quarters. The sign of this effect is intuitive since graduating into a recession increases the labor market advantage of high-skilled majors relative to low-skilled majors.[64]

[60] We follow a similar approach to Altonji et al. (2012) and Blom (2013) who use ACS data to analyze major choice by graduation year.

[61] We have also analyzed educational attainment in the pooled sample used in sections 5 and 6 and obtained qualitatively similar outcomes. However, we find the ACS analysis more reliable.

[62] In the ACS we cannot measure whether an individual has additional years of schooling that did not contribute to a degree. Our analysis will therefore not pick up individuals who were induced to return to school because of the economy but never completed their degree.

[63] Since all observations are measured in the same 3-year window and we include graduation year fixed effects, we do not include any controls for potential experience. Graduation year fixed effects are useful for two reasons. First, they control for the fact that the returns to education change substantially over this time period. Second, they take into account the fact that younger cohorts have had less time to complete graduate education, although results are robust to varying the window of graduation years included. This means we rely on cross-sectional variation in division unemployment rates to identify the main effect of U_c. Note that the results on the main effect of U_c for the dependent variables analyzed above are similar when we include graduation year fixed effects (compare columns 2 and 3 from table 3, for example).

[64] Surprisingly, Bedard and Herman (2008) find the opposite, that Ph.D. enrollment of higher-skilled college

8 Changes in the Link between Entry Labor Market Conditions and Outcomes: How Will Graduates from The Great Recession Fare?

Summarizing our results to this point, for college graduates from 1976 to 2011, we find modest negative effects of U_c on labor market outcomes. We also find that the higher-earning college majors are somewhat sheltered from these entry-condition effects, widening their labor market advantage when they graduate into poor economic conditions. The unemployment rate was 9.3% in 2009 and 9.6% in 2010, 3.5 and 3.8 ppts above the mean unemployment rate over this time period. The analysis thus far implies that the outcomes for those graduating in 2009 or 2010 will be similar to those implied by tables 4 and 5, which fit the effects for a 4 ppt increase in the graduating unemployment rate. In this section, we ask if the patterns that underlie these predictions have changed over time. We have two main findings. First, the recent period including the Great Recession saw much larger impacts of U_c on recent entrants. Second, the relative advantage of higher-skilled graduates during recessions has largely disappeared.

Table 3, columns 5 and 6 report log earnings regression results, augmenting those reported in columns 2 and 3, respectively, by allowing the effects to differ for those graduating in 2004 or later.[65] The coefficients on U_c and $U_c\beta^{major}$ represent the effects for those who graduated before 2004. Both of these coefficients are very similar to their values for the sample as a whole (from columns 1-4). To get the total effect of U_c for those graduating on or after 2004, one should add the coefficient on $post * U_c$ to the main U_c effect. The coefficient of -0.0279 (0.0077) on $post * U_c$ (column 5) implies a more than doubling of the main U_c effect for these recent graduation years. To understand the total differential effect across β^{major} for those graduating on or after 2004, one should add the $post * U_c\beta^{major}$ coefficient to the $U_c\beta^{major}$ effect. The coefficient of -0.0121 (0.0050) on $post * U_c\beta^{major}$ (column 6) is opposite in sign to the coefficient on $U_c\beta^{major}$ and similar in magnitude, thereby almost exactly offsetting the positive differential effect across β^{major} for graduates from the earlier period.

To more easily interpret the results in the context of the Great Recession, we again fit the impacts of graduating into a 4 ppt higher U_c (obtained from regressions of the form in column 5 of table 3), as well as the $U_c\beta^{major}$ interactions (obtained from regressions of the form specified in column 6 of table 3), for workers at various experience levels. Table 9 summarizes these results for the outcomes of interest, fitting separate effects for those

majors is more counter-cyclical than that of the average major, inconsistent with our results on the differential impact across β^{major}. However, their sample is restricted to science and engineering majors; effects could be reversed in this sample of graduates from already high-earning majors.

[65]Specifically, we interact all of our key explanatory variables in (1) (PE, PE^2, U_c, U_cPE, U_cPE^2, β^{major}, $\beta^{major}PE$, $U_c\beta^{major}$, $U_c\beta^{major}PE$) with an indicator equaling 1 if the worker graduated in 2004 or later (plus a main effect of graduating on or after 2004). Results in this section are qualitatively similar for a range of cutoff dates prior to 2004.

graduating before 2004 and those graduating on or after 2004. Since recent graduates have not yet accumulated much experience, we report effects for one and three years out from school, as well as the average effect over the first 5 years of experience. It is worth repeating that the coefficients involving U_c are identified by booms as well as recessions even though we frequently use the term "graduating into a large recession" when characterizing our results.

Panel A reports the main effect of a 4 ppt rise in U_c. It shows that the negative earnings effect (columns 1 and 2) more than doubles in magnitude in the later period. The average effect over the first 5 years out of school increases in magnitude from a 0.04 (0.0145) log earnings loss to a 0.09 (0.027) log earnings loss. The difference in the first year out of school is even larger. Graduates unlucky enough to graduate into a large recession before 2004 earned 0.08 less in log earnings in the first year, while those graduating into a recession in 2004 or later earned 0.19 less in log earnings. Not only was the Great Recession characterized by high values of U_c, but the negative consequences of those high values appear to be much larger than in the past.

The subsequent columns in table 9 help interpret the mechanisms underlying these differences.[66] First, columns 3 and 4 show earnings impacts on a restricted sample of full-time workers. Graduates into large recessions before 2004 saw almost no earnings losses when they were employed full-time, while those graduating into the Great Recession still bore substantial earnings losses. This suggests that a substantial part of the pre-2004 effect is driven by an inability to find full-time work. Columns 7 and 8 corroborate this, showing that the probability of working full-time is 0.12 lower for those graduating into a large recession pre-2004 but only 0.03 lower in the later period. The probability of being employed is largely unaffected in both periods (columns 5 and 6). We find similar impacts on wage rates across periods (columns 9 and 10). We find no significant impacts on occupation quality (columns 11 and 12), negative and marginally significant effects on match quality pre-2004 (column 13) and no effects on match quality in the later period (column 14).

Panel B presents results on the differential effects of a 4 ppt increase in U_c across β^{major}. While overall earnings effects are much larger in magnitude for graduates from 2004-2011, these effects are much more evenly distributed across college major. Pre-2004, high β^{major} majors saw a substantial widening of their earnings advantage when graduating into a recession. These effects are not present in the later period either in the full sample (column 1) or in the sample restricted to full-time workers (column 2). Similarly, for those graduating in the later period we find almost no differential impacts on the other dependent variables considered in the table.

Interestingly, both larger magnitude U_c effects and the smaller magnitude $U_c\beta^{major}$effects do not appear to be solely a phenomenon of the Great Recession. We obtain very similar results when we include graduates from 1998-2011 in the later period, which includes both the

[66] The regressions underlying these results are summarized in web appendix tables 1-6, column 5 from each table. Regressions underlying results reported in panel B are summarized in column 6 from each table.

"dot com boom" years of the late 1990s and the 2001 recession. This suggests that graduates from the 2001 recession saw similar labor market impacts per unit change in U_c as those from the Great Recession. There are a number of potential explanations for the different pattern in the recent two recessions. First, both saw prolonged jobless recoveries, meaning unlucky recent graduates might have had to spend more time on the sidelines. However, if that were the case we would have expected larger impacts on employment and hours in the recent period, and we find the opposite. Second, the industries impacted by recessions have varied over time. Employment losses in the 1981-82 recession were disproportionately drawn from manufacturing, as were those in the 1991 recession, which also saw sizable employment losses in construction. Therefore college graduates in these recessions may have been somewhat sheltered overall. While manufacturing losses were also important in the 2001 recession so were job losses in information technology stemming from the "dot com" bubble burst and job gains during the bubble. The 2001 recession may have therefore been fairly costly for college graduates and in particular high-earning college graduates. The Great Recession the 2007-09 was unusually broad-based, impacting almost every sub group proportionately. College graduates were less sheltered in this recession and the finance industry in particular saw large losses.

These two recent recessions may then have leveled the playing field to some degree across education groups and within college graduates; that is, college graduates bore something closer to their "fair share", relative to non-college workers, and the same was true for high-earning majors relative to low-earnings majors.

8.1 The Role of Changes in Cyclicality of Demand for College Graduates

The labor demand measures discussed in section 6.3 should speak to the issue of sectoral impacts across recessions as well as to whether there has been a more general increase in the exposure of college graduates to business cycle variation. Column 3 and 4 of table 6 report regressions of the divisional value of U_c^{major} on the divisional value of U_c, β^{major}, and $\beta^{major} * U_c$ for the 1971-2003 and 2004-2012 periods, respectively. We also control for a cubic time trend over the 1971-2003 period, but this makes little difference (compare columns 2 and 3). The main effect of U_c increases from 0.199 (0.0047) in the earlier period to 0.508 (0.0071) in the later period, a factor of 2.55. Recall from table 9 that the five-year average earnings loss associated with U_c more than doubled from the early to the late period (increasing in magnitude by a factor of 2.21). Therefore, it appears that much of the difference pre- and post-2004 can be accounted for by a change in the relationship between unemployment of college graduates and aggregate unemployment. Unemployment regressions at the national level (columns 7 and 8) show an increase in the coefficient on U_c from 0.44 (0.017) for 1971-2003 to 0.587 (0.198) for 2004-2012. This increase is smaller in percentage terms, but is still very large.

The coefficient on $\beta^{major} * U_c$ declines in magnitude from -0.0331 (0.0038) for 1971-2003 to -0.0087 (0.0068), indicating the cyclicality of demand for higher-skilled majors has increased relative to the average major. The coefficients in the table imply that demand for higher-skilled majors is 16.6% less cyclically sensitive than demand for the average major over 1971-2003 but only 1.7% less cyclical in recent years.

Figure 1 summarizes the change in the relative cyclicalities of high- and low-earning majors. Here we plot the average major-specific national unemployment rate for three groups of college majors – those in the top β^{major} quartile, the middle 50% of majors, and the bottom β^{major} quartile of majors – from 1971 to 2012.[67] The figure also plots the aggregate national unemployment rate over this time period (dashed line). All unemployment rates depict the same cyclical pattern. There are also clear level differences across the three major-specific unemployment rates; for almost all of the sample period, the unemployment rate is highest for the low-earning majors (green line) and lowest for the high-earning majors (blue line). This likely reflects the fact that low-earning majors are also less skilled at finding steady work, but might also reflect average labor demand conditions relative to supply. The cyclicality of the major-specific unemployment rates also differs. For most of the time period, the low-earning majors exhibit the largest increases in recessions and the largest declines in booms. However, in the last decade these relationships are less clear. In the 2001 recession, the higher β^{major} group actually reaches the highest unemployment rate peak. In the run up to the Great Recession, the unemployment rate for all three groups is essentially the same; the low-earning majors reach the highest peak unemployment rate during the recession, but the difference across groups appears smaller than in some of the previous recessions such as the 1981-82.

Figure 1 and table 6 together suggest that labor demand for high-earning majors has seen an increase in its sensitivity to the business cycle in the recent period. This may explain part of the disappearance of the advantage of high-skilled majors graduating into a recession in the post period. But since estimated differences in the sensitivity of major-specific unemployment rates to aggregate economic fluctuations were relatively small even in the pre period, the decline is probably not the whole explanation.[68]

9 Conclusion

In this paper we measure the labor market consequences of graduating from college in times of higher unemployment and study how those consequences vary with the skill level and the

[67] These reflect unweighted averages of major-specific national unemployment rates in a given year. Division unemployment rates look similar but noisier.

[68] Controlling for U_c^{major} or for the major-specific employment growth rate in the regressions underlying table 9 has almost no effect on the interactions between β^{major} and U_c. We noted above that these measures are noisy.

occupational concentration of the college major. Most of the analysis pools information on the graduating classes of 1976-2011, but we also examine whether labor market conditions matter more for recent college classes, including those from the Great Recession.

We find that early careers are disrupted by poor labor market conditions. A large recession at the time of graduation reduces earnings and wages by roughly 11% and 3% (respectively) in the first year, and it reduces the probability of full-time employment by 0.095. With the exception of wage rates, these effects are fairly short-lived, fading out over the first seven years of a career. The effects on wages persist for the 10 year potential experience window that we focus on.

We also find that the early careers of better higher-skilled majors are less sensitive to aggregate conditions at graduation. (The results are similar whether we use the earnings premium of the major or other skill measures.) In other words, the earnings gap across college majors widens in recessions. A person in a typically high-earning major increases his or her earnings advantage by a third when graduating in a bad recession relative to an average major, and this effect remains large for the first seven years after college graduation. These differential effects reflect increases in the probability of employment and full-time employment for higher-skilled majors relative to lower-skilled majors graduating into a recession, as well as differential effects on wage rates.

We do not have a full explanation for the differential impacts of entry conditions across college major. We do show that the unemployment rates of higher paying majors are less sensitive to the business cycle, but the difference in sensitivity is too small to account for the differential impacts on earnings. It could be that lower-skilled majors spend more of their early experience years out of full-time employment and suffer more from skill depreciation. However, we had expected lower-skilled majors to be less sensitive to this depreciation. It could instead be that higher-skilled majors can more easily recover from early setbacks because of more productive job search. This seems unlikely, however, since the largest differential effects are concentrated in the years just after graduation.

Effects on occupation quality and match quality may be able to account for some of the differential earnings and wage effects across majors. High-skilled majors graduating into a recession are relatively more likely to be in occupations that are both higher paying and more typical for their major, compared to lower-skilled majors. This is consistent with prior work on college graduates in Norway (Liu et al. 2012), for economics Ph.D.'s (Oyer 2006), and for MBA's (Oyer 2008), which all find that the earnings losses associated with graduating into a recession can be accounted for by worse access to higher paying industries.

Overall, our results for the 1976-2011 time span fit well with the previous literature. They are quite consistent with Oreopoulos et al. (2012), who study labor market shocks in Canada and find modest earnings effects of graduating in a recession that persist for a few years and are smaller in magnitude for higher-skilled majors. Our estimates of wage effects for the average major are smaller in both magnitude and persistence, compared with Kahn's (2010) analysis of the 1981-82 recession. Besides studying a broader set of demographic groups (Kahn restricts her analysis to white males) we also study college graduates from a much longer range of years. Concerning educational attainment, our finding that those graduating into a recession are slightly more likely to obtain an advanced degree is consistent with Kahn and broadly consistent with the small literature on the cyclicality of graduate enrollment rates (Bedard and Herman (2008) and Johnson (2013)). Again, we provide evidence for a larger range of graduation years and by college major.

We find effects on earnings are substantially more negative for graduates from the Great Recession. The per unit effect of an increase in the aggregate unemployment rate for graduates from 2004-2011 is more than double the value for graduates from 1976-2003. A substantial part of this increase is probably explained by the fact that the unemployment rates of college graduates as whole became much more sensitive to aggregate economic conditions in the years surrounding the Great Recession,

We also find that the effects of economic conditions have become much more evenly distributed across college major. It looks as though the "modern recession" is more broad-based, impacting recent college graduates and higher-skilled majors to a greater extent than we find for previous recessions.

The unemployment rates of higher-earning majors are no longer less sensitive to the business cycle, but the change is too small to explain the disappearance of the advantage of high-skilled majors graduating into a recession in the post period. Further work is needed on the types of shocks that lead to persistent (and differential) impacts on recent college graduates. This may yield a better understanding of the nature of recessions and recoveries of the last two decades.

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10 Data Appendix

We begin by describing the data sets used in this paper, with detailed variable creation from each data set. Appendix table 7 summarizes variable description by data set. We then describe the creation of major characteristics.

Some variables are created in the same way throughout the data sets. In all data sets, information on race, gender, and age are straightforward to obtain. We code race/ethnicity in three categories: Hispanic, black non-Hispanic, and other non-Hispanic.[69] Potential experience is defined as year minus bachelor's degree graduation year. All earnings and wage measures are adjusted to 2006 dollars using the Consumer Price Index (CPI). We restrict to earnings greater than $500 in our main sample and top code annual earnings at $400,000. We exclude earnings of enrolled workers and those in the year of college graduation. CPI-adjusted wages must be greater than 0 and are top- and bottom-coded to be between $5 and $250 per hour. Analysis of wages and the occupation measures is restricted to those with a valid earnings observation. Analysis of employment and full-time employment is restricted to the non-enrolled but have no restrictions on earnings.

Our preferred measure of labor market conditions at graduation is the unemployment rate at the census division level. The U.S. Census Bureau defines nine divisions: New England, Middle Atlantic, East North Central, West North Central, East South Central, West South Central, South Atlantic, Mountain, and Pacific. We obtain the annual unemployment rate for each census division from the Bureau of Labor Statistics Local Area Unemployment Statistics. We restrict all of our analysis to workers who graduated college between ages 20 and 24, inclusive. This eliminates about 3% of the available sample, mostly from late graduates. We also restrict to workers age 22 to 35 with 13 or fewer years of potential experience.

10.1 Data sets

The National Longitudinal Surveys of Youth

The National Longitudinal Survey of Youth 1979 (NLSY79) and 1997 (NLSY97) are nationally representative surveys administered by the Bureau of Labor Statistics, designed to gather information about transitions from school to the labor market. The NLSY79 follows 12,686 youths who were aged 14 to 22 in 1979. Respondents were surveyed each year from 1979 to 1994 and biennially thereafter; because of our restrictions on age and potential experience, we use data through 2000. College graduates in this survey graduated between

[69] Some data sets, including the ACS, have more detailed information on race/ethnicity, but others have only these three options; we use these three categories to be consistent across data sources. Multiple data sets also do not have a "mixed-race" option, so we cannot consistently code mixed-race respondents; we must rely on their own report of their race/ethnicity given the options. If mixed-race is an option, we code them as "other non-Hispanic".

1979 and the late 1980s, a period that included a the severe 1981-82 recession. The NLSY97 follows almost 9,000 respondents who were aged 12 to 16 in 1996 and have been surveyed annually from 1997-2010. These cohorts graduated from college between 2000 and 2009, a period that included the 2001 recession. In our regressions, we include separate survey fixed effects for the NLSY79 and for the NLSY97.

In both surveys, annual earnings are taken from a direct question about wage and salary earnings in the prior calendar year.[70] The wage measure is the hourly rate of pay in the current or most recent job. Employment and enrollment are based on questions about status at the time of the survey date. Full-time employment is defined as usually working at least 35 hours per week at the current job. Highest grade completed is taken from a direct question each year about highest degree completed. We use occupation in the current or most recent job, which is available at the 1970 3-digit census categorization over the time period we use. To have consistent coding across data sets, we convert to 1990 3-digit codes using the mapping made available by Ruggles et al. (2010). Below we explain how occupation is mapped into our two dependent variables of interest: the earnings return to the occupation and whether or not the occupation is one of the top 5 for that major.

Year of college graduation is straightforward to create since both surveys contain questions about educational attainment each year. In the NLSY79, we use the response to the "year of degree" question in the first year after graduation, and then fill in missing values by going forward. In the NLSY97, we use the BLS-created variable for date of bachelor's degree. We take advantage of the restricted-access geocodes to gain information on state (and census division) of college degree and current location. If the graduation year is a survey year, we define state of graduation as the state of residence at the time of the survey. Respondents who graduated before 1979 are excluded from our analysis. Less than 10 respondents fit this category.

The NLSY surveys each have their own college major categories; the NLSY79 has hundreds of categories, while the NLSY97 has only about 50. For each survey separately, we construct a crosswalk from the NLSY major categories to the 51 Department of Education categories based on the names of the majors.

The National Survey of College Graduates

The National Survey of College Graduates 1993 (NSCG93) and 2003 (NSCG03) are cross-sectional data sets made up of samples of 148,905 and 100,402 workers, respectively, administered by the National Science Foundation. The sample frame is those who reported having a college degree in the previous decennial census (1990 and 2000, respectively). These data sets each yield one year of labor market outcomes for a range of college graduation cohorts. Given our age restrictions, workers in the NSCG93 sample graduated from college between

[70] For example, the 1990 survey asks for earnings in 1989, and we code these as 1989 annual earnings.

1976 and 1990, a period containing two recessions. The NSCG03 sample graduated between 1986 and 2000, a period containing the 1991 recession.

In both NSCG samples, annual earnings and wages are the same measure: annual salary in the current job. Information on hours worked or hourly pay is not available, so we cannot construct a separate wage measure. Employment and full-time employment (a direct question on full-time or part-time status) are measured at the survey date.[71] Enrollment at survey date is available in the NSCG93 but not in the NSCG03. Though we typically exclude enrolled workers from the analyses of labor market outcomes, we must include everyone from the NSCG03 (who meets the other criteria). We therefore treat the NSCG93 and the NSCG03 as separate surveys when coding survey fixed effects. Highest degree completed is taken from a direct question; we convert degree completed to highest grade completed by treating a master's degree as 18 years, a professional degree as 19 years, and a doctoral degree as 20 years. Occupation is occupation in the principal job during the reference week. The NSF uses its own occupation codes, which we map into 1990 census 3-digit codes using our own mapping.[72] Below we explain how occupation is mapped into our two dependent variables of interest: the earnings return to the occupation and whether or not the occupation is one of the top 5 for that major.

Year of college graduation is taken from a direct question as is division of college graduation in the NSCG93. In the NSCG03, we do not have location of graduation, and we instead use division of current residence. We do not have state-level information. College major is also taken from a direct question, and is given in the NSF's own categories, of which there are about 200. We map these into the Department of Education categories using a mapping based on the names of the majors.

The Baccalaureate and Beyond

The Baccalaureate and Beyond 1993 (BB93) and 2008 (BB08) are longitudinal surveys administered by the Department of Education National Center for Education Statistics. The BB93 consists of about 11,000 students who graduated from college in 1993; workers were surveyed in 1994, 1997, and 2003. The BB08 is composed of about 19,000 college graduates from 2008, who are surveyed in 2009. Because each BB survey covers only one year of graduates, neither survey on its own provides much variation in economic conditions at the time of graduation. Instead these surveys provide cross-sectional variation in college major and division of graduation, and help identify effects of control variables.

In the BB93, annual earnings and wages are the same measure as in the NSCG: annual salary in the current job (or job in the reference month, depending on the survey wave). In the BB08, we use actual earned income in 2009, annualized to account for the date of

[71] The questionnaire defines full-time as working 35 or more hours per week.

[72] The NSF occupation categories tend to be more detailed for science- and engineering-related fields and less detailed for other fields.

the survey within 2009 for both annual earnings and wages; this only counts earnings in the primary job. Employment, enrollment, and full-time status refer to either the time of the survey or the reference month, depending on the survey wave; full-time status is a direct question asking full-time or part-time status in the primary job. Highest degree completed and occupation in the job at the time of the survey (or in the reference month) are taken from direct questions; we use occupation information for the primary job only. The BB has only about 40 occupation categories, which we map into 1990 occupation codes using names of occupations. Below we explain how occupation is mapped into our two dependent variables of interest: the earnings return to the occupation and whether or not the occupation is one of the top 5 for that major. We treat the waves BB93 as one survey and the BB08 as another when defining our survey fixed effects.

Year of college graduation is straightforward since in each survey all respondents graduated in the same year. For location of graduation, we utilize a direct question about the state of the respondent's undergraduate institution. Majors are given in about 100 categories in the BB93, which we crosswalk to the Department of Education categories using our own mapping. The BB03 gives majors in CIP codes, which are very similar to the Department of Education codes, so this crosswalk is simple.

The National Longitudinal Study

The National Longitudinal Study (NLS72) is a panel survey administered by the Department of Education. The sample is about 16,000 high school seniors in 1972, with the bulk of eventual college graduates graduating in 1976. We exploit two waves of the survey with post-graduation information (1979 and 1986); most workers provided information about 1977 and 1978 in the 1979 wave, while in 1986 a smaller subset of the sample (roughly 40%) was asked for job and pay information about the years between 1979 and 1986, giving us multiple years of observation. We obtain year of college graduation using the 1976, 1979, and 1986 follow-up waves and the information from the intervening years. If no other information is available, we assign graduation year as the first year in which a respondent says he or she has at least four years of college. Because these workers are in a single high school graduation cohort, the NLS72 provides little variation in economic conditions at the time of graduation. Thus the same caveats apply here as those described with the BB data sets.

The NLS72 gives us the starting and ending/current wage in the most recent job. Our wage measure is the average of the two. We multiply wages by hours worked in the past year in the most recent job (a direct question) to get the annual earnings measure. Employment and occupation are at the time of the survey. Occupation is given in 1970 3-digit census codes, which we map to 1990 codes using the mapping from Ruggles et al. (2010). Below we explain how occupation is mapped into our two dependent variables of interest: the earnings return to the occupation and whether or not the occupation is one of the top 5 for that major. Highest grade completed is based on a direct question about years of school completed. We do not have enrollment information. Thus we must include all observations meeting the other criteria into our analyses that typically exclude the enrolled. The waves of the NLS72 are treated as one survey from the perspective of our survey fixed effects.

Location of college graduation is determined by using the zip code in the year of presumed graduation, which we map to the state level. College major information is derived from data on the respondents' college transcripts. This has about 50 categories, which we map to the Department of Education codes using our own mapping.

The Survey of Income and Program Participation

The Survey of Income and Program Participation (SIPP) is a series of two-, three-, and four-year panels covering the period from 1984 to 2011, administered by the U.S. Census Bureau.[73] Each worker is surveyed every four months during his or her panel's stay in the sample and provides monthly data on employment, earnings, hourly wages, enrollment, and other key variables. Combining all the panels of SIPP together, we have about 60,000 person-year observations. Respondents in our restricted age range graduated between 1971 and 2008, and we have earnings observations from 1984 to 2011.[74] From 1984 to 1993 (excluding 1985), field of bachelor's degree can only be measured with certainty for those with exactly a bachelor's degree, because the survey only asks for field of highest degree. In those waves, we therefore only use respondents with exactly a bachelor's degree, whereas all college graduates are included from 1996 forward. We treat the two time periods (survey panels 1984-1993, and survey panels 1996-2008[75]) as two separate surveys from the perspective of our survey fixed effects.

We define annual earnings as the average monthly earnings for non-enrolled months times twelve. Wages are earnings divided by the sum of hours worked across all months where the respondent was not enrolled.[76] Respondents report earnings and hours separately for up to two jobs per month, and we include earnings from both jobs in our measures of earnings and wages. Employment is the fraction of non-enrolled months the worker worked at least one week, and full-time is defined as the fraction of non-enrolled months the worker worked at least 35 hours per week.

Respondents can list two occupations for each month, but one is listed as the primary occupation. Below we explain how a given occupation is mapped into our two dependent variables of interest: the earnings return to the occupation and whether or not the occupation

[73] The education module which asks for degree and major information is not included in the 1985 panel, and therefore we do not use it. The 1984 panel does not have enrollment information, so for this panel we treat all workers as not enrolled.

[74] Because data from the last panel is (at the time of this analysis) only available through part of 2012, we do not use 2012 earnings information.

[75] The last panel began in 2008 and has data through 2011; we refer to this as the 2008 panel.

[76] An hourly rate of pay measure is available, but only for the minority of workers who are paid hourly.

is one of the top 5 for that major. For the SIPP, we define these variables as the average of those values for the primary occupation over all months that it is observed in a given year.

The education module in the second wave contains direct questions on year and field of degree. We do not have location of degree and instead use the state of residence in the earliest wave of the panel. Panels 1984-1993 contains one set of 20 major classifications, while panels 1996-2008 contain a different set of 18 major classifications.[77] This is another reason why we treat the early and later SIPP panels as two separate surveys when defining survey fixed effects. These major categories are listed in appendix tables 3a and 3b, respectively. For some variables, we must generate a crosswalk between these classifications and the 51 Department of Education categories. We do so based on the names of the majors and report the crosswalks in appendix tables 4a and 4b. We cannot link medicine/dentistry and vocational studies from the early panels and liberal arts/humanities from the later panels to the 51 Department of Education categories. These majors are therefore dropped from analyses where the use of the crosswalks is necessary. When we include major fixed effects in our regressions, we treat the SIPP majors as distinct from the Department of Education majors, giving us a total of 89 major categories.

Highest grade completed can be defined from direct questions about highest degree completed in the second wave of each panel. Workers could still have obtained further schooling by the later waves of a given panel, but we cannot observe this. Enrolled is defined as the fraction of months in a given year where the worker was enrolled.

The American Community Survey

The American Community Survey (ACS), administered annually since 2001 by the U.S. Census Bureau, consists of large repeat cross-sections meant to substitute for the decennial census. In 2009, the survey introduced a question on college major. We therefore take advantage of the three survey waves, 2009, 2010, and 2011, which each cover roughly 2 million households. Our age restrictions leave us with respondents who graduated from college between 1996 and 2010, covering a period with two booms and two busts. We categorize all three ACS waves as one survey, for the purposes of our survey fixed effects.

The earnings measure is total wage and salary income in the past 12 months. Unfortunately, we do not know when the respondent was interviewed, and thus we do not know if the earnings refers mostly to the prior year, to the current year, or equally to both. We therefore follow the ACS's own reporting practices and assign the earnings as being measured in the survey year, rather than the prior calendar year. To construct wages, we divide annual earnings by the product of weeks worked in the prior 12 months and usual hours per week. Employment and enrollment are defined at the survey date. We define a worker

[77] Because the early panels have field of highest degree rather than field of bachelor's degree, the major categories include things generally related to graduate degrees, such as law and medicine. The later panels, which ask for field of bachelor's degree, are more typical of a bachelor's degree.

as being employed full-time if at the survey date (s)he reports usually working at least 35 hours per week. Highest grade completed is based on a question about highest degree completed. Occupation is available at the 1990 census 3-digit level using the variable created by Ruggles et al (2010), and reflects the most recent job. Below we explain how occupation is mapped into our two dependent variables of interest: the earnings return to the occupation and whether or not the occupation is one of the top 5 for that major.

The ACS unfortunately does not contain time or location of college degree. We instead impute the year of graduation as the year a respondent was likely 22 (the modal age in the other data sets) in May. For workers born in the first two quarters of the year, the year of graduation is birth year plus 22. For workers born in the second half of the year, graduation year is birth year plus 23.[78] We use current state and division of residence as the graduating state and division. The ACS has its own categories for college major, which we map to the Department of Education categories based on major names.

We use a subset of our ACS sample to analyze educational attainment, as described in section 7. For this analysis, we expand the non-enrolled sample to include older respondents whose implied graduation date falls between 1976 and 2006 and was at least 5 years before the survey date. We also use the provided survey weights for this analysis.

Occupation variables We exploit the large samples in the ACS to create two occupation variables. The first is the estimated earnings return to the 3-digit 1990 census occupation averaged over the 3 survey years (2009-2011). For a sample of non-enrolled, full-time employed workers aged 25-59, earning at least $500 in the past 12 months, we regress log annual earnings on worker characteristics (race, education, and a cubic in potential experience) and occupation fixed effects. We use these occupation fixed effects as our measure of occupation quality, merging them at the 3-digit census code level for the occupations reported in the pooled data. We could have instead estimated occupation return from our pooled data sets, but we prefer the precision and consistency of the large ACS samples. We have also estimated a wage return to occupation (estimating the regression described above but on log wages – earnings divided by the product of weeks and usual hours) and obtained extremely similar results – unsurprising given a 0.98 correlation between the two measures. For the SIPP, this measure is the average earnings return across all months in the year with a valid occupation observation.

The second occupation measure, meant to reflect match quality in the current job, is an indicator for whether the current occupation (reported in the pooled data) is among the top 5 occupations for a given major, using 1990 census 3-digit occupation codes. We classify the top 5 occupations for each major using the three ACS samples (2009-2011) and restricting to non-enrolled, full-time employed college graduates aged 25-59 earning at least $500 in the past 12 months. For the SIPP, we exploit our created major crosswalk to map

[78] Results are robust to choice of the quarter cut-off.

major-occupations from SIPP into major-occupations from the 51 Department of Education categories, then average these over the months in the year with occupation observations.

The Current Population Survey March Supplement

The Current Population Survey (CPS) March Supplement, is an annual supplement to the monthly Bureau of Labor Statistics CPS used to generate data on the employment situation. The supplement contains information about labor market outcomes over the previous calendar year. We do not include this sample in our analysis of the effects of entry conditions and college major on future labor market outcomes because it does not contain data on college major or year of graduation.[79] However, we use surveys from 1971 to 2012 to generate supplemental information on employment and unemployment across occupations and industries.

For each 3-digit 1990 census occupation and one-digit industry (12 categories based on the 1990 census codes: agriculture, mining and construction, durable manufacturing, non-durable manufacturing, transportation and utilities, wholesale and retail trade, finance and real estate, business services, personal services, entertainment, professional services, and public administration) pairing we create measures of annual employment and unemployment. We restrict the sample to employed college graduates aged 25 to 59. An occupation-industry-specific unemployment rate is defined as the number of unemployed workers who were most recently employed in that occupation-industry, divided by those unemployed workers plus employment in the occupation-industry. We then aggregate these unemployment rates to the major level using a major to occupation-industry mapping, which we describe in the next section.

We use a similar approach to generate a major-specific employment growth measure. We use the same CPS sample to obtain employment in each occupation-industry cell in each year, then aggregate employment to the major level using the same mapping as described above. We define the growth rate as the first difference in log employment at the major level..

10.2 Major Characteristics

In all data sets but the SIPP, it is straightforward to map majors into 51 categories used by the Department of Education (hereafter Ed). For the pooled data, the early SIPP, and the late SIPP, we regress log annual earnings on controls (gender, race, region, potential experience, and year dummies) and major fixed effects, separately for each data set, with psychology as the excluded category in each regression. The major fixed effects are the major

[79] In a supplemental analysis, we include the CPS March in our pooled data, imputing year of degree to year of birth plus 22 and imputing the college major variables to the overall sample mean. We find similar effects of entry conditions on labor market outcomes.

earnings measure. We standardize them to be mean zero and standard deviation one after combining the data sources. This regression is performed on those aged 36 to 59, which excludes the main estimation sample to avoid any simultaneity concerns.

The SAT math and the O*Net measure of occupational skill for each major are as described in the text.

The occupational concentration of the major is also obtained at the Ed-major level and then mapped into the SIPP. For this variable, we pool the non-SIPP data and get the fraction of people in each major that go into each 1990 census 3-digit occupation. Our preferred measure is the share of workers from each major that go into the five most common occupations, but results are similar for the top three and top seven as well. This measure is obtained using only those age 25 to 36.

For the major-specific demand measures described in the previous section (using the March CPS), we require a major to occupation-industry mapping. We obtain this by pooling the ACS and NSCG03 (the NSCG93 does not have information on industry). Using employed college graduates aged 25 to 59, we find the share of employment from each major in each occupation-industry cell, using 3-digit occupation codes and 1-digit industry codes, both from the 1990 classification. We then apply this mapping to the occupation-industry measures from the March CPS to get major-level measures. This mapping is from the Department of Education major categories to occupation-industry cells. Once we have obtained the major-specific unemployment rate and employment growth, we map it into SIPP categories using our crosswalk.

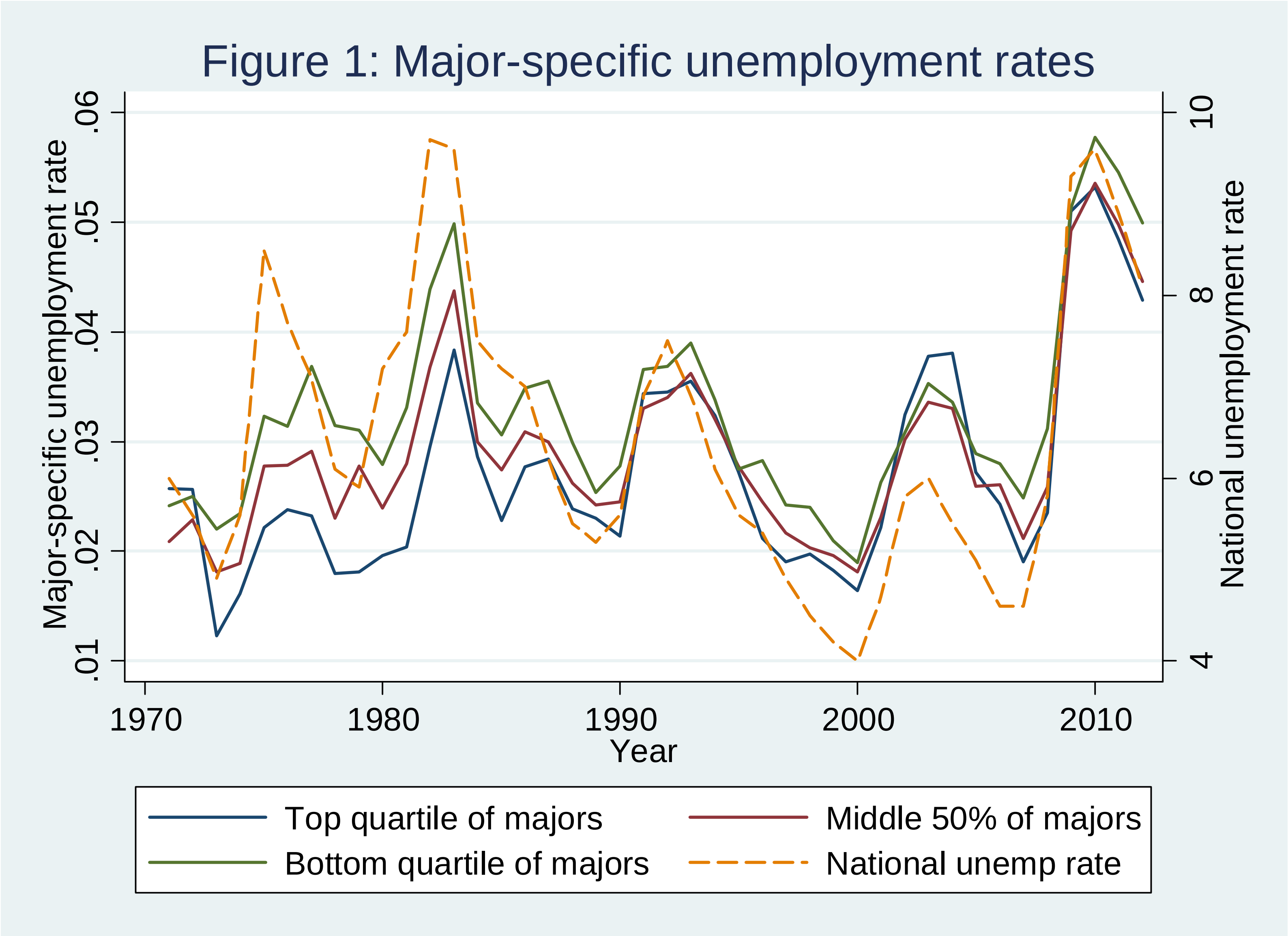

Figure 1: Major-specific unemployment rates
Major-specific unemployment rate
.01
.02
.03
.04
.05
.06
National unemployment rate
4
6
8
10
1970
1980
1990
2000
2010
Year
Top quartile of majors
Middle 50% of majors
Bottom quartile of majors
National unemp rate

Table 1: Summary Statistics for Primary Earnings Sample
with Equal Weighting across Graduation Year-Potential Experience-Division Cells

Variable	n	Mean	St Dev	Min	Max
Male	400,923	0.48	0.50	0	1
Black	400,923	0.06	0.24	0	1
Hispanic	400,923	0.04	0.20	0	1
Potential experience	400,923	6.38	3.56	1	13
Graduation year	400,923	1990.29	8.70	1976	2010
Graduation unemployment rate (division) (%)	400,923	6.23	1.76	2.8	12.5
Graduation unemployment rate (national) (%)	400,923	6.39	1.43	4.0	9.7
Year	400,923	1996.67	8.96	1977	2011
Current unemployment rate (division) (%)	400,923	6.19	1.78	3.0	12.5
Annual earnings (2006 $)	400,923	45,513	32,181	501	400,000*
Log annual earnings	400,923	10.50	0.76	6.22	12.90
Full-time	400,923	0.85	0.33	0	1
Employed	400,923	0.96	0.17	0	1
Highest grade completed	400,913	16.40	0.90	16	20
Summary Statistics for Relevant Samples					
Employed	454,477	0.89	0.30	0	1
Full-time	454,477	0.77	0.40	0	1
Annual earnings (2006 $) if full time	352,364	50,530	31,759	502	400,000
Log annual earnings if full time	352,364	10.68	0.56	6.22	12.90
In top 5 most common occupations for major	377,413	0.40	0.47	0	1
Occupational log earnings return	395,587	-0.71	0.32	-1.62	0.04
Has advanced degree	1,153,034	0.35	0.48	0	1

Notes: The primary sample (top panel) includes non-enrolled workers age 22-35 with potential experience 1 to 13 with a valid annual earnings observation (greater than $500 in 2006 dollars). The regression samples for employed and full-time (bottom panel) exclude enrolled workers but have no restriction on earnings, and also include those with potential experience equal to zero. The occupation variables are restricted to the primary earnings sample and must have a non-missing occupation observation. The sample for advanced degrees is restricted to the ACS and includes non-enrolled college graduates from 1976 to 2006 with at least 5 years of potential experience.
*Topcoded

Table 2: Characteristics of Department of Education Major Categories

Major:	β^{major}	SAT Math	Occupation Skill Level	Avg. U_c^{major} (%)	Concentration
Chemical Engineering	1.87	*	1.97	2.66	0.54
Economics	1.57	1.51	0.50	3.03	-0.57
Electrical Engineering	1.49	2.60	1.70	2.83	1.31
Finance	1.41	0.70	0.25	2.98	0.32
Mechanical Engineering	1.30	1.91	1.98	2.83	0.87
Chemistry	1.26	1.11	1.46	2.26	0.23
Computer Programming	1.21	*	0.04	2.43	2.02
All Other Engineering	1.05	1.76	1.41	3.09	0.17
Computer and Info Tech	1.04	0.81	1.18	3.19	1.43
Biological Sciences	1.04	1.05	1.31	2.11	-0.59
Civil Engineering	1.03	1.49	2.37	2.56	1.87
Accounting	0.95	*	0.84	2.90	1.36
Nursing	0.87	-0.50	1.81	1.53	2.74
Mathematics	0.83	1.45	0.97	2.60	0.15
Political Science	0.78	0.00	0.59	2.72	-0.47
Physics	0.72	*	1.76	2.52	0.19
International Relations	0.68	0.47	0.21	2.91	-0.88
Marketing	0.56	-0.31	-0.95	3.57	-0.23
Other Med/Health Services	0.52	-0.50	0.22	1.85	-0.20
Misc. Business and Med. Support	0.50	*	-0.30	3.14	-0.98
Precision Prod. & Industrial Arts	0.40	*	0.43	3.43	0.46
Medical Tech	0.38	*	-0.77	2.20	0.88
Business Mgmt and Admin	0.16	-0.30	-0.46	3.23	-0.72
Earth and Other Physical Sci	0.13	*	0.86	2.72	-0.50
Area, Ethnic, and Civ. Studies	0.05	0.54	-0.12	2.77	-0.93
Engineering Tech	0.00	-0.30	0.11	2.90	-0.53
Public Administration and Law	-0.01	*	-0.14	3.46	-0.07
Multidisciplinary or General Sci	-0.04	*	0.20	2.81	-1.01
Journalism	-0.06	*	-0.70	3.23	-0.28
Architecture	-0.06	*	1.51	3.11	1.14
History	-0.21	0.19	-0.12	2.80	-0.60
Communications	-0.25	-0.70	-1.00	3.45	-0.96
Public Health	-0.50	*	0.24	2.86	-0.74
Protective Services	-0.54	*	-0.78	2.65	-0.26
Letters: Lit, Writing, Other	-0.66	0.28	-0.68	2.86	-0.75
Foreign Language	-0.69	0.41	-0.42	2.61	-0.63
Environmental Studies	-0.74	0.25	-0.11	3.30	-1.16
Psychology	-0.75	-0.48	-0.04	2.65	-0.70
Other Social Science	-0.79	-0.69	-0.54	2.88	-1.05
Leisure Studies and Basic Skills	-0.82	-1.23	-1.73	4.00	-0.59
Fitness and Nutrition	-1.07	-0.99	-1.04	3.02	-0.91
Commercial Art and Design	-1.11	-0.45	-1.77	4.13	0.63
Agriculture and Agr. Science	-1.16	0.10	-1.04	3.43	-0.94
Social Work & Human Resources	-1.20	-1.35	-0.10	2.71	0.38
Family and Consumer Science	-1.33	-1.36	-1.16	2.72	-0.59
Art History and Fine Arts	-1.47	0.28	-1.75	3.64	-0.95
Secondary Education	-1.48	*	-0.46	2.12	1.66
Library Science and Education	-1.56	-0.96	-0.75	2.04	1.58
Film and Other Arts	-1.77	-0.11	-2.13	3.99	-1.13
Music and Speech/Drama	-1.90	-0.52	-1.84	3.29	-0.79
Philosophy and Religion	-2.47	0.72	0.01	2.75	-0.30

Notes: All measures except U_c^{major} are given in standard deviations. β^{major} is the earnings return to the major, based on authors' calculations. SAT math is the average SAT math score in the major, obtained from the Baccalaureate and Beyond. Occupation skill is the degree of critical thinking and problem sovling required of the occupation, based on O*NET task measures and authors' calculations. U_c^{major} is the average of annual major-specific unemployment rates, based on authors' calculations. Concentration is based on the share of workers in a major who are in the top 5 occupations for that major, based on authors' calculations.See the text for details on each measure.

* value is suppressed due to small sample sizes in the Baccalaureate and Beyond.

Table 3: Annual Earnings as a Function of Entry Conditions and Major Characteristics

	(1)	(2)	(3)	(4)	(5)	(6)
Entry unemployment rate (U_c)	-0.0277***	-0.0278***	-0.0291***	-0.0291***	-0.0203***	-0.0280***
	(0.0053)	(0.0051)	(0.0052)	(0.0066)	(0.0057)	(0.0055)
U_c*potexp	0.0076***	0.0080***	0.0080***	0.0080***	0.0063***	0.0078
	(0.0020)	(0.0020)	(0.0018)	(0.0021)	(0.0021)	(0.0022)
U_c*potexp^2	-0.0005***)	-0.0006*	-0.0005***	-0.0005***	-0.0004**	-0.0005***
	(0.0002)	(0.0002)	(0.0001)	(0.0002)	(0.0002)	(0.0002)
β^{major}	0.1683***					
	(0.0074)					
β^{major}*potexp	0.0041***	0.0033***	0.0031***	0.0031***	0.0042***	0.0036***
	(0.0011)	(0.0011)	(0.0008)	(0.0010)	(0.0013)	(0.0009)
β^{major}* U_c	0.0077*	0.0129***	0.0135***	0.0135***	0.0169***	0.0168***
	(0.0041)	(0.0037)	(0.0027)	(0.0037)	(0.0044)	(0.0035)
β^{major}* U_c*potexp	-0.0008	-0.0017***	-0.0020***	-0.0020***	-0.0023***	-0.0024***
	(0.0006)	(0.0005)	(0.0004)	(0.0005)	(0.0006)	(0.0005)
Post*Uc					-0.0279***	-0.0240***
					(0.0077)	(0.0100)
Post*Uc*potexp					0.0163**	0.0090
					(0.0073)	(0.0072)
Post*U_c*potexp^2					-0.0028**	-0.0016
					(0.0014)	(0.0013)
Post*β^{major}					0.0172	0.0147
					(0.0149)	(0.0114)
Post*β^{major}*potexp					-0.0040	-0.0038
					(0.0028)	(0.0026)
Post*β^{major}* U_c					-0.0117**	-0.0121**
					(0.0056)	(0.0050)
Post*β^{major}* U_c*potexp					-0.0004	0.0008
					(0.0025)	(0.0021)
Major fixed effects		X	X	X	X	X
Grad year fixed effects			X	X		X
Cluster at grad year-division	X	X			X	
Cluster at grad year-major-division				X		
Observations	51,716	51,716	51,716	51,716	51,716	51,716
R-squared	0.295	0.322	0.327	0.327	0.377	0.325

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Notes: Observations in these regressions are major-gradyear-division-potexp cells. We weight by the major's share of observations in the gradyear-potexp group. U_c is the divisional unemployment rate in the year the cohort graduated from college. Potexp is years since college graduation. β^{major} is the earnings return to the major, estimated on a sample of workers age 36-59 in our pooled, unweighted data. Survey dummies, year dummies, a quadratic in potential experience, gender, race, and region controls are also included. The sample is non-enrolled workers from age 22 to 35, with potential experience 1 to 13, with at least $500 in annual earnings in 2006 dollars.

Table 4: Effect of 4-ppt Rise in Graduation Unemployment Rate

	Dependent Variable:						
	Earnings:		Employment:			Occupation Variables:	
	All	Full-time	Pr(Employed)	Pr(Full time)	Wages	Earnings Return	Pr(in top 5 for major)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Average effect	-0.0311***	-0.0167*	-0.0006	-0.0054	-0.0311***	-0.0038	-0.0149
(s.e.)	(0.0114)	(0.0094)	(0.0040)	(0.0064)	(0.0101)	(0.0056)	(0.0111)
Effect at potexp =							
1	-0.1114***	-0.0460**	0.0008	-0.0947***	-0.0360**	-0.0107	-0.0256*
	(0.0206)	(0.0186)	(0.0067)	(0.0128)	(0.0155)	(0.0081)	(0.0155)
3	-0.0565***	-0.0214*	0.0026	-0.0261***	-0.0293**	-0.0069	-0.0183
	(0.0134)	(0.0119)	(0.0047)	(0.0078)	(0.0117)	(0.0062)	(0.0117)
7	0.0001	-0.0043	-0.0005	0.0310***	-0.0284**	-0.0014	-0.0108
	(0.0147)	(0.0112)	(0.0048)	(0.0082)	(0.0125)	(0.0071)	(0.0140)
10	-0.0039	-0.0197*	-0.0086	0.0036	-0.0386***	0.0009	-0.0112
	(0.0137)	(0.0105)	(0.0052)	(0.0081)	(0.0113)	(0.0059)	(0.0123)

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Notes: Sample for columns 1, 2, 5, 6, and 7 includes non-enrolled workers age 22-35 with potential experience 1 to 13 with a valid annual earnings observation (greater than $500 in 2006 dollars). The regression samples for employed and full-time exclude enrolled workers but have no restriction on earnings, and also include those with potential experience equal to zero. Observations in these regressions are major-gradyear-division-potexp cells. We weight by the major's share of observations in the gradyear-potexp group. Uc is the divisional unemployment rate in the year the cohort graduated from college. Potexp is years since college graduation. Survey dummies, year dummies, a quadratic in potential experience, gender, race, and region controls are also included.

Table 5: Effects of 4 ppt rise in U_c interacted with β^{major}

	Dependent variable:						
	Earnings:		Employment:		Occupation Variables:		
	All	Full-time	Pr(Employed)	Pr(Full time)	Wages	Earnings Return	Pr(in top 5 for major)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Panel A: Coefficients on β^{major}						
Main effect	0.1683***	0.1541***	0.0034	0.0367***	0.1382***	0.1457***	0.0030
(s.e.)	(0.0074)	(0.0062)	(0.0024)	(0.0042)	(0.0062)	(0.0037)	(0.0073)
Major char * PE	0.0041***	0.0029***	0.0005	-0.0023***	0.0047***	0.0013**	0.0040***
(s.e.)	(0.0011)	(0.0009)	(0.0004)	(0.0006)	(0.0009)	(0.0005)	(0.0010)
	Panel B: Interaction of Major Characteristic and Entry Unemployment Rate						
Average effect	0.0179***	0.0189***	0.0040	0.0119***	0.0099*	0.0070**	0.0095*
(s.e.)	(0.0063)	(0.0054)	(0.0027)	(0.0043)	(0.0054)	(0.0030)	(0.0055)
Effect at potexp =							
1	0.0538***	0.0315***	0.0118**	0.0208***	0.0110	0.0170***	0.0045
	(0.0108)	(0.0094)	(0.0049)	(0.0079)	(0.0095)	(0.0051)	(0.0092)
3	0.0379***	0.0259***	0.0084**	0.0168***	0.0105	0.0125***	0.0067
	(0.0083)	(0.0073)	(0.0038)	(0.0061)	(0.0072)	(0.0040)	(0.0071)
7	0.0059	0.0147***	0.0014	0.0089**	0.0095*	0.0037	0.0112**
	(0.0061)	(0.0050)	(0.0026)	(0.0039)	(0.0054)	(0.0029)	(0.0054)
10	-0.0180**	0.0063	-0.0037	0.0030	0.0088	-0.0030	0.0146**
	(0.0083)	(0.0065)	(0.0034)	(0.0051)	(0.0075)	(0.0038)	(0.0071)

*** p<0.01, ** p<0.05, * p<0.1

Notes: Sample for columns 1, 2, 5, 6, and 7 includes non-enrolled workers age 22-35 with potential experience 1 to 13 with a valid annual earnings observation (greater than $500 in 2006 dollars). The regression samples for employed and full-time exclude enrolled workers but have no restriction on earnings, and also include those with potential experience equal to zero. Observations in these regressions are major-gradyear-division-potexp cells. We weight by the major's share of observations in the gradyear-potexp group. Uc is the divisional unemployment rate in the year the cohort graduated from college. Potexp is years since college graduation. β^{major} is the earnings return to the major, estimated on a sample of workers age 36-59 in our pooled, unweighted data. Survey dummies, year dummies, a quadratic in potential experience, gender, race, and region controls are also included.

Table 6: Major-Specific Unemployment Rates

	Dependent Variable: U_c^{major}							
	Division				National			
	1971-2012	1971-2003	1971-2003	2004-2012	1971-2012	1971-2003	1971-2003	2004-2012
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Entry unemployment rate (U_c)	0.2546***	0.2046***	0.1988***	0.5078***	0.5061***	0.3268***	0.4414***	0.5866***
	(0.0043)	(0.0040)	(0.0047)	(0.0071)	(0.0152)	(0.0131)	(0.0168)	(0.0198)
β^{major}	-0.0373*	0.0051	0.0051	-0.0776	0.0386	0.0051	0.1431*	-0.0811
	(0.0218)	(0.0246)	(0.0242)	(0.0478)	(0.0650)	(0.0246)	(0.0754)	(0.1336)
$\beta^{major}* U_c$	-0.0233***	-0.0331***	-0.0331***	-0.0087	-0.0344***	-0.0331***	-0.0537***	-0.0058
	(0.0033)	(0.0038)	(0.0038)	(0.0068)	(0.0099)	(0.0038)	(0.0117)	(0.0191)
Cubic time trend	X		X		X		X	
Observations	16,983	12,852	12,852	4,131	2,091	1,683	1,683	408
R-squared	0.452	0.222	0.246	0.559	0.558	0.314	0.410	0.685

*** p<0.01, ** p<0.05, * p<0.1

Note: The dependent variable in all columns is the major-specific unemployment rate, created using occupation-industry-specific unemployment rates and a major-to-occupation-industry mapping, all using workers aged 25 to 59. Columns 1-4 are at the divisional level, while columns 5-8 are at the national level. No other controls are included except when we use a cubic time trend. The unemployment rate on the right hand side is the overall unemployment rate (at either the division or national level, as appropriate.

Table 7: Effects of 4 ppt rise in Uc interacted with major concentration ("top 5 share")

	Dependent variable:						
	Earnings:		Employment:			Occupation Variables	
	All	Full-time	Pr(Employed)	Pr(Full time)	Wages	Earnings Return	Pr(in top 5 for major)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Panel A: Coefficients on β^{major}						
Main effect	0.0514***	0.0378***	0.0048**	0.0073*	0.0526***	-0.0008	0.1497***
(s.e.)	(0.0080)	(0.0069)	(0.0023)	(0.0039)	(0.0067)	(0.0047)	(0.0074)
Major char * PE	-0.0036***	-0.0017*	-0.0006	-0.0004	-0.0028***	-0.0014**	0.0004
(s.e.)	(0.0012)	(0.0010)	(0.0004)	(0.0006)	(0.0010)	(0.0006)	(0.0010)
	Panel B: Interaction of Major Characteristic and Entry Unemployment Rate						
Average effect	-0.0119**	-0.0089*	-0.0046*	-0.0027	-0.0135***	-0.0010	-0.0242***
(s.e.)	(0.0061)	(0.0049)	(0.0025)	(0.004)	(0.0051)	(0.0029)	(0.0054)
Effect at potexp =							
1	-0.0267***	-0.0186**	-0.0098**	-0.0043	-0.0202**	-0.0047	-0.0131
	(0.0103)	(0.0086)	(0.0045)	(0.0076)	(0.0089)	(0.0049)	(0.0093)
3	-0.0201**	-0.0143**	-0.0075**	-0.0036	-0.0172***	-0.0031	-0.0181**
	(0.0079)	(0.0066)	(0.0034)	(0.0058)	(0.0067)	(0.0038)	(0.0071)
7	-0.0070	-0.0057	-0.0028	-0.0021	-0.0113**	0.0003	-0.0279***
	(0.0062)	(0.0048)	(0.0025)	(0.0038)	(0.0052)	(0.0028)	(0.0054)
10	0.0029	0.0008	0.0006	-0.0011	-0.0068	0.0028	-0.0354***
	(0.0088)	(0.0066)	(0.0035)	(0.0051)	(0.0075)	(0.0038)	(0.0074)

*** p<0.01, ** p<0.05, * p<0.1

Notes: Sample for columns 1, 2, 5, 6, and 7 includes non-enrolled workers age 22-35 with potential experience 1 to 13 with a valid annual earnings observation (greater than $500 in 2006 dollars). The regression samples for employed and full-time exclude enrolled workers but have no restriction on earnings, and also include those with potential experience equal to zero. Observations in these regressions are major-gradyear-division-potexp cells. We weight by the major's share of observations in the gradyear-potexp group. Uc is the divisional unemployment rate in the year the cohort graduated from college. Potexp is years since college graduation. The major concentration measure is the share of graduates from the major that go into the 5 most common census 3-digit occupations. Survey dummies, year dummies, a quadratic in potential experience, gender, race, and region controls are also included.

Table 8: Probability of Attaining an Advanced Degree
Sample: ACS College Graduates who Graduated from 1976-2006

	(1)	(2)	(3)
Entry unemployment rate (U_c)	0.0012*	0.0014**	0.0014**
	(0.0007)	(0.0007)	(0.0007)
β^{major}	0.0122***		
	(0.0040)		
$\beta^{major} * U_c$	-0.0029***	-0.0023***	-0.0015***
	(0.0006)	(0.0005)	(0.0005)
Major fixed effects		X	X
Grad year fixed effects	X	X	X
Cluster at grad year-division	X	X	X
β^{major} interacted with cubic time trend			X
Observations	1,052,820	1,052,820	1,052,820
R-squared	0.011	0.083	0.083

*** p<0.01, ** p<0.05, * p<0.1

Notes: The sample is college graduates who graduated from 1976 to 2006 with at least 5 years of potential experience. We exclude enrolled people. β^{major} is the earnings return to the major, estimated on a sample of workers age 36-59 in our pooled, unweighted data. U_c is the divisional unemployment rate in the year of college graduation.

Table 9: Labor Market Entry Effects in the Great Recession

	Dependent variable													
	Earnings:				Employment:						Occupation:			
	All		Full-time		Pr(Employed)		Pr(Full Time)		Wages		Earnings Return		Pr(in top 5 for major)	
	Pre-04	Post-04	Pre-04	Post-04	Pre-04	Post-04	Pre-04	Post-04	Pre-04	Post-04	Pre-04	Post-04	Pre-04	Post-04
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	Panel A: Effects of a 4 ppt rise in U_c, for those graduating before and after 2004													
Average effect, 5 yrs	-0.0406***	-0.0898***	-0.0069	-0.0595***	0.0016	0.0084	-0.0456***	-0.0018	-0.0300**	-0.0527**	-0.0062	0.0030	-0.0251*	-0.0114
(s.e.)	(0.0145)	(0.0266)	(0.0146)	(0.0220)	(0.0059)	(0.0073)	(0.0100)	(0.0121)	(0.0137)	(0.0203)	(0.0075)	(0.0087)	(0.0145)	(0.0146)
Effect at potexp =														
1	-0.0811***	-0.1927***	-0.0175	-0.1229***	-0.0018	0.0116	-0.1186***	-0.0329**	-0.0398**	-0.0288	-0.0099	-0.0099	-0.0365*	0.0052
	(0.0230)	(0.0211)	(0.0230)	(0.0190)	(0.0089)	(0.0104)	(0.0170)	(0.0153)	(0.0193)	(0.0215)	(0.0109)	(0.0082)	(0.0210)	(0.0183)
3	-0.0374**	-0.0639*	-0.0053	-0.0403	0.0022	0.0101	-0.0381***	0.0027	-0.0289**	-0.0420**	-0.0060	0.0022	-0.0241*	-0.0201
	(0.0144)	(0.0322)	(0.0143)	(0.0238)	(0.0059)	(0.0087)	(0.0097)	(0.0164)	(0.0137)	(0.0214)	(0.0075)	(0.0104)	(0.0144)	(0.0160)
	Panel B: Effects of 4 ppt rise in U_c interacted with β^{major}, for those graduating before and after 2004													
Average effect, 5 yrs	0.0480***	0.0002	0.0306***	-0.0030	0.0137***	-0.0016	0.0228***	-0.0003	0.0108	-0.0031	0.0172***	-0.0032	-0.0003	-0.0014
(s.e.)	(0.0106)	(0.0117)	(0.0090)	(0.0102)	(0.0046)	(0.0056)	(0.0077)	(0.0071)	(0.0094)	(0.0099)	(0.0052)	(0.0050)	(0.0095)	(0.0090)
Effect at potexp =														
1	0.0671***	0.0187	0.0377***	0.0000	0.0189***	-0.0133*	0.0288***	0.0013	0.0113	0.0022	0.0231***	-0.0022	-0.0048	0.0230**
	(0.0138)	(0.0144)	(0.0121)	(0.0124)	(0.0060)	(0.0078)	(0.0100)	(0.0101)	(0.0124)	(0.0116)	(0.0067)	(0.0069)	(0.0123)	(0.0112)
3	0.0480***	0.0002	0.0306***	-0.0030	0.0137***	-0.0016	0.0228***	-0.0003	0.0108	-0.0031	0.0172***	-0.0032	-0.0003	-0.0014
	(0.0106)	(0.0117)	(0.0090)	(0.0102)	(0.0046)	(0.0056)	(0.0077)	(0.0071)	(0.0094)	(0.0099)	(0.0052)	(0.0050)	(0.0095)	(0.0090)

Notes: Sample for earnings wage, and occupation regressions includes non-enrolled workers age 22-35 with potential experience 1 to 13 with a valid annual earnings observation (greater than $500 in 2006 dollars). The regression samples for employed and full-time exclude enrolled workers but have no restriction on earnings, and also include those with potential experience equal to zero. Observations in these regressions are major-gradyear-division-potexp cells. We weight by the major's share of observations in the gradyear-potexp group. Uc is the divisional unemployment rate in the year the cohort graduated from college. Potexp is years since college graduation. Survey dummies, year dummies, a quadratic in potential experience, gender, race, and region controls are also included. The two periods are graduates in 2003 and earlier, and graduates in 2004 and later. We include a "post-2004" dummy and interact it with potexp, potexp squared, the unemployment rate, and the unemployment rate's interactions with potexp.

Appendix Table 1
Data Sources (Earnings Sample)

Data source	Grad years	Earnings years	Earnings observations
NLSY79	1979-1989	1980-1993, 1995, 1997	9,102
NLSY97	2000-2008	2003-2009	3,545
NLS72	1976-1978	1977-1986	6,157
B&B 93/03	1993	1994, 1997, 2003	12,904
B&B 08/09	2008	2009	6,340
NSCG 1993	1980-1990	1993	24,832
NSCG 2003	1990-2000	2003	11,575
ACS 09-11	1996-2010	2009-2011	284,557
SIPP	1976-2009	1984-2011	46,159

Notes: An observation here is a worker-year. Valid earnings observations are defined as observations in which the worker is not enrolled in school and has at least $500 in annual earnings in 2006 dollars. We restrict to workers aged 22 to 35 with 1 to 13 years of potential experience, defined as years since graduation.

Appendix Table 2

Unweighted Sample Coverage: Graduation Unemployment Rates and Potential Experience

	Years since college graduation					
U_c	1-2	3-4	5-7	8-10	11-13	Total
<5%	10,277	30,617	32,783	47,751	44,936	166,364
5-6%	12,497	17,549	35,324	27,873	19,474	112,717
6-7%	9,791	7,258	21,327	17,276	6,385	62,037
7-8%	5,451	2,766	7,075	7,714	5,882	28,888
8-9%	5,921	1,206	2,028	4,172	2,024	15,351
>9%	10,214	1,050	1,866	3,794	2,900	19,824
Total	54,151	60,446	100,403	108,580	81,601	405,181

Notes: An observation here is a worker-year. This table includes only valid earnings observations, defined as a worker aged 22 to 35 with potential experience 1 to 13 with at least $500 in annual earnings in 2006 dollars. U_c is the annual census division unemployment rate. Potential experience is years since graduation.

Appendix Table 3a: Characteristics of SIPP Major Categories, 1984 to 1993 Waves

Major:	β^{major}	SAT Math	Occupation Skill Level	Avg. U_c^{major} (%)	Concentration
Mathematics and Statistics	1.34	1.46	0.97	2.60	0.15
Engineering and Computers	1.25	1.45	1.38	2.97	0.94
Economics	0.85	1.51	0.50	3.04	-0.56
Business/Management	0.30	0.09	-0.16	3.18	-0.05
Nursing/Pharmacy/Health	0.30	-1.00	0.39	2.28	0.42
Law	0.19	-0.28	-0.14	2.80	-0.06
Police Science and Law Enforcement	0.17	-1.53	-0.78	2.66	-0.25
Physical or Earth Sciences	0.11	0.68	0.99	2.56	-0.31
Biology	-0.06	1.05	1.32	2.11	0.58
Psychology	-0.22	-0.64	-0.05	2.66	-0.49
Home Economics	-0.25	-1.36	-1.17	2.72	-0.58
Other	-0.26	-0.12	-1.41	3.67	-0.36
English and Journalism	-0.33	-0.24	-0.83	3.17	-0.79
Liberal Arts and Humanities	-0.44	0.41	-0.42	2.61	0.63
Social Sciences	-0.67	-0.15	-0.08	2.86	-0.80
Agriculture or Forestry	-0.75	0.10	-1.04	3.43	-0.94
Vocational and Technical Studies	-0.86				
Education	-1.17	-0.95	-0.74	2.04	1.59
Medicine and Dentistry	-1.40				
Religion or Theology	-2.16	0.73	0.01	2.76	-0.29

Notes: All measures except U_c^{major} are given in standard deviations. See the text for details on each measure. β^{major} is the earnings return to the major, based on authors' calculations, and is estimated in the SIPP itself. The other measures are mapped from B&B major categories to SIPP categories using the crosswalks in appendix tables 4a and 4b. SAT math is the average SAT math score in the major, obtained from the Baccalaureate and Beyond. Occupation skill is the degree of critical thinking and problem sovling required of the occupation, based on O*NET task measures and authors' calculations. Ucmajor is the average of annual major-specific unemployment rates, based on authors' calculations. Concentration is based on the share of workers in a major who are in the top 5 occupations for that major, based on authors' calculations. A blank space indicates that no value exists, because there is no B&B major category that maps into this SIPP category.

Appendix Table 3b: Characteristics of SIPP Major Categories, 1996 to 2008 Waves

Major:	β^{major}	SAT Math	Occupation Skill Level	Avg. U_c^{major} (%)	Concentration
Pre-Professional	2.60	-0.28	-0.14	2.81	-0.06
Engineering	1.57	1.82	1.61	2.93	0.69
Computer and Information	1.36	0.80	0.95	3.02	1.56
Mathematics and Statistics	1.22	1.46	0.97	2.60	0.15
Natural Sciences	0.98	0.91	1.19	2.27	-0.49
Health Sciences	0.75	-1.03	0.35	2.31	0.35
Business/Management	0.64	0.26	-0.09	3.17	-0.10
Other	0.51	-1.23	-1.73	4.01	-0.59
Foreign Languages	0.45	0.41	-0.42	2.61	-0.63
Liberal Arts and Humanities	0.34				
Psychology	0.09	-0.64	-0.05	2.66	-0.49
Egnlish and Literature	0.07	0.28	-0.68	2.87	-0.75
Social Sciences	0.01	-0.35	-0.18	2.83	-0.72
Philosophy/Religion/Theology	-0.06	0.73	0.01	2.76	-0.29
Communications	-0.07	-0.67	-0.95	3.42	-0.83
Art and Architecture	-0.24	0.01	-1.27	3.64	-0.29
Education	-0.58	-0.99	-0.78	2.11	1.39
Agriculture or Forestry	-0.75	0.10	-1.04	3.43	-0.94

Notes: All measures except U_c^{major} are given in standard deviations. See the text for details on each measure. β^{major} is the earnings return to the major, based on authors' calculations, and is estimated in the SIPP itself. The other measures are mapped from B&B major categories to SIPP categories using the crosswalks in appendix tables 4a and 4b. SAT math is the average SAT math score in the major, obtained from the Baccalaureate and Beyond. Occupation skill is the degree of critical thinking and problem sovling required of the occupation, based on O*NET task measures and authors' calculations. Ucmajor is the average of annual major-specific unemployment rates, based on authors' calculations. Concentration is based on the share of workers in a major who are in the top 5 occupations for that major, based on authors' calculations. A blank space indicates that no value exists, because there is no B&B major category that maps into this SIPP category.

Appendix Table 4a: Dept of Education to Early SIPP Major Crosswalk

Early SIPP Major	Dept of Education Major	Ed Share (Men)	Ed Share (Women)
Agriculture/Forestry	Agriculture/Ag Science	1.00	1.00
Biology	Biological Sciences	1.00	1.00
Business/Mgmt	Finance	0.16	0.10
Business/Mgmt	Marketing	0.21	0.25
Business/Mgmt	Business Mgmt/Admin	0.14	0.20
Business/Mgmt	Accounting	0.49	0.45
Economics	Economics	1.00	1.00
Education	Secondary Education	0.08	0.03
Education	Other Education and Library Science	0.92	0.97
Engineering/Computers	All Other Engineering	0.21	0.23
Engineering/Computers	Chemical Engineering	0.04	0.08
Engineering/Computers	Civil Engineering	0.07	0.08
Engineering/Computers	Computer Programming	0.05	0.09
Engineering/Computers	Computer/Info Tech	0.24	0.28
Engineering/Computers	Electrical Engineering	0.14	0.10
Engineering/Computers	Engineering Tech	0.06	0.05
Engineering/Computers	Mechanical Engineering	0.14	0.08
Engineering/Computers	Precision Production/Industrial Arts	0.04	0.02
English/Journalism	Communications	0.49	0.44
English/Journalism	Journalism	0.40	0.45
English/Journalism	Letters: Lit, Writing, Other	0.10	0.10
Home Economics	Family and Consumer Science	1.00	1.00
Law	Public Administration and Law	1.00	1.00
Liberal Arts/Humanities	Foreign Language	1.00	1.00
Math/Statistics	Mathematics	1.00	1.00
Medicine/Dentistry	--	--	--
Nursing/Pharm/Health	Misc. Business and Med. Support	0.54	0.24
Nursing/Pharm/Health	Fitness and Nutrition	0.19	0.10
Nursing/Pharm/Health	Other Med/Health Services	0.17	0.26
Nursing/Pharm/Health	Medical Tech	0.02	0.02
Nursing/Pharm/Health	Public Health	0.02	0.02
Nursing/Pharm/Health	Nursing	0.07	0.35
Other	Leisure Studies and Basic Skills	0.11	0.10
Other	Architecture	0.19	0.09
Other	Commercial Art and Design	0.15	0.21
Other	Art History and Fine Arts	0.21	0.27
Other	Film and Other Arts	0.13	0.14
Other	Music and Speech/Drama	0.22	0.19
Physical/Earth Science	Multidisciplinary or General Science	0.16	0.29
Physical/Earth Science	Physics	0.23	0.09
Physical/Earth Science	Chemistry	0.34	0.40
Physical/Earth Science	Earth and Other Physical Sci	0.27	0.22
Police Science	Protective Services	1.00	1.00
Psychology	Psychology	0.85	0.77
Psychology	Social Work and Human Resources	0.15	0.23
Religion/Theology	Philosophy and Religion	1.00	1.00
Social Sciences	Other Social Science	0.28	0.42
Social Sciences	Area, Ethnic, and Civic Studies	0.03	0.06
Social Sciences	Political Science	0.29	0.23
Social Sciences	History	0.26	0.16
Social Sciences	International Relations	0.05	0.07
Social Sciences	Environmental Studies	0.09	0.06
Vocational Studies	--	--	--

Notes: We construct the Dept of Ed-to-SIPP major crosswalk based on the names of the majors. The shares are calculated using the pooled non-SIPP data, separately by gender.

Appendix Table 4b: Dept of Education to Late SIPP Major Crosswalk

Early SIPP Major	Dept of Education Major	Ed Share (Men)	Ed Share (Women)
Agriculture/Forestry	Agriculture and Agr. Science	1	1
Art/Architecture	Precision Production/ Industrial Arts	0.16	0.02
Art/Architecture	Architecture	0.17	0.09
Art/Architecture	Commercial Art and Design	0.14	0.23
Art/Architecture	Art History and Fine Arts	0.19	0.3
Art/Architecture	Film and Other Arts	0.12	0.15
Art/Architecture	Music and Speech/Drama	0.21	0.21
Business/Mgmt	Economics	0.13	0.08
Business/Mgmt	Finance	0.14	0.09
Business/Mgmt	Marketing	0.12	0.19
Business/Mgmt	Business Mgmt/Administration	0.43	0.42
Business/Mgmt	Accounting	0.18	0.23
Communications	Communications	0.83	0.81
Communications	Journalism	0.17	0.19
Computer/Info Tech	Computer and Info Tech	0.83	0.75
Computer/Info Tech	Computer Programming	0.17	0.25
Education	Secondary Education	0.08	0.03
Education	Other Education and Library Science	0.88	0.87
Education	Family and Consumer Science	0.04	0.1
Engineering	All Other Engineering	0.32	0.38
Engineering	Mechanical Engineering	0.21	0.12
Engineering	Electrical Engineering	0.21	0.16
Engineering	Civil Engineering	0.11	0.13
Engineering	Chemical Engineering	0.06	0.12
Engineering	Engineernig Tech	0.09	0.08
English/Literature	Letters: Lit., Writing, Other	1	1
Foreign Language	Foreign Language	1	1
Health Sciences	Misc. Business/Med Support	0.54	0.24
Health Sciences	Fitness and Nutrition	0.19	0.1
Health Sciences	Other Med/Health Services	0.17	0.26
Health Sciences	Medical Tech	0.02	0.02
Health Sciences	Public Health	0.02	0.02
Health Sciences	Nursing	0.07	0.35
Liberal Arts/Humanities	--	--	--
Math/Statistics	Mathematics	1.00	1.00
Nature Sciences	Multidisciplinary/General Science	0.07	0.08
Nature Sciences	Physics	0.09	0.02
Nature Sciences	Chemistry	0.14	0.11
Nature Sciences	Earth and Other Physical Science	0.11	0.06
Nature Sciences	Biological Sciences	0.6	0.73
Other	Leisure Studies and Basic Skills	1	1
Philogophy/Religion	Philosophy and Religion	1	1
Pre-Professional	Public Admin and Law	1	1
Psychology	Psychology	0.85	0.77
Psychology	Social Work and Human Resources	0.15	0.23
Social Sciences	Other Social Sciences	0.23	0.36
Social Sciences	Area, Ethnic, and Civic Studies	0.02	0.05
Social Sciences	Political Science	0.24	0.19
Social Sciences	Protective Serivces	0.19	0.14
Social Sciences	History	0.21	0.14
Social Sciences	International Relations	0.04	0.06
Social Sciences	Environmental Studies	0.08	0.05

Notes: We construct the Dept of Ed-to-SIPP major crosswalk based on the names of the majors. The shares are calculated using the pooled non-SIPP data, separately by gender.

Appendix Table 5: Effects of 4 ppt rise in U_c interacted with SAT Math

	Dependent variable:						
	Earnings:		Employment:			Occupation Variables:	
	All	Full-time	Pr(Employed)	Pr(Full time)	Wages	Earnings Return	Pr(in top 5 for major)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Panel A: Coefficients on SAT Math						
Main effect	0.1167***	0.1092***	0.0015	0.0221***	0.0976***	0.0946***	0.0136**
(s.e.)	(0.0075)	(0.0064)	(0.0020)	(0.0023)	(0.0061)	(0.0035)	(0.0067)
Major char * PE	0.0013	0.0001	-0.0003	-0.0003	0.0009	-0.0007	0.0031***
(s.e.)	(0.0011)	(0.0009)	(0.0003)	(0.0006)	(0.0009)	(0.0005)	(0.0009)
	Panel B: Interaction of Major Characteristic and Entry Unemployment Rate						
Average effect	0.0206***	0.0221***	0.0054**	0.0097**	0.0096*	0.0024	0.0002
(s.e.)	(0.0062)	(0.0050)	(0.0022)	(0.0039)	(0.0053)	(0.0029)	(0.0051)
Effect at potexp =							
1	0.0461***	0.0359***	0.0128***	0.0204***	0.0120	0.0054	-0.0105
	(0.0110)	(0.0089)	(0.0041)	(0.0074)	(0.0094)	(0.0051)	(0.0088)
3	0.0347***	0.0298***	0.0095***	0.0156***	0.0109	0.0041	-0.0058
	(0.0084)	(0.0069)	(0.0031)	(0.0056)	(0.0072)	(0.0039)	(0.0068)
7	0.0121**	0.0175***	0.0029	0.0062*	0.0087*	0.0014	0.0037
	(0.0060)	(0.0046)	(0.0021)	(0.0034)	(0.0051)	(0.0027)	(0.0050)
10	-0.0049	0.0084	-0.0020	-0.0009	0.0071	-0.0006	0.0109
	(0.0081)	(0.0061)	(0.0030)	(0.0045)	(0.0070)	(0.0035)	(0.0069)

*** p<0.01, ** p<0.05, * p<0.1

Notes: Sample for columns 1, 2, 5, 6, and 7 includes non-enrolled workers age 22-35 with potential experience 1 to 13 with a valid annual earnings observation (greater than $500 in 2006 dollars). The regression samples for employed and full-time exclude enrolled workers but have no restriction on earnings, and also include those with potential experience equal to zero. Observations in these regressions are major-gradyear-division-potexp cells. We weight by the major's share of observations in the gradyear-potexp group. Uc is the divisional unemployment rate in the year the cohort graduated from college. Potexp is years since college graduation. SAT Math is the average SAT math score in the major, calculated from the two pooled waves of the Baccalaureate and Beyond. Survey dummies, year dummies, a quadratic in potential experience, gender, race, and region controls are also included.

Appendix Table 6: Effects of 4 ppt rise in U_c interacted with Occupational Skill of the Major

	Dependent variable:						
	Earnings:		Employment:			Occupation Variables:	
	All	Full-time	Pr(Employed)	Pr(Full time)	Wages	Earnings Return	Pr(in top 5 for major)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Panel A: Coefficients on Major's Occupation Skill						
Main effect	0.1266***	0.1149***	0.0060***	0.0187***	0.1178***	0.0950***	0.0576***
(s.e.)	(0.0072)	(0.0060)	(0.0020)	(0.0037)	(0.0062)	(0.0035)	(0.0061)
Major char * PE	0.0002	-0.0007	-0.0001	-0.0004	-0.0011	-0.0012**	0.0025***
(s.e.)	(0.0011)	(0.0009)	(0.0003)	(0.0005)	(0.0009)	(0.0005)	(0.0008)
	Panel B: Interaction of Major Characteristic and Entry Unemployment Rate						
Average effect	0.0099	0.0134***	0.0029	0.0089**	-0.0004	0.0001	-0.0116**
(s.e.)	(0.0061)	(0.0051)	(0.0021)	(0.0038)	(0.0051)	(0.0030)	(0.0051)
Effect at potexp =							
1	0.0309***	0.0220**	0.0072*	0.0183***	-0.0005	0.0019	-0.0146*
	(0.0107)	(0.0094)	(0.0037)	(0.0072)	(0.0091)	(0.0052)	(0.0087)
3	0.0215***	0.0182**	0.0053*	0.0141***	-0.0005	0.0011	-0.0133**
	(0.0082)	(0.0071)	(0.0028)	(0.005)	(0.0069)	(0.0040)	(0.0066)
7	0.0029	0.0106**	0.0015	0.0057*	-0.0004	-0.0005	-0.0106**
	(0.0060)	(0.0047)	(0.0021)	(0.0034)	(0.0050)	(0.0028)	(0.0051)
10	-0.0111	0.0048	-0.0014	-0.0006	-0.0003	-0.0017	-0.0086
	(0.0083)	(0.0062)	(0.0030)	(0.0045)	(0.0070)	(0.0037)	(0.0071)

*** p<0.01, ** p<0.05, * p<0.1

Notes: Sample for columns 1, 2, 5, 6, and 7 includes non-enrolled workers age 22-35 with potential experience 1 to 13 with a valid annual earnings observation (greater than $500 in 2006 dollars). The regression samples for employed and full-time exclude enrolled workers but have no restriction on earnings, and also include those with potential experience equal to zero. Observations in these regressions are major-gradyear-division-potexp cells. We weight by the major's share c observations in the gradyear-potexp group. Uc is the divisional unemployment rate in the year the cohort graduated from college. Potexp is years since college graduation. The occupational skill of the major is derived from O*Net measures of critical thinking and problem solving; we take the average value of workers from the major, calculated in the ACS. Survey dummies, year dummies, a quadratic in potential experience, gender, race, and region controls are also included.

Appendix Table 7: Details of Variables of Interest by Data Set

Variable	NLSY79	NLSY97	NLS72	B&B 93/03	B&B 08/09	NSCG93
Annual earnings	Earnings in prior calendar year	Earnings in prior calendar year	Wage in primary job times annual hours in that job	Annual salary in current job or job in reference month (depending on wave)	Earnings in 2009, annualized to adjust for the timing of the interview	Annual salary in current job
Rate of pay (wages)	Hourly rate of pay in current/most recent job	Hourly rate of pay in current/most recent job	Average of starting and ending/current wages in primary job	Annual salary in current job or job in reference month (depending on wave)	Earnings in current year, annualized	Annual salary in current job
Employment	Employed at date of survey	Employed at date of survey	Employed at date of survey	Employed at date of survey or in reference month	Employed in reference month	Employed at date of survey
Full-time employment	Usually work 35 or more hours per week	Usually work 35 or more hours per week	Annual hours greater than 1,750 (35*50)	Question asks full-time or part-time, at time of survey or reference month	At least 35 hours per week in 2009	Question asks full-time or part-time; questionnaire defines full-time as 35 or more hours per week
Occupation	Current/most recent job	Current/most recent job	Primary job at time of survey (not necessarily current)	Job at time of survey or in reference month	Primary job at time of survey	Principal job in survey reference week
Enrollment	Enrolled at time of survey	Enrolled at time of survey	No enrollment informationo	Enrolled at time of survey or in reference month	Enrolled at time of survey	No enrollment information
Highest grade completed	Highest degree completed	Highest degree completed	Years of schooling completed	Highest degree completed	Highest degree completed	Highest degree completed
Year of graduation	Use questions on highest degree completed each year	Created variable for year of bachelor's degree	Use questions on highest grade completed each year	All 1993	All 2008	Direct question about first bachelor's degree
Location of graduation	State of residence in year of graduation	State of residence in year of graduation	Zip code in year of graduation	Direct question about state of undergraduate institution	Direct question about state of undergraduate institution	Direct question about Census division of first bachelor's degree
College major	Direct questions; hundreds of categories	Direct questions; roughly 50 categories	Derived from student transcript data; roughly 50 categories	Direct question; roughly 100 categories	Direct question; roughly 50 categories	Direct question about first bachelor's degree; hundreds of categories

NSCG03	ACS 09-11	SIPP 84-93	SIPP 96-08
Annual salary in current job	Total wage and salary earnings over past 12 months	Sum of monthly earnings over the year	Sum of monthly earnings over the year
Annual salary in current job	Earnings divided by the product of weeks worked in past 12 months and usual hours worked	Annualized earnings divided by total hours over the year	Annualized earnings divided by total hours over the year
Employed at date of survey	Employed at date of survey	Fraction of the year employed and not enrolled (months employed divided by 12)	Fraction of the year employed and not enrolled (months employed divided by 12)
Question asks full-time or part-time; questionnaire defines full-time as 35 or more hours per week	Usually work 35 or more hours per week	Fraction of the year working 35 or more hours per week and not enrolled	Fraction of the year working 35 or more hours per week and not enrolled
Principal job in survey reference week	Job at time of survey	Primary occupation given each month; for occupation measures, we use average of the 12	Primary occupation given each month; for occupation measures, we use average of the 12
Enrolled during reference week	Enrolled at time of survey	Fraction of the year enrolled (no enrollment information in 1984 panel)	Fraction of the year enrolled
Highest degree completed	Years of schooling completed	Highest degree completed	Highest degree completed
Direct question about first bachelor's degree	Imputed from year and quarter of birth	Direct question	Direct question
No location of graduation information; we use location of current residence	No location of graduation information; we use location of current residence	No location of graduation information; we use location of current residence	No location of graduation information; we use location of current residence
Direct question about first bachelor's degree; hundreds of categories	Direct question; hundreds of categories	Only field of highest degree; 20 categories	Direct question; 18 categories

Web Table 1: Annual Earnings as a Function of Entry Conditions and Major Characteristics
Restricted to Full-Time Workers

	(1)	(2)	(3)	(4)	(5)	(6)
Entry unemployment rate (U_c)	-0.0116**	-0.0115**	-0.0100**	-0.0100*	-0.0044	-0.0086*
	(0.0045)	(0.0046)	(0.0044)	(0.0054)	(0.0057)	(0.0047)
Post*Uc					-0.0263***	-0.0230***
					(0.0075)	(0.0082)
U_c*potexp	0.0034**	0.0038**	0.0028*	0.0028*	0.0019	0.0024
	(0.0016)	(0.0017)	(0.0014)	(0.0016)	(0.0018)	(0.0015)
Post*Uc*potexp					0.0132***	0.0110*
					(0.0051)	(0.0060)
U_c*potexp^2	-0.0003**	-0.0003**	-0.0002*	-0.0002	-0.0002	-0.0002
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Post*U_c*potexp^2					-0.0022**	-0.0017
					(0.0010)	(0.0011)
β^{major}	0.1541***					
	(0.0062)					
Post*β^{major}					-0.0134	-0.0131
					(0.0120)	(0.0098)
β^{major}*potexp	0.0029***	0.0022**	0.0021***	0.0021***	0.0020**	0.0018**
	(0.0009)	(0.0008)	(0.0006)	(0.0008)	(0.0010)	(0.0007)
Post*β^{major}*potexp					0.0004	0.0003
					(0.0024)	(0.0023)
β^{major}* U_c	0.0020	0.0073**	0.0079***	0.0079**	0.0088**	0.0094***
	(0.0037)	(0.0034)	(0.0024)	(0.0033)	(0.0042)	(0.0030)
Post*β^{major}* U_c					-0.0084	-0.0094**
					(0.0054)	(0.0043)
β^{major}* U_c*potexp	0.0002	-0.0006	-0.0007**	-0.0007*	-0.0008	-0.0009**
	(0.0005)	(0.0005)	(0.0003)	(0.0004)	(0.0005)	(0.0004)
Post*β^{major}* U_c*potexp					0.0002	0.0005
					(0.0019)	(0.0018)
Major fixed effects		X	X	X	X	X
Grad year fixed effects			X	X		X
Cluster at grad year-division	X	X			X	
Cluster at grad year-major-division				X		
Observations	47,120	47,120	47,120	47,120	47,120	47,120
R-squared	0.407	0.431	0.435	0.435	0.436	0.436

*** p<0.01, ** p<0.05, * p<0.1

Notes: Observations in these regressions are major-gradyear-division-potexp cells. We weight by the major's share of observations in the gradyear-potexp group. U_c is the divisional unemployment rate in the year the cohort graduated from college. Potexp is years since college graduation. β^{major} is the earnings return to the major, estimated on a sample of workers age 36-59 in our pooled, unweighted dataSurvey dummies, year dummies, a quadratic in potential experience, gender, race, and region controls are also included. The sample is full-time non-enrolled workers from age 22 to 35, with potential experience 1 to 13, with at least $500 in annual earnings in 2006 dollars.

Web Table 2: Employment as a Function of Entry Conditions and Major Characteristics

	(1)	(2)	(3)	(4)	(5)	(6)
Entry unemployment rate (U_c)	-0.0000	0.0002	-0.0027	-0.0027	-0.0004	-0.0033*
	(0.0017)	(0.0017)	(0.0018)	(0.0022)	(0.0022)	(0.0019)
Post*Uc					0.0033	-0.0007
					(0.0034)	(0.0045)
U_c*potexp	0.0004	0.0004	0.0010	0.0010	0.0007	0.0014**
	(0.0006)	(0.0006)	(0.0007)	(0.0007)	(0.0007)	(0.0006)
Post*Uc*potexp					-0.0004	-0.0002
					(0.0027)	(0.0035)
U_c*$potexp^2$	-0.0001	-0.0001	-0.0001	-0.0001	-0.0001	-0.0001*
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Post*U_c*$potexp^2$					-0.0001	-0.0000
					(0.0001)	(0.0007)
β^{major}	0.0034					
	(0.0024)					
Post*β^{major}					0.0126*	0.0101
					(0.0070)	(0.0065)
β^{major}*potexp	0.0005	0.0009**	0.0004	0.0004	0.0013***	0.0007**
	(0.0004)	(0.0004)	(0.0003)	(0.0004)	(0.0004)	(0.0003)
Post*β^{major}*potexp					-0.0027	-0.0023
					(0.0017)	(0.0015)
β^{major}* U_c	0.0041**	0.0032	0.0030**	0.0030	0.0053**	0.0047***
	(0.0021)	(0.0021)	(0.0012)	(0.0020)	(0.0026)	(0.0015)
Post*β^{major}* U_c					-0.0084***	-0.0080***
					(0.0032)	(0.0024)
β^{major}* U_c*potexp	-0.0005**	-0.0004*	-0.0004**	-0.0004*	-0.0007**	-0.0006***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0003)	(0.0002)
Post*β^{major}* U_c*potexp					0.0021*	0.0021**
					(0.0011)	(0.0010)
Major fixed effects		X	X	X	X	X
Grad year fixed effects			X	X		X
Cluster at grad year-division	X	X			X	
Cluster at grad year-major-division				X		
Observations	52,609	52,609	52,609	52,609	52,609	52,609
R-squared	0.137	0.150	0.155	0.155	0.147	0.148

*** p<0.01, ** p<0.05, * p<0.1

Notes: Observations in these regressions are major-gradyear-division-potexp cells. We weight by the major's share of observations in the gradyear-potexp group. U_c is the divisional unemployment rate in the year the cohort graduated from college. Potexp is years since college graduation. β^{major} is the earnings return to the major, estimated on a sample of workers age 36-59 in our pooled, unweighted data.Survey dummies, year dummies, a quadratic in potential experience, gender, race, and region controls are also included. The sample is non-enrolled workers from age 22 to 35, with potential experience 0 to 13.

Web Table 3: Full-Time Employment as a Function of Entry Conditions and Major Characteristics

	(1)	(2)	(3)	(4)	(5)	(6)
Entry unemployment rate (U_c)	-0.0237***	-0.0237***	-0.0278***	-0.0278***	-0.0296***	-0.0292***
	(0.0033)	(0.0032)	(0.0036)	(0.0041)	(0.0042)	(0.0038)
Post*Uc					0.0214***	0.0143**
					(0.0056)	(0.0067)
U_c*potexp	0.0102***	0.0103***	0.0112***	0.0112***	0.0119***	0.0117***
	(0.0013)	(0.0013)	(0.0012)	(0.0013)	(0.0015)	(0.0012)
Post*Uc*potexp					-0.0064	-0.0068
					(0.0051)	(0.0047)
U_c*potexp^2	-0.0008***	-0.0008***	-0.0009***	-0.0009***	-0.0009***	-0.0009***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Post*U_c*potexp^2					0.0004	0.0004
					(0.0010)	(0.0009)
β^{major}	0.0367***					
	(0.0042)					
Post*β^{major}					0.0212**	0.0227**
					(0.0100)	(0.0088)
β^{major}*potexp	-0.0023***	-0.0023***	-0.0019***	-0.0019***	-0.0016**	-0.0013**
	(0.0006)	(0.0006)	(0.0005)	(0.0006)	(0.0007)	(0.0006)
Post*β^{major}*potexp					-0.0055***	-0.0058***
					(0.0018)	(0.0020)
β^{major}* U_c	0.0047	0.0047	0.0052***	0.0052**	0.0068*	0.0072***
	(0.0029)	(0.0029)	(0.0020)	(0.0025)	(0.0036)	(0.0025)
Post*β^{major}* U_c					-0.0066	-0.0069*
					(0.0042)	(0.0035)
β^{major}* U_c*potexp	-0.0003	-0.0004	-0.0005*	-0.0005	-0.0007	-0.0007**
	(0.0004)	(0.0004)	(0.0003)	(0.0003)	(0.0004)	(0.0003)
Post*β^{major}* U_c*potexp					0.0006	0.0005
					(0.0014)	(0.0013)
Major fixed effects		X	X	X	X	X
Grad year fixed effects			X	X		X
Cluster at grad year-division	X	X			X	
Cluster at grad year-major-division				X		
Observations	52,433	52,433	52,433	52,433	52,433	52,433
R-squared	0.150	0.162	0.165	0.165	0.163	0.163

*** p<0.01, ** p<0.05, * p<0.1

Notes: Observations in these regressions are major-gradyear-division-potexp cells. We weight by the major's share of observations in the gradyear-potexp group. U_c is the divisional unemployment rate in the year the cohort graduated from college. Potexp is years since college graduation. β^{major} is the earnings return to the major, estimated on a sample of workers age 36-59 in our pooled, unweighted data. Survey dummies, year dummies, a quadratic in potential experience, gender, race, and region controls are also included. The sample is non-enrolled workers from age 22 to 35, with potential experience 0 to 13.

Web Table 4: Rate of Pay as a Function of Entry Conditions and Major Characteristics

	(1)	(2)	(3)	(4)	(5)	(6)
Entry unemployment rate (U_c)	-0.0096**	-0.0090**	-0.0123***	-0.0123**	-0.0099**	-0.0127***
	(0.0039)	(0.0039)	(0.0042)	(0.0055)	(0.0048)	(0.0045)
Post*Uc					0.0027	-0.0035
					(0.0071)	(0.0079)
U_c*potexp	0.0009	0.0011	0.0016	0.0016	0.0016	0.0020
	(0.0015)	(0.0015)	(0.0015)	(0.0016)	(0.0016)	(0.0016)
Post*Uc*potexp					-0.0006	-0.0081
					(0.0053)	(0.0059)
U_c*potexp^2	-0.0001	-0.0001	-0.0001	-0.0001	-0.0001	-0.0001
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Post*U_c*potexp^2					-0.0012	0.0004
					(0.0010)	(0.0011)
β^{major}	0.1382***					
	(0.0062)					
Post*β^{major}					-0.0026	-0.0016
					(0.0117)	(0.0100)
β^{major}*potexp	0.0047***	0.0040***	0.0041***	0.0041***	0.0042***	0.0040***
	(0.0009)	(0.0008)	(0.0007)	(0.0008)	(0.0010)	(0.0008)
Post*β^{major}*potexp					-0.0024	-0.0026
					(0.0027)	(0.0023)
β^{major}* U_c	-0.0021	0.0024	0.0027	0.0027	0.0030	0.0028
	(0.0036)	(0.0033)	(0.0024)	(0.0032)	(0.0042)	(0.0031)
Post*β^{major}* U_c					-0.0018	-0.0023
					(0.0050)	(0.0042)
β^{major}* U_c*potexp	0.0008*	0.0001	-0.0001	-0.0001	-0.0001	-0.0007
	(0.0005)	(0.0004)	(0.0004)	(0.0004)	(0.0005)	(0.0004)
Post*β^{major}* U_c*potexp					-0.0010	-0.0006
					(0.0021)	(0.0018)
Major fixed effects		X	X	X	X	X
Grad year fixed effects			X	X		X
Cluster at grad year-division	X	X			X	
Cluster at grad year-major-division				X		
Observations	51,526	51,526	51,526	51,526	51,526	51,526
R-squared	0.990	0.990	0.990	0.990	0.993	0.993

*** p<0.01, ** p<0.05, * p<0.1

Notes: Observations in these regressions are major-gradyear-division-potexp cells. We weight by the major's share of observations in the gradyear-potexp group. U_c is the divisional unemployment rate in the year the cohort graduated from college. Potexp is years since college graduation. β^{major} is the earnings return to the major, estimated on a sample of workers age 36-59 in our pooled, unweighted data.Survey dummies, year dummies, a quadratic in potential experience, gender, race, and region controls are also included. The sample is non-enrolled workers from age 22 to 35, with potential experience 1 to 13, with at least $500 in annual earnings in 2006 dollars.

Web Table 5: Occupation Earnings as a Function of Entry Conditions and Major Characteristics

	(1)	(2)	(3)	(4)	(5)	(6)
Entry unemployment rate (U_c)	-0.0022	-0.0027	-0.0021	-0.0021	-0.0025	-0.0026
	(0.0003)	-0.002	(0.0026)	(0.0033)	(0.0027)	(0.0027)
Post*Uc					0.0000	0.0022
					(0.0033)	(0.0048)
U_c*potexp	0.0003	0.0005	0.0003	0.0003	0.0005	0.0006
	(0.0009)	-0.0008	(0.0008)	(0.0010)	(0.0009)	(0.0009)
Post*Uc*potexp					0.0008	0.0005
					(0.0024)	(0.0034)
U_c*potexp^2	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Post*U_c*potexp^2					0.0001	0.0000
					(0.0005)	(0.0006)
β^{major}	0.1457***					
	(0.0037)					
Post*β^{major}					-0.0015	-0.0015
					(0.0070)	(0.0059)
β^{major}*potexp	0.0013**	0.0006	0.0006*	0.0006*	0.0006	0.0006
	(0.0005)	(0.0005)	(0.0004)	(0.0005)	(0.0006)	(0.0004)
Post*β^{major}*potexp					0.0005	0.0005
					(0.0012)	(0.0012)
β^{major}* U_c	-0.0007	0.0041***	0.0042***	0.0042***	0.0055***	0.0058***
	(0.0018)	(0.0015)	(0.0013)	(0.0016)	(0.0019)	(0.0017)
Post*β^{major}* U_c					-0.0060**	-0.0063***
					(0.0026)	(0.0024)
β^{major}* U_c*potexp	0.0001	-0.0005**	-0.0006***	-0.0006***	-0.0007***	-0.0007***
	(0.0003)	(0.0002)	(0.0002)	(0.0002)	(0.0003)	(0.0002)
Post*β^{major}* U_c*potexp					0.0006	0.0006
					(0.0009)	(0.0009)
Major fixed effects		X	X	X	X	X
Grad year fixed effects			X	X		X
Cluster at grad year-division	X	X			X	
Cluster at grad year-major-division				X		
Observations	50,790	50,790	50,790	50,790	50,790	50,790
R-squared	0.398	0.356	0.398	0.398	0.398	0.398

*** p<0.01, ** p<0.05, * p<0.1

Notes: Observations in these regressions are major-gradyear-division-potexp cells. We weight by the major's share of observations in the gradyear-potexp group. U_c is the divisional unemployment rate in the year the cohort graduated from college. Potexp is years since college graduation. β^{major} is the earnings return to the major, estimated on a sample of workers age 36-59 in our pooled, unweighted data. Survey dummies, year dummies, a quadratic in potential experience, gender, race, and region controls are also included. The sample is non-enrolled workers from age 22 to 35, with potential experience 1 to 13, with at least $500 in annual earnings in 2006 dollars.

Web Table 6: Match Quality as a Function of Entry Conditions and Major Characteristics

	(1)	(2)	(3)	(4)	(5)	(6)
Entry unemployment rate (U_c)	-0.0095**	-0.0064*	-0.0030	-0.0030	-0.0091*	-0.0036
	(0.0041)	(0.0039)	(0.0045)	(0.0059)	(0.0053)	(0.0048)
Post*Uc					0.0104	0.0052
					(0.0069)	(0.0073)
U_c*potexp	0.0014	0.0010	0.0014	0.0014	0.0018	0.0016
	(0.0017)	(0.0017)	(0.0015)	(0.0017)	(0.0019)	(0.0016)
Post*Uc*potexp					-0.0071	-0.0059
					(0.0045)	(0.0053)
U_c*potexp^2	-0.0001	-0.0001	-0.0001	-0.0001	-0.0001	-0.0001
	(0.0002)	(0.0002)	(0.0001)	(0.0001)	(0.0002)	(0.0001)
Post*U_c*potexp^2					0.0012	0.0016
					(0.0009)	(0.0010)
β^{major}	0.0030					
	(0.0073)					
Post*β^{major}					-0.0326**	-0.0293***
					(0.0127)	(0.0098)
β^{major}*potexp	0.0040***	0.0028***	0.0031***	0.0031***	0.0019*	0.0022***
	(0.0010)	(0.0008)	(0.0007)	(0.0008)	(0.0011)	(0.0008)
Post*β^{major}*potexp					0.0030	0.0024
					(0.0023)	(0.0021)
β^{major}* U_c	0.0009	0.0006	0.0011	0.0011	-0.0020	-0.0012
	(0.0036)	(0.0031)	(0.0023)	(0.0033)	(0.0043)	(0.0031)
Post*β^{major}* U_c					0.0080	0.0069*
					(0.0051)	(0.0042)
β^{major}* U_c*potexp	0.0007	0.0003	0.0003	0.0003	0.0007	0.0006
	(0.0004)	(0.0004)	(0.0003)	(0.0004)	(0.0005)	(0.0004)
Post*β^{major}* U_c*potexp					-0.0037**	-0.0036**
					(0.0015)	(0.0016)
Major fixed effects		X	X	X	X	X
Grad year fixed effects			X	X		X
Cluster at grad year-division	X	X			X	
Cluster at grad year-major-division				X		
Observations	45,279	45,279	45,279	45,279	45,279	45,279
R-squared	0.039	0.229	0.231	0.231	0.229	0.228

*** p<0.01, ** p<0.05, * p<0.1

Notes: Observations in these regressions are major-gradyear-division-potexp cells. We weight by the major's share of observations in the gradyear-potexp group. Uc is the divisional unemployment rate in the year the cohort graduated from college. Potexp is years since college graduation. βmajor is the earnings return to the major, estimated on a sample of workers age 36-59 in our pooled, unweighted data. Survey dummies, year dummies, a quadratic in potential experience, gender, race, and region controls are also included. The sample is non-enrolled workers from age 22 to 35, with potential experience 1 to 13, with at least $500 in annual earnings in 2006 dollars.