

Who Scars the Easiest? College Quality and the Effects of Graduating into a Recession*

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Abstract

Graduating from college into a recession is associated with earnings losses, but less is known about how these effects vary across colleges. Using restricted-use data from the National Survey of College Graduates, we study how the effects of graduating into worse economic conditions vary over college quality in the context of the Great Recession. We find that earnings losses are concentrated among graduates from relatively high-quality colleges. Key mechanisms include substitution out of the labor force and into graduate school, decreased graduate degree completion, and differences in the economic stability of fields of study between graduates of high- and low-quality colleges.

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1 Introduction

To what extent do the adverse effects of graduating into a recession vary with college quality? Economists have long been interested in the short- and long-run consequences of exposure to negative economic shocks. Several papers have documented large and persistent negative labor market effects associated with graduating into a recession (e.g., [Kahn \(2010\)](#); [Oreopoulos et al. \(2012\)](#)), and other work has demonstrated that individuals graduating into a worse economy find it more difficult to match to a job that is compatible with their undergraduate field of study ([Liu et al., 2016](#)). However, comparatively less is known about how scarring effects differ between students who graduate from higher- versus lower-quality colleges. If these scarring effects are disproportionately concentrated among individuals graduating from better or worse schools, then this heterogeneity may have important implications for income inequality and inter-generational mobility. Additionally, while the existence of a college quality premium has been extensively documented in the economics literature, there has been less attention paid to whether and to what extent this premium varies over the business cycle.

We study this question in the context of the 2008 financial crash and the subsequent Great Recession using restricted-use versions of the National Surveys of College Graduates (NSCG). The NSCG is a well-suited dataset for our study, since it offers large sample sizes for all birth cohorts while also containing exact institutions of graduation in its restricted-use version, thus allowing us to link measures of college quality to survey respondents. Using a fixed effects design and leveraging variation in unemployment rates at graduation across states and over time, we find that the earnings losses of entering the labor market during a recession are larger for graduates from high-quality institutions relative to their peers who graduate from lower quality colleges. We find that on average, a student who attends a one standard deviation higher quality college earns around \$3,700 more per year. However, this difference is \$384 (i.e., around 10%) smaller for students graduating in a state with a one percentage point higher unemployment rate. Separating institutions into quartiles of quality reveals that this is driven by graduates of top-quartile colleges, who earn -\$2,113 less annually if they graduate from a state with a one percentage point higher unemployment rate.

Our analysis includes individuals with zero earnings, and we find that the labor force participation margin is one of the key mechanisms behind our earnings results. Among

individuals who graduate into a recession, those from high-quality colleges substitute away from employment and into graduate school, whereas those from lower-quality colleges do not. Initially, one might think that this human capital investment would eventually benefit high-quality college graduates such that the negative earnings effect of graduating into a recession would disappear in the long run. In heterogeneity analyses by time since graduation, we find some evidence that the magnitude of the earnings penalties for graduates in top-quartile quality colleges decreases over time, but we still find noisy negative point estimates in the long run. We also find qualitatively similar results when limiting the sample to individuals who are in the labor force and not currently enrolled in graduate school, although the magnitude of these results is attenuated from our main estimates. A similar pattern emerges when limiting the sample to individuals who are neither enrolled in graduate school nor have any graduate degrees.

We also find evidence that many of the high-quality college graduates who enroll in graduate school during a recession do not complete their graduate degrees. Although students from higher quality colleges are more likely to *enroll* in graduate school, they are *less* likely to *complete* a graduate degree. Another mechanism behind our earnings results is undergraduate field of study: students from high-quality colleges are more likely to major in fields that are more adversely affected by the recession (e.g. STEM, social science) while students from lower quality colleges are more likely to major in fields that are resilient over the business cycle (e.g., education). As a final mechanism, we find suggestive evidence that graduating into a recession reduces geographic labor mobility relatively more for higher-quality college graduates. These findings have important implications for designing and targeting policies to combat the negative effects of recessions, as well as for assessing the impact of recessions on equity and social mobility.

The remainder of the paper proceeds as follows. Section 2 reviews the relevant literature and details our contribution to it. Section 3 describes our data, and section 4 details our empirical strategy for studying our research question. Section 5 presents our results and gives a more detailed comparison of our results to related recent work, and Section 6 discusses some broader implications of our findings before concluding.

2 Literature

This paper contributes to several strands of the economics literature, most directly to the literature that studies the persistent “scarring” effects of recession exposure upon labor market entry on individual outcomes (see [von Wachter \(2020\)](#) for a recent review). Graduating into recessions is associated with substantially depressed earnings for at least 10 years. While some work has suggested that these scarring effects fade after approximately a decade, other work has found that the effects can reemerge later in life and be near-permanent ([Schwandt and von Wachter, 2019](#); [Stuart, 2022](#)). As data availability increases, a growing literature has studied the effects of the Great Recession by leveraging spatial variation in the shocks it induced, generally finding that the scarring effects associated with these shocks are severe ([Rinz, 2019](#); [Yagan, 2019](#); [Rothstein, 2021](#)).

A smaller subset of this literature considers heterogeneity of scarring effects between more and less advantaged groups of individuals. [Schwandt and von Wachter \(2019\)](#) find that scarring effects are larger for high school dropouts relative to individuals with more education, and larger for white individuals than non-white individuals. [Arellano-Bover \(2022\)](#) finds that the negative effects of bad labor market conditions on skill development are larger for individuals with lower parental education. Our findings that graduates of higher-quality colleges suffer greater losses than graduates of lower-quality colleges demonstrate that these patterns are not uniform, especially when focusing on four-year college graduates.

Two existing papers have also considered how the effects of graduating into a recession vary by college type. Both [Oreopoulos et al. \(2012\)](#), who study Canadian college students who graduated into recessions in the early 1980s and 90s, and [Weinstein \(2023\)](#), who studies graduates of selective colleges in the United States during the Great Recession, find that losses from graduating into a recession are larger among graduates of less selective colleges. However, compared to these studies, our baseline analysis captures a broader sample that more comprehensively captures heterogeneity in scarring effects among college graduates. First, our analysis focuses individuals with zero earnings. This is an important distinction and reveals a difference in the conceptual model behind our analysis as compared to past work, where we see the effect of graduating to a recession on individuals’ labor force participation as being a key mechanism explaining recession scarring.¹ This is also empirically

¹While we do not propose a formal model as in [Huckfeldt \(2022\)](#), our conceptual framework allows for individuals to choose whether to enter the labor market (or, alternatively, enroll in graduate school) after observing labor market conditions upon graduation from college.

motivated by our context of the Great Recession, during which real wages stayed fairly stable while employment collapsed. Additionally, we use variation across the entire college quality distribution of the United States while [Weinstein \(2023\)](#) focuses on differences between graduates of elite (i.e., very high-quality) universities and the rest of the distribution. A deeper comparison between our work and these papers may be found in [Section 5.4](#).

Our paper also fits into the broader literature on the relationship between college quality and earnings. Papers in this literature generally find that attending a higher-quality college increases earnings ([Black et al., 2005](#); [Hoekstra, 2009](#); [Zimmerman, 2014](#); [Smith et al., 2020](#); [Kozakowski, 2023](#)), with effects persisting up to 30 years after college attendance ([Dillon and Smith, 2020](#)).² Our primary contribution on top of these papers is to explore how differences in earnings between graduates of higher- and lower-quality colleges vary over the business cycle.

Our work explores multiple mechanisms behind the main earnings effects, many of which have been studied in previous literature. First, our work contributes to the literature on how recessions affect higher education enrollment. [Barr and Turner \(2013\)](#) and [Long \(2014\)](#) have both shown that the Great Recession led to increases in college enrollment for undergraduates. We find that these countercyclical enrollment patterns hold for graduate enrollment as well, particularly for graduates from high-quality undergraduate institutions. [Bedard and Herman \(2008\)](#), [Kahn \(2010\)](#), and [Altonji et al. \(2016\)](#) also study the effects of economic downturns on graduate school enrollment and graduate degree attainment over earlier periods. Findings are mixed across recession measures and demographic groups. We add to these findings by investigating how graduate school enrollment during recessions varies by undergraduate college quality. Our findings of strong graduate enrollment effects among graduates of high-quality undergraduate institutions suggest that noisiness of previous estimates may be due to heterogeneity in effects by college quality.

Finally, our work relates to the literature on the relationship between labor markets conditions and major/occupation. [Altonji et al. \(2016\)](#) find that the negative effects of graduating into a recession are concentrated among lower-paying majors, but the effects of the Great Recession are more evenly distributed across majors than earlier recessions. We focus on broad major categories and find that STEM and social science graduates experience relatively worse effects of graduating in a worse economy, while education majors perform

²In contrast, a few other papers have found limited scope for college quality to increase earnings - see [Dale and Krueger \(2002, 2014\)](#); [Mountjoy and Hickman \(2021\)](#).

better. Prior work has also found that the teaching profession is more stable through recessions than other occupations (Kopelman and Rosen, 2016; Nagler et al., 2020; Deneault, 2023). Another potential mechanism is cyclical skill mismatch (i.e., when an individual is working in a field requiring different skills than the field in which they were trained). Previous literature has explored this, such as Liu et al. (2016) who find that the likelihood of skill mismatch at a worker’s initial job is higher in worse economic conditions. We explore this effect and how it varies over college quality but do not find any evidence for meaningful heterogeneity. We also investigate changes in geographical mobility as a mechanism for earning losses. Yagan (2014) found that migratory insurance, where individuals in heavily shocked areas move to more prosperous areas for economic opportunity, played a relatively small role in the Great Recession compared to earlier recessions. We find evidence that graduates of higher quality colleges are more prone to decreases in inter-state mobility, which could contribute to their larger earnings losses relative to lower quality college graduates.

3 Data and Summary Statistics

We use restricted-access versions of the National Survey of College Graduates (NSCG) 2010, 2013, 2015, 2017, and 2019 accessed via the Census RDC (U.S. Census Bureau, 2023). The NSCG sample is drawn from the American Community Survey and includes individuals who have earned a bachelor’s degree, reside in the United States or Puerto Rico, and are younger than 76 years old. We restrict our sample to include individuals who earned their BA between 2000 and 2012 to focus on the Great Recession while maintaining a reasonably narrow range of cohorts and ages among individuals in the sample. These sample restrictions imply that respondent’s earnings are measured between one and 19 years after they graduate from college. While we are interested in the dynamics of scarring effects over time, we are limited in how much we can explore due to statistical power, so our main estimates pool across all years since graduation. We present heterogeneity analyses with coarse measures of years since graduation and find suggestive results that the negative effects for high-quality college graduates persist past 6 years since graduation.³

The restricted-use version includes information on the exact college from which respon-

³For some respondents, we observe multiple earnings measures over time, since the NSCG has a panel component. Unfortunately, the small number of repeat respondents does not allow for us to take advantage of this panel nature. The inclusion of multiple observations per person does not change our main conclusions, as we cluster standard errors at the state by cohort level and find similar results when re-weighting the sample such that each person has equal weight.

dents obtained their degrees, which we link to the Integrated Postsecondary Education Data System (IPEDS) to construct the quality of the college attended (U.S. Department of Education, 2021). Following Dillon and Smith (2020), our college quality measure is an index combining the pseudo-median SAT⁴ score of entering students (midpoint of 25th and 75th percentiles), the applicant rejection rate, the student-faculty ratio, and the average salary of faculty engaged in instruction. We take the first principal component of this index and use it to calculate percentiles of our index across the enrollment-weighted distribution of four-year non-specialty colleges in the United States.⁵ In our specifications, we use both a standardized version of this continuous measure and an alternative measure which includes indicators for each quality quartile. We prefer this college quality index that combines multiple proxies of quality to reduce measurement error (Black and Smith, 2006) but also considered specifications that use each proxy separately as a robustness check and found little change in our main results. We note that we only observe college graduates, so our analysis may be understating the degree to which labor market outcomes vary by college quality since higher-quality colleges boost graduation rates (Cohodes and Goodman, 2014; Dillon and Smith, 2020).

Table 1 presents summary statistics for our sample. Linking individuals to their institutions of graduation requires that they graduate from a U.S. college, which forces us to drop any individuals in the sample that obtained their degree from an international school before moving to the U.S. We present summary statistics for our sample both with and without these dropped individuals — the restriction reduces the proportion of Asian individuals in the sample, but other variables such as income, unemployment, and rates of graduate degree attainment do not change meaningfully, suggesting that linking individuals to their exact institution of study does not inject meaningful selection into the sample. As the sample includes only those who obtained a college degree, it is not representative demographically or economically of the U.S. as a whole.

Table 2 presents summary statistics for the analysis sample, broken down by college quality quartile.⁶ A few differences emerge. Demographically, the proportion of Asians

⁴We default to using SAT scores due to superior coverage across universities compared to ACT scores. If an institution does not report SAT scores but does report ACT scores, we convert the ACT scores to their rough SAT equivalent before proceeding.

⁵Also following Dillon and Smith (2020), we use 2008 as our base year and calculate our college quality index for any college that has at least two of the four proxies.

⁶Note that since quality quartiles are created before individuals in our sample are merged to them, the number of individuals in each quartile need not be the same and indeed are not due to higher-quality colleges exhibiting substantially higher graduation rates.

increases with college quality, especially for top-quartile graduates, while earnings, graduate degree attainment, maternal education, and likelihood of completing a STEM bachelor’s increase monotonically as we move up the quality distribution. The graduates of lower quality colleges are also older on average, reflecting a higher share of them completing non-traditional college paths. Respondents in our sample are, on average, in their early-to-mid 30s, which means that the average effects we estimate in our specification will be capturing the effect of worse unemployment rates upon graduation after a moderate amount of time in the labor market. We will, however, conduct heterogeneity exercises by years of potential experience in an effort to better understand dynamic effects. Graduates of higher quality colleges are also generally more likely to move away from their state of graduation and/or state of birth.

Table 3 reports summary statistics of the colleges themselves over the quality distribution. Higher-quality colleges, on average, have larger student populations and higher tuition. The percent of public colleges in each quality quartile is increasing over the bottom three quartiles but lowest for the top quartile. Mechanically, each of the proxies of college quality (mean SAT scores, applicant rejection rate, faculty/student ratio, and average faculty salary) increase over the distribution. It is notable that, for each of these proxies, the largest jumps between quartiles occurs between the third and top quartile.

4 Empirical Strategy

To first understand the main effects of graduating into a worse labor market and graduating from a high-quality college, we estimate:

$$Y_{istr} = \phi_r + \gamma_s + \theta_t + \alpha_0 \mathbf{X}_i + \alpha_1 U_{st} + \alpha_2 Q_i + \epsilon_{istr}, \quad (1)$$

where Y_{istr} is an outcome variable of interest for individual i who graduated in year t from a college in state s and was surveyed in year r . The specification includes survey year fixed effects ϕ_r to strip out macroeconomic trends, state of graduation fixed effects γ_s to control for differences in state means in the outcome variable, and cohort fixed effects θ_t to account for changes in outcomes common across all graduates of a particular year. Note that the combination of the survey year and cohort fixed effects controls for years of potential experience since graduation. We also include a vector of individual characteristics \mathbf{X}_i , which includes indicators for race, sex, ethnicity, and mother’s and father’s education

level. The main variables of interest are U_{st} , the unemployment rate of the state s from which individual i graduated in year of their graduation t , and Q_i , the quality of i 's college of graduation.

The coefficient α_1 represents the effect of graduating into a labor market with a one percentage point higher unemployment rate. The identifying variation comes from individuals *within* a cohort graduating into different *local* labor market conditions depending on their state of graduation. This specification is in keeping with previous entries of the literature that have studied the scarring impacts of the recession, allowing us to gauge the face validity of our estimate of α_1 by benchmarking it against other estimates in the literature. Meanwhile, individuals who graduate from a one standard deviation higher quality college earn α_2 dollars more, on average, which we will compare to other estimates of the returns to college quality.⁷ We include an error term ϵ_{istr} and cluster our standard errors at the state of graduation by cohort level⁸.

To assess heterogeneity in the effects of the recession over college quality, we next estimate the specification:

$$Y_{istr} = \phi_r + \gamma_s + \theta_t + \alpha_0 \mathbf{X}_i + \alpha_1 U_{st} + \alpha_2 Q_i + \alpha_3 U_{st} Q_i + \alpha_4 U_{st} \mathbf{X}_i + U_{st} \theta_t + \epsilon_{istr}. \quad (2)$$

The parameter of interest α_3 quantifies the extent to which the impacts of graduating into a worse labor market differed for individuals based on the quality of the college from which they graduated. A positive sign would imply that graduates from higher-quality colleges were harmed relatively less by graduating into a bad labor market than their peers from lower-quality colleges. On the other hand, a negative sign would imply the college quality earnings premium is smaller during recessions than it is during good times. We also include the unemployment rate interacted with cohort fixed effects θ_t and individual controls, $U_{st} \mathbf{X}_i$, to account for differing effects over the business cycle⁹.

Because we do not have exogenous variation in college quality, we interpret our results as differences in the scarring effects of recessions between graduates of higher- and lower-quality colleges, but not necessarily the causal effect of attending a higher-quality college on scarring effects. We control for some of the selection into college quality by including the following

⁷One standard deviation is equivalent to about a 30 percentile increase in the college quality distribution.

⁸We have experimented with other levels of clustering and found that our results are minimally sensitive to them.

⁹Interacting cohort fixed effects with the local unemployment rate in particular serves a similar role to including state-by-cohort fixed effects, which itself is impossible due to collinearity with U_{st} .

individual characteristics in \mathbf{X}_i : sex, race, ethnicity, mother’s education level and father’s education level¹⁰. Even so, students likely sort into colleges based on characteristics that we do not observe, such as student ability. The direction of this selection is likely positive: if higher-ability students are more likely to attend higher-quality colleges and are also more likely to earn more, this would mean that our coefficient is upwardly biased. Moreover, there would be further bias upward if, for instance, higher-ability individuals were more resilient against recessionary shocks than their lower-ability counterparts. In our baseline results, correcting for this would have the effect of making the negative effect we uncover stronger. We also investigate whether selection into college varied considerably over the time range we study and find little evidence to this effect; see [Appendix A](#).

A natural question is whether the state-level unemployment rate is the most relevant measure of college graduates’ labor market. In [Section 5.3](#), we explore how our results are affected by using alternative unemployment rate measures. First, we employ data on where colleges’ graduates locate from LinkedIn, collected by [Conzelmann et al. \(2022b\)](#), and find little difference in results from our baseline analysis using state-level unemployment rates ([Conzelmann et al., 2022a](#)). We also present results that use the national unemployment rate as the source of variation. An advantage of this analysis is that it focuses directly on the effects of graduating into the Great Recession as opposed to being located in local labor markets that were more or less affected by it; its limitation is that it prevents us from being able to include cohort fixed effects due to immediate collinearity issues. Still, the general conclusions from this analysis confirm our main results, shown in [Tables C.2](#) and [C.3](#).

Our primary outcomes of interest are earnings and labor force participation. In our main specification, we measure earnings in levels and winsorize at the 95th percentile to prevent the large right tail in earnings among college graduates from dominating our results.¹¹ To measure labor force participation, we use estimate linear probability models with the following indicator variables as outcomes: employed, unemployed, out of the labor force, and current enrollment in graduate school. We explore the sensitivity of our results under alternative functional forms and alternate earnings outcomes in [Section 5.3](#).

¹⁰We also consider alternate specifications that add additional college major fixed effects in [Supplemental Table C.1](#).

¹¹While not winsorizing does not qualitatively change our results, we prefer this specification, as earnings outliers can be especially extreme for high-quality college graduates.

5 Results

5.1 Baseline

Table 4 shows our baseline results from estimating equations (1) and (2), where the outcome is annual earnings. We do not condition on labor force participation, so individuals with zero earnings are included. The first column focuses on the separate effects of the unemployment rate and college quality on annual earnings. On average, we find that students who graduate from a one-standard deviation higher-quality college earn 3,700 dollars annually. This generally aligns with Dillon and Smith (2020), who find using the NLSY-97 that a 30 percentile increase in college quality (the rough equivalent of our one standard deviation increase) for a middle-ability student increases earnings by around 4,400 dollars.

The estimate of U_{st} implies that a one percentage point increase in the state unemployment rate upon graduation decreases annual earnings by around 759 dollars, which is consistent in magnitude with previous studies. However, the inclusion of cohort-by-unemployment rate interactions going forward will often make the interpretation of the unemployment rate coefficient alone quite difficult, as it captures the effect of a higher unemployment rate only for the left-out cohort year interaction. For instance, columns (2) and (5) of Table 4, which examine the interaction of college quality and unemployment rate with the full set of interacted controls, report *positive* and noisy coefficients for the coefficient for U_{st} . A cleaner interpretation of the effect of the unemployment rate alone is shown in columns (3) and (6), where all control variables have been omitted. In these specifications, the impact of higher unemployment rates return to being negative and strongly significant. These columns also highlight that while the inclusion of the controls substantively impacts estimates of the returns of college quality, they do little to the estimates of the impact of the interaction between college quality and local labor market conditions on earnings. Given that our main interest is in this interaction term, in most specifications going forward we include all controls variables but suppress reporting of the uninteracted U_{st} coefficients for clarity.

Returning to the second column of Table 4, we now focus on the interaction term of the unemployment rate and college quality, which gives insight into how scarring effects vary with college quality. We find that a one percentage point increase in the unemployment rate shrinks the earnings advantage of a one standard deviation increase in quality by around 384 dollars, roughly 10 percent of the baseline college quality differences we find

in the specification without the interaction. This result may also be viewed graphically in [Figure 1](#), where we estimate earnings returns to an increase in college quality separately for each graduation cohort from 2000 to 2012: the returns hold roughly steady from the cohorts of 2000 to 2007 before appearing to drop in 2008 when the recession began. Despite the noise in the figure, the estimated return to college quality for the 2009, 2011 and 2012 cohorts are statistically significantly different from the 2007 cohort at the 10 percent level or less, and robustness tests we conduct later that pool cohort coefficients into pre- and post-2007 groups detect differences that are strongly significant, both statistically and substantively.

The fourth, fifth, and sixth columns of [Table 4](#) use our second measure of college quality, where we include indicators for each quartile of the enrollment-weighted college quality distribution. As expected, we see in column 4 that earnings are strongly increasing in college quality. This specification suggests that the college quality earnings differences are nonlinear - while moving from the first quartile to the second quartile increases annual earnings by about 800 dollars (not statistically significant), moving from the second to third and from third to fourth quartile each increase earnings by around 4,000 dollars. The unemployment rate-college quality interaction terms align with our results from the continuous measure, showing that individuals who attended higher-quality colleges experienced a larger earnings penalty from graduating into a recession than those who attended lower quality colleges. While not all coefficients are statistically different from each other in percentage terms, distinctions crystallize when we conduct a subgroup analysis: in [Table 5](#), we break out these quality quartiles to completely separately estimate the effect of graduating into a worse labor market by quality quartile. This analysis again reveals that most of the effect is coming through graduates at the top of the college distribution: among individuals who graduate from a top-quartile college, those who are in a state with a one percentage point higher unemployment rate at graduation earn \$2,113 less per year.

[Table 6](#) shows our main results for labor force participation. Binary variables are scaled by 100 so that effects can be interpreted as percentage point changes. We see in column 1 that employment during a downturn, the decrease in employment is larger for individuals who attended higher quality colleges. When the state unemployment rate is one percentage point higher, individuals who attended a one standard deviation higher quality college are 0.32 percentage points less likely to be employed. Column 2 shows that this is driven by individuals dropping out of the labor force rather than shifting into unemployment. Column 3 uses “currently enrolled in graduate school” as an outcome and shows that graduating

from college during an economic downturn increases the probability of being enrolled in graduate school, and this effect is amplified for students who have graduated from high-quality colleges. In fact, the increased probability of being currently enrolled is roughly equal to the decrease in labor force participation.¹² Column 5 breaks out the enrollment results by college quality quartile and shows that impacts are driven by top quartile graduates.

For employed individuals, we additionally explore how the effect of graduating in a recession varies by college quality for their number of hours worked. Column 5 shows that, unlike the large extensive margin effects on labor force participation, the change in hours conditional on being employed does not vary much over the college quality distribution. We also do not find any evidence that, among the employed, the probability of working outside one’s field during a recession varies by college quality (see column 6).¹³

5.2 Mechanisms and Heterogeneity

Given the results from [Oreopoulos et al. \(2012\)](#) and [Weinstein \(2023\)](#) that found that individuals from more selective colleges fared better when graduating into adverse labor market conditions, the nature of the heterogeneity we find may be surprising. We next aim to unpack the mechanisms driving our results so as to justify them and better situate them in the previous literature.

The results displayed in [Table 6](#) suggest that substitution from labor force participation to graduate school enrollment may be an important driver of our earnings results. However, if graduates from high quality colleges who enroll in graduate school earn higher returns from their graduate degrees upon completion, they may eventually end up out-earning their peers from lower quality colleges who did not enroll in graduate school.¹⁴ To begin probing this, we follow the literature in investigating to what extent our estimated scarring effects vary with (potential) labor market experience.¹⁵ Relatively small sample sizes in the NSCG prevent us from having adequate power for fully flexible event-study-style analyses ([Oreopoulos et al.](#),

¹²This does not necessarily mean that individuals are directly substituting employment and enrollment, since some students may be simultaneously enrolled and working. So, in [Table C.4](#), we consider the four mutually exclusive combinations of working and enrollment and indeed find that most of the movement is out of “working, not enrolled” and into “not working, enrolled”, although there are modest statistically insignificant increases in “working, enrolled” and “not working, not enrolled.”

¹³The NSCG includes a question asking respondents, “To what extent was your work on your principle job related to your highest degree?” Option responses are closely related, somewhat related, and not related. We count responses of “not related” as working outside one’s field.

¹⁴For a general time series of graduate program enrollment/completion rates by years of post-undergraduate experience, refer to [Table C.5](#)

¹⁵We proxy for labor market experience with years of potential experience; i.e., the difference between graduation cohort and current year.

2012; Yagan, 2019; Rinz, 2019), so we instead group individuals based on whether they have more or less than 6 years of labor market experience before estimating the impacts of higher unemployment rates on earnings separately for each college quality quartile. The results of this exercise are shown in Table 7. Among top-quartile graduates, we find modest evidence that the scarring effects attenuate over time, but the estimates are unfortunately noisy across the college quality distribution. This may be consistent with returns to graduate degrees eventually improving outcomes for high-quality graduates, but said improvement may be limited by graduate program non-completion and what sort of programs individuals are enrolling in. Next, we further delve into the graduate school enrollment results and investigate whether the higher enrollment is leading to higher graduate degree attainment.

Table 6 shows results for whether respondents are “currently enrolled” in graduate school at the time that they are surveyed. For some graduates, we observe this measure multiple times, since the NSCG is a panel for some respondents. In results presented in Table 8, we include only one observation per person and define the outcome as “ever observed enrolled”, which takes a value of one if we observe respondents as currently enrolled at least once when responding to the survey. Note that this measure takes a value of zero for respondents who hold a graduate degree but completed it before they are surveyed. We prefer this measure since we are also interested in drop-out from graduate school as an outcome variable. We have no way of knowing if an individual enrolled in graduate school before dropping out if we do not observe them enrolling in the first place. Thus, we would be introducing bias by counting an individual who we observe with a graduate degree (but not enrolled) as “ever enrolled” but not counting an individual who enrolled and dropped out before we observe them.

Table 8 shows the results for “ever observed enrolled” in any graduate school, as well as broken down results by degree type (Master’s, PhD, or professional). We concentrate on the quartiles college quality measure, since the result from Table 6 showed that the interaction effect of the unemployment rate at graduation and college quality on being “currently enrolled” was driven by graduates from the top quality quartile. The first column shows that relative to bottom-quality quartile college graduates, graduates from the top quality quartile who graduated into a labor market with a one percentage point higher unemployment rate were 0.88 percentage points more likely to have ever enrolled in any graduate program. This effect is driven by enrollment in PhD programs and professional programs (e.g., law school, medical school).

Next, we examine the effect of graduating in a recession on the probability of completing a graduate degree. In [Table 9](#), we include one observation for each individual and estimate whether they hold any graduate degree by the last time we observe them (unconditional on us ever observing them as being enrolled). We find that relative to bottom-quality quartile college graduates, although graduates from high quality colleges are more likely to enroll in graduate school if they graduated into a worse labor market, they are *less* likely to hold a completed degree. This suggests that individuals from high quality colleges who graduate into a recession are likely to drop out of their graduate program before completing it and therefore that our main finding of earnings losses from graduating into a recession being concentrated among graduates from high quality colleges is unlikely to be reversed over time. Additionally, since these results are not conditional on being observed as enrolled, this is likely a combination of negative selection of students into graduate school during a recession as well as an increased probability of dropout among students who would have pursued graduate school even absent the recession.

The second mechanism that we uncover for our negative earnings effects is field of study. First, we show that there are differences in major choice across colleges that vary systematically by college quality. [Table C.6](#) shows the percentage of each college quality quartiles' graduates who graduate with degrees in five broad major categories: STEM (i.e., science, technology, engineering, and math), social sciences, health, education, and business. Graduates from high quality colleges are much more likely to major in STEM: 28 percent of graduates from the top quartile choose a STEM major, compared to just 13 percent of graduates from the bottom quartile. High quality college graduates are also more likely to complete majors in the social sciences. On the other hand, graduates from lower quality colleges are more likely to major in health and business. They are also much more likely to major in education: bottom-quartile graduates are over three times as likely to major in education as top-quartile graduates.

These differences in majors have implications for how graduates from different colleges will fare when graduating into a worse labor market, since labor demand for some majors is much more stable over the business cycle than others. In [Table 10](#), we show how the returns to these majors vary with the unemployment rate that students face at graduation. In this specification, we do not include the interaction term of college quality with the unemployment rate but rather include an interaction term of the unemployment rate with

each major group.¹⁶ Table 10 shows that while the earnings of individuals who major in STEM and social sciences tend to decline when the unemployment rate is higher, individuals who major in education actually earn more if they graduated into a labor market with a higher unemployment rate. Thus, part of the reason that we find stronger earnings losses from graduating into a recession among individuals who attended high quality colleges is because graduates from high quality college tend to major in subjects that are more sensitive to fluctuations in the business cycle.

Finally, we investigate the interaction between college quality and economic conditions upon graduation on labor mobility. College graduates (particularly those from high-quality colleges) are highly geographically mobile, and this propensity to move for higher-paying jobs is an important recent driver of the college earnings premium (Diamond, 2016). However, research has indicated that the Great Recession depressed labor mobility, which offers another potential mechanism behind our main results (Yagan, 2014). Table C.7 probes this issue, and we find suggestive evidence that higher quality college graduates are less likely to move out of the state of their college by the time they are observed when they graduate into a worse labor market. The effects appear to be stronger for men: men from third and fourth quartile schools who experience a one percentage point higher unemployment rate upon graduation are each about two percentage points less likely to migrate, relative to men from bottom-quality quartile colleges.

Taken together, our investigation points to several mechanisms behind our main result that earnings losses from recessions are relatively higher for graduates from higher quality colleges. First, graduates from high quality colleges substitute out of the labor force and into graduate school when they experience a worse labor market upon graduation. However, they are unlikely to complete these graduate degrees and are ultimately less likely to hold an advanced degree if they graduated into a recession. Second, graduates from lower quality colleges tend to major in fields that are more resilient to recessions. Finally, graduating into a recession may decrease labor mobility for high-quality college graduates, especially for men.

5.3 Robustness

We also estimate specifications where we restrict the sample to individuals with only a BA (i.e., those who have not obtained and are not currently enrolled in any graduate school)

¹⁶We still include the main effect of college quality to capture average differences in earnings across colleges.

or to those who are both in the labor force and not currently enrolled in any graduate school. We do not prefer these specifications since they condition on endogenous variables but still find them valuable in understanding how much of our main result is coming through labor force participation/graduate school enrollment. Results are presented in the first four columns of [Table C.8](#). We find qualitatively similar results to our main findings, although the estimates are smaller and often not statistically significant.

The final two columns of [Table C.8](#) address the question of what the most relevant labor market is for college graduates. To construct an alternate unemployment measure, we use “Grads on the Go” data, provided by [Conzelmann et al. \(2022b\)](#). For each college, they collect data from LinkedIn on where its graduates locate and provide the fraction of each college’s graduates that live in each state. We use this data to construct college-specific unemployment rates for each year by multiplying each state’s unemployment rate (in the relevant year of graduation) by the college’s share of graduates residing in that state.¹⁷ Results are very similar to our baseline specification using state-level unemployment rates.

In [Table C.9](#), we also experiment with measuring earnings in logs as well as log-plus-1 to avoid dropping zeros. We also include results where we use hourly wages, measured as total earnings divided by hours worked in the previous year, as the dependent variables instead of annual earnings. For our main binary outcomes, we additionally present average marginal effects from probit models (rather than the baseline linear probability models) in [Table C.10](#). In all cases our results hold qualitatively.

Because we measure the unemployment rate at the time of graduation, there may be some concerns that part of what we are capturing is individuals’ endogenous timing of graduation in response to the recession. It could be that college students choose to delay graduation a year to wait out a recession, and that their tendency to do so varies with college quality. We investigate this in two ways. First, we use the state unemployment rate when individuals are age 22, which should not be affected by students’ response to the recession. The results are shown in [Table C.11](#). The first two columns replace the unemployment rate at graduation with the age 22 unemployment rate, while the third and fourth column instrument for the graduation rate with the age 22 rate. Both are similar to our main results, and if anything, more negative for high-quality college grads. Second, we return to our baseline specification but use individuals’ age at graduation as an outcome,

¹⁷Note that the timing of the college’s shares in each location is slightly misaligned with the timing of our sample: the LinkedIn data uses graduates from 2010 to 2015.

shown [Table C.12](#), but find little evidence of meaningful heterogeneity. We also estimate specifications that, in addition to including our main measure of the unemployment rate in the state of graduation, control for the unemployment rate in individuals' birth state or in the year that they graduated from high school in [Table C.13](#). [Table C.14](#) down-weights individuals who appear multiple times so that each person has equal weight. Neither test meaningfully impacts our results.

We also assess whether our results are sensitive to our measure of college quality by using each individual sub-index of college quality (faculty-student ratios, rejection rates, faculty salaries and test scores) as our measure of college quality instead. While we were not able to disclose the point estimates of this exercise, the sign and statistical significance of our estimates do not change relative to the baseline results when using any individual component. We also run specifications with the Barron's selectivity categories, although we note that the Barron's categories capture a different sort of heterogeneity than our main quality measure - they provide several small categories at the top of the quality distribution but group together around three quarters of the sample into one category for the lower/middle parts of the distribution. Still, the qualitative results from this exercise match our baseline results, although the estimates are not statistically different from each other.

Finally, we use coarser measures of time and recession severity to construct a 2X2 difference-in-difference setup to address potential lingering concerns about our baseline identification strategy. Our first difference is before/after the recession in 2008, and our second difference is based on the change in the state unemployment rate between 2007 and 2009, as in [Yagan \(2019\)](#). We characterize states as receiving a "bad shock" if the unemployment rate change is above the median. This is not our preferred specification because it does not take advantage of all of the variation in unemployment rates across states like our continuous measure does, but it aligns more closely with previous literature and gives additional evidence on how recession scarring varies with college quality. [Table C.15](#) show the results from this exercise. The first column shows that relative to bottom-quality quartile graduates, individuals who graduated after the recession from a top quartile college in a state with a bad recession shock earn around 6,000 dollars less than those in a state with a less severe recession shock, after accounting for the earnings differences between these states before the recession. Including additional interactions for time period by college quality category does not meaningfully change the results of this exercise.

5.4 Comparison to Other Studies

In this section, we take a more detailed look at explanations for differences in our results from two other studies that have considered how the effects of graduating into a recession vary across types of colleges. [Oreopoulos et al. \(2012\)](#) find that Canadian college students who graduated into a recession suffered smaller and less persistent earnings losses if they graduated from generally higher-earning majors and colleges. Several important differences between the setting and methods of [Oreopoulos et al. \(2012\)](#) and our work are worth highlighting: in addition to focusing on an earlier time period (graduates from 1976 to 1995 as opposed to 2000-2012) in a different country, the authors restrict their sample to only men with strictly positive earnings and no graduate degrees, thus missing any effects on women as well as considerably reducing the role that substitution from the labor force toward further education can play in their analysis.¹⁸

The setting in [Weinstein \(2023\)](#) is closer to ours, as he also uses variation from the Great Recession in the United States. However, there are several methodological differences that lead to our seemingly opposing results. The first is a difference in college quality/selectivity measures. [Weinstein \(2023\)](#) uses Barron’s categories, which as noted above provide a high degree of detail at the top of the distribution but little variation in the middle and bottom of the distribution. The entirety of the top two categories that Weinstein uses (Ivy Plus and Barron’s Tier 1 (Elite)), along with 95 percent of students in his third category (Barron’s Tier 2 (Highly Selective)) fall within our top-quality quartile. Meanwhile, his fourth category (Barron’s Tiers 3-5), which is used as the base category in his analysis, spans all four of our quality quartiles.¹⁹ Thus, we make broader comparisons across the college quality distribution while Weinstein’s comparison is more akin to elite universities versus the rest of the distribution. In our view, this distinction allows our papers to be quite complementary to one another.

Second, we use different earnings measures. Our primary earnings measure is mean earnings in levels, which we choose to capture endogenous differences in labor force participation, while Weinstein’s main measure is the log of each college’s median income after

¹⁸It is also worth acknowledging that the authors assess the robustness of their results to expanding the sample to include workers with graduate degrees and to limiting the sample to workers with positive earnings in every year and find little change from their main results in either case. However, the importance and prevalence of graduate degrees increased considerably between the 1980s and the 2000s, which provides another potential explanation for why substitution out of the labor force into graduate education plays a larger role in our analysis.

¹⁹Specifically, 29 percent of students in Barron’s Tiers 3-5 fall in our bottom quality quartile, while 32, 30, and 8 percent fall in our second, third, and top quartiles, respectively.

restricting to positive earners, which may understate the role of substitution out of the labor force into graduate education in a similar manner to [Oreopoulos et al. \(2012\)](#). Third, the (implicit) weighting differs between our sample and Weinstein's. After applying the NSCG's sampling weights, our student-level data is nationally representative of bachelor's degree holders, so our results represent the mean impact across all college graduates. Weinstein's data is institution-level, so smaller universities carry more weight per student.

Since Weinstein uses public-use mobility report card data, we are able to directly show how these three differences affect results. When we use Weinstein's specification and data but change the college quality measure from Barron's categories to our quartiles measure, use mean earnings as the outcome variable, and weight by institution size, we broadly replicate our results. Details can be found in [Appendix B](#).

6 Conclusion

Graduating into a recession is associated with losses in earnings, but less is known about how these effects vary based on where an individual graduated from. We study how the effects of graduating into an economic downturn vary with college quality in the context of the Great Recession. Using restricted-use data from the National Survey of College Graduates, we find that graduation into worse economic conditions is associated with earnings losses that are concentrated among graduates from relatively high-quality colleges. We identify several mechanisms behind these results: first, graduates from high-quality colleges who graduate during a worse labor market are more likely to exit the labor force and enroll in graduate school. However, they are *less* likely to earn graduate degrees, implying increased levels of dropout both for marginal enrollees as well as those who would have enrolled absent the recession. Second, relative to lower-quality college graduates, graduates from high-quality colleges tend to major in fields that are more sensitive to business cycle fluctuations, so a recession affects the earnings of graduates from high-quality colleges more. Third, geographic mobility appears to decrease for students from high-quality college when they graduate in a downturn. These findings suggest that who stands to lose the most from graduating into a recession may be more subject to context than previously thought.

These findings also have implications for how the Great Recession impacted the economic mobility for those who graduated into it. The backgrounds of students varies considerably over the college quality distribution: more than 10% of students in bottom-quartile colleges

had parents in the bottom quintile in the national income distribution, while the corresponding statistic for students in top-quartile colleges was less than 5% — further, the proportion of students in these colleges with parents in the top income percentile was 0.8% and 7.7%, respectively.²⁰ The heterogeneity we find points to a potential leveling of the playing field for individuals who graduated into the recession, at least among college graduates. Further investigations into how these results evolve over time may be worthwhile.

²⁰These statistics obtained from using our measures of college quality in conjunction with college mobility report cards from [Chetty et al. \(2020\)](#).

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7 Tables and Figures

Table 1: Summary Statistics

Variable	Mean/SD	Mean/SD
Age	34.65 (8.14)	34.36 (8.01)
Asian	0.11 (0.32)	0.08 (0.27)
Black	0.11 (0.31)	0.11 (0.31)
White	0.79 (0.41)	0.83 (0.37)
Hispanic	0.11 (0.31)	0.09 (0.29)
Married	0.64 (0.48)	0.64 (0.48)
Has MA	0.25 (0.43)	0.24 (0.43)
Has Professional Degree	0.04 (0.20)	0.05 (0.21)
Has PHD	0.02 (0.14)	0.02 (0.13)
Mother college dummy	0.40 (0.49)	0.41 (0.49)
STEM BA	0.21 (0.41)	0.19 (0.39)
Undergraduate Loans (\$1,000s)	10.34 (19.82)	10.38 (19.43)
Total Income (\$1,000s)	54.97 (45.36)	50.69 (35.16)
Unemployed	0.03 (0.18)	0.03 (0.17)
Not in Labor Force	0.08 (0.28)	0.08 (0.27)
Currently Enrolled in Graduate Program	0.11 (0.31)	0.11 (0.31)
Currently Enrolled in MA	0.06 (0.23)	0.06 (0.23)
Currently Enrolled in Prof. Degree	0.01 (0.10)	0.01 (0.10)
Currently Enrolled in PHD	0.02 (0.13)	0.01 (0.12)
Moved from State of Graduation	0.41 (0.49)	0.36 (0.48)
Moved from State of Birth	0.53 (0.50)	0.50 (0.50)
Has Children	0.45 (0.50)	0.44 (0.50)
Sample	Whole	Analysis
Observations	173,000	144,000

Notes: Data from 2010, 2013, 2015, 2017, and 2019 Waves of the National Survey of College Graduates; see text for details. Analysis sample contains individuals with undergraduate institutions that can be linked to IPEDS data. Cell counts rounded following disclosure avoidance protocols.

Table 2: Summary Statistics by College Quality

Variable	Mean/SD	Mean/SD	Mean/SD	Mean/SD
Quality Quartile	1	2	3	4
Age	36.60 (9.25)	35.34 (8.88)	33.73 (7.25)	32.61 (6.37)
Asian	0.04 (0.19)	0.05 (0.21)	0.06 (0.23)	0.15 (0.35)
Black	0.14 (0.34)	0.13 (0.34)	0.10 (0.30)	0.07 (0.25)
White	0.83 (0.37)	0.83 (0.37)	0.86 (0.35)	0.81 (0.39)
Hispanic	0.09 (0.29)	0.09 (0.28)	0.10 (0.30)	0.09 (0.29)
Married	0.67 (0.47)	0.65 (0.48)	0.64 (0.48)	0.60 (0.49)
Has MA	0.22 (0.41)	0.24 (0.43)	0.23 (0.42)	0.26 (0.44)
Has Professional Degree	0.02 (0.13)	0.02 (0.14)	0.04 (0.19)	0.09 (0.29)
Has PHD	0.01 (0.08)	0.01 (0.11)	0.01 (0.11)	0.03 (0.17)
Mother college dummy	0.28 (0.45)	0.32 (0.47)	0.43 (0.49)	0.57 (0.50)
STEM BA	0.13 (0.34)	0.15 (0.35)	0.18 (0.39)	0.28 (0.45)
Undergraduate Loans (1000s)	12.98 (21.29)	11.48 (19.71)	9.55 (18.68)	8.48 (18.28)
Total Income (1000s)	44.64 (30.92)	46.63 (32.23)	51.32 (34.46)	57.51 (39.26)
Hourly Wage	22.85 (16.61)	23.95 (17.41)	25.88 (18.08)	28.57 (20.06)
Unemployed	0.03 (0.16)	0.03 (0.17)	0.03 (0.18)	0.03 (0.17)
Not in Labor Force	0.08 (0.27)	0.08 (0.27)	0.07 (0.25)	0.08 (0.27)
Currently Enrolled in Graduate Program	0.09 (0.29)	0.09 (0.29)	0.10 (0.30)	0.13 (0.33)
Currently Enrolled in MA	0.06 (0.24)	0.05 (0.22)	0.06 (0.23)	0.06 (0.23)
Currently Enrolled in Prof. Degree	0.00 (0.07)	0.00 (0.07)	0.01 (0.09)	0.02 (0.15)
Currently Enrolled in PHD	0.01 (0.10)	0.01 (0.10)	0.01 (0.11)	0.02 (0.15)
Moved from State of Graduation	0.33 (0.47)	0.29 (0.45)	0.33 (0.47)	0.46 (0.50)
Moved from State of Birth	0.44 (0.50)	0.45 (0.50)	0.50 (0.50)	0.57 (0.49)
Has Children	0.53 (0.50)	0.46 (0.50)	0.43 (0.50)	0.37 (0.48)
Observations	20000	28000	35000	60000

Notes: Data from 2010, 2013, 2015, 2017, and 2019 Waves of the National Survey of College Graduates; see text for details. Analysis sample contains individuals with undergraduate institutions that can be linked to IPEDS data. College quality defined following [Dillon and Smith \(2020\)](#). Cell counts rounded following disclosure avoidance protocols.

Table 3: College Characteristics by CQ Quartile

Variable	Mean/SD	Mean/SD	Mean/SD	Mean/SD
Quality Quartile	1	2	3	4
Public	0.36 (0.48)	0.40 (0.49)	0.41 (0.49)	0.26 (0.44)
Number of Students (FTE)	3,329 (4,020)	4,829 (5,650)	6,536 (7,214)	7,153 (8,690)
Tuition (In-state)	12,702 (7,283)	15,487 (8,772)	17,410 (10,143)	27,176 (12,319)
Tuition (Out-of-state)	15,266 (5,505)	18,828 (5,826)	21,145 (7,031)	30,406 (8,158)
Mean SAT	958 (76)	1,030 (71)	1,104 (72)	1,256 (113)
Rejection Rate	0.26 (0.16)	0.34 (0.14)	0.38 (0.16)	0.54 (0.18)
Faculty/Student Ratio	0.05 (0.02)	0.06 (0.01)	0.07 (0.02)	0.10 (0.05)
Average Faculty Salary	51,869 (10,756)	61,280 (10,151)	69,677 (10,601)	87,474 (17,030)

Notes: Data at the college-level from the Integrated Postsecondary Education Data System (IPEDS). Tuition is the same in-state and out-of-state for private institutions. College quality defined following [Dillon and Smith \(2020\)](#).

Table 4: Results for Earnings

VARIABLES	(1) Earnings	(2) Earnings	(3) Earnings	(4) Earnings	(5) Earnings	(6) Earnings
UR at Graduation	-759.1* (417.3)	353.8 (1,979)	-2,267*** (208)	-759.5* (417.0)	961.5 (2,031)	-1,695*** (398)
College Quality Q2				801.7 (935.7)	2,093 (2,911)	3,125 (3,239)
College Quality Q3				4,763*** (986.6)	9,410*** (3,166)	11,380*** (3,465)
College Quality Q4				8,797*** (1,041)	15,750*** (3,067)	18,970*** (3,247)
CQ Q2 X UR					-229.6 (427.6)	-248.8 (471.7)
CQ Q3 X UR					-760.3 (472.1)	-738.3 (514.8)
CQ Q4 X UR					-1,138** (463.7)	-1,096** (464.2)
CQ (SD)	3,684*** (382.7)	6,037*** (1,150)	7,249*** (1,185)			
CQ (SD) X UR		-383.9** (177.8)	-368.3** (173.9)			
Observations	144000	144000	144000	144000	144000	144000
Controls	YES	YES	NO	YES	YES	NO
R-squared	0.164	0.168	0.044	0.163	0.167	0.043

Notes: Standard errors clustered at the cohort-by-state-of-graduation level are in parentheses. *: $p < 0.1$. **: $p < .05$. ***: $p < 0.01$. Table reports estimate of Equations (1) and (2). Data from 2010, 2013, 2015, 2017 and 2019 Waves of the National Survey of College Graduates; see text for details. College quality defined following [Dillon and Smith \(2020\)](#). Controls include fixed effects for survey year, state, and cohort; indicators for race, sex, and parental education; and cohort FEs, race, sex, and parental education indicators interacted with the unemployment rate. Cell counts rounded following disclosure avoidance protocols.

Table 5: Subgroup Analysis Results

Variables	(1) Earnings	(2) Earnings	(3) Earnings	(4) Earnings
UR at Graduation	41 (945)	-447.3 (862)	135 (773.4)	-2,113*** (732.7)
Observations	20000	28000	35000	60000
R-squared	0.156	0.157	0.169	0.177
CQ Quartile	1	2	3	4

Notes: Standard errors clustered at the cohort-by-state-of-graduation level are in parentheses. *: $p < 0.1$. **: $p < .05$. ***: $p < 0.01$. Table reports estimate of Equations (1) and (2), separating effects by college quality quartile and experience category. Data from 2010, 2013, 2015, 2017 and 2019 Waves of the National Survey of College Graduates; see text for details. College quality defined following [Dillon and Smith \(2020\)](#). Controls include fixed effects for survey year, state, and cohort; and indicators for race, sex, and parental education. Cell counts rounded following disclosure avoidance protocols.

Table 6: Results for Employment Variables

VARIABLES	Employed	NILF	Enrolled	Enrolled	Hours	Work Outside Field
CQ (SD)	1.747* (0.946)	-2.124*** (0.801)	-0.547 (0.677)		37.39* (19.89)	-0.857 (1.296)
CQ (SD) X UR at Graduation	-0.321** (0.151)	0.352*** (0.122)	0.357*** (0.112)		-0.534 (3.143)	-0.134 (0.202)
College Quality Q2				-0.908 (2.119)		
College Quality Q3				-0.000939 (2.339)		
College Quality Q4				-0.872 (2.015)		
CQ Q2 X UR				0.166 (0.334)		
CQ Q3 X UR				0.213 (0.411)		
CQ Q4 X UR				0.808** (0.329)		
Observations	144000	144000	144000	144000	131000	131000
R-squared	0.026	0.032	0.044	0.044	0.054	0.017

Notes: Standard errors clustered at the cohort-by-state-of-graduation level are in parentheses. *: $p < 0.1$. **: $p < .05$. ***: $p < 0.01$. Table reports estimate of Equation (2). Data from 2010, 2013, 2015, 2017 and 2019 Waves of the National Survey of College Graduates; see text for details. College quality defined following [Dillon and Smith \(2020\)](#). Controls include fixed effects for survey year, state, and cohort; indicators for race, sex, and parental education; and cohort FEs, race, sex, and parental education indicators interacted with the unemployment rate. NILF: not in labor force. Enrolled: currently enrolled in any graduate program. Work Outside Field: indicator variable for respondent working outside their field of undergraduate study. Cell counts rounded following disclosure avoidance protocols.

Table 7: Heterogeneity by Experience and CQ Quartile

Variables	(1) Earnings	(2) Earnings	(3) Earnings	(4) Earnings	(5) Earnings	(6) Earnings	(7) Earnings	(8) Earnings
UR at Graduation	1,573 (1,117)	-592 (1,251)	237.3 (983)	-499.7 (1,047)	41.17 (1,037)	-58.77 (903.2)	-2,165*** (835.8)	-1,526 (960.9)
Observations	6000	14,000	8,000	21000	10000	25000	17000	43000
R-squared	0.164	0.135	0.109	0.146	0.157	0.136	0.124	0.125
CQ Quartile	1	1	2	2	3	3	4	4
Experience	≤ 6 years	> 6 years	≤ 6 years	> 6 years	≤ 6 years	> 6 years	≤ 6 years	> 6 years

Notes: Standard errors clustered at the cohort-by-state-of-graduation level are in parentheses. *: $p < 0.1$. **: $p < 0.05$. ***: $p < 0.01$. Table reports estimate of Equations (1) and (2), separating effects by college quality quartile and experience category. Data from 2010, 2013, 2015, 2017 and 2019 Waves of the National Survey of College Graduates; see text for details. College quality defined following [Dillon and Smith \(2020\)](#). Controls include fixed effects for survey year, state, and cohort; and indicators for race, sex, and parental education. Cell counts rounded following disclosure avoidance protocols.

Table 8: Ever Observed Enrolled Results

VARIABLES	(1) Any	(2) MA	(3) PHD	(4) Professional
CQ Q2	-0.259 (3.472)	-0.146 (2.994)	0.713 (0.916)	-0.182 (0.607)
CQ Q3	2.259 (3.829)	3.516 (2.943)	-0.220 (0.959)	-0.905 (1.072)
CQ Q4	-0.876 (3.336)	0.994 (2.720)	-0.348 (0.981)	-1.976* (1.060)
CQ Q2 X UR at Graduation	-0.0450 (0.542)	-0.293 (0.494)	-0.0643 (0.122)	0.0149 (0.0981)
CQ Q3 X UR at Graduation	-0.165 (0.641)	-0.753 (0.499)	0.110 (0.138)	0.239 (0.176)
CQ Q4 X UR at Graduation	0.881* (0.523)	-0.260 (0.433)	0.348** (0.150)	0.689*** (0.180)
Observations	75000	75000	75000	75000
R-squared	0.034	0.025	0.009	0.028

Notes: Standard errors clustered at the cohort-by-state-of-graduation level are in parentheses. *: $p < 0.1$. **: $p < .05$. ***: $p < 0.01$. Table reports estimate of Equation (2). Data from 2010, 2013, 2015, 2017 and 2019 Waves of the National Survey of College Graduates; see text for details. College quality defined following [Dillon and Smith \(2020\)](#). Controls include fixed effects for survey year, state, and cohort; and indicators for race, sex, and parental education. Column headers indicate which type of postgraduate enrollment variable is considered in the given regression. Cell counts rounded following disclosure avoidance protocols.

Table 9: Degree Attainment Results

VARIABLES	(1) Any	(2) MA	(3) PHD	(4) Professional
CQ Q2	4.382 (4.029)	2.366 (3.873)	0.970* (0.573)	1.046 (1.025)
CQ Q3	2.933 (3.901)	1.853 (3.670)	1.212** (0.599)	-0.132 (1.617)
CQ Q4	20.26*** (3.701)	5.842* (3.516)	3.349*** (0.622)	11.07*** (1.705)
CQ Q2 X UR at Graduation	-0.431 (0.630)	-0.244 (0.610)	-0.101 (0.0932)	-0.0860 (0.132)
CQ Q3 X UR at Graduation	0.0677 (0.600)	-0.145 (0.569)	-0.108 (0.0951)	0.321 (0.268)
CQ Q4 X UR at Graduation	-1.347** (0.530)	-0.383 (0.518)	-0.243*** (0.0903)	-0.721*** (0.231)
Observations	75000	75000	75000	75000
R-squared	0.068	0.039	0.022	0.045

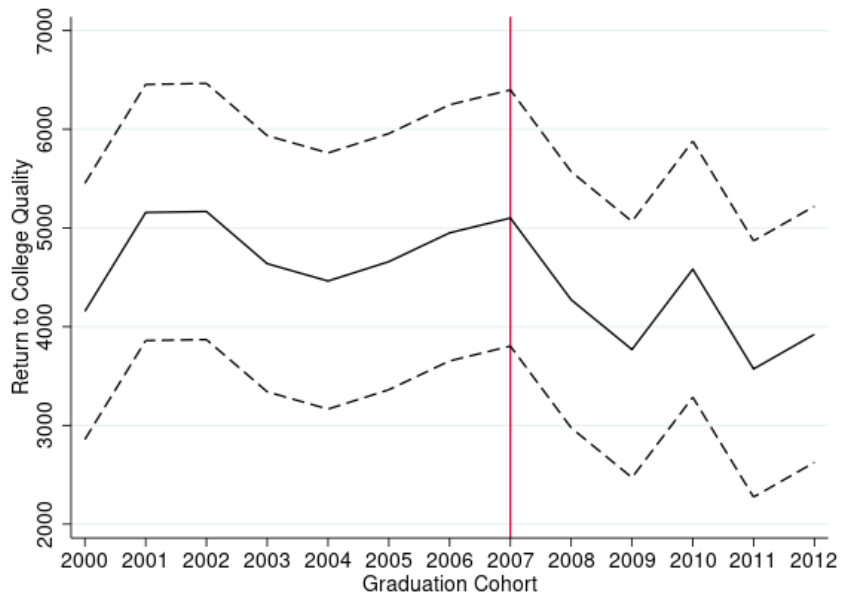
Notes: Standard errors clustered at the cohort-by-state-of-graduation level are in parentheses. *: $p < 0.1$. **: $p < .05$. ***: $p < 0.01$. Table reports estimate of Equation (2). Data from 2010, 2013, 2015, 2017 and 2019 Waves of the National Survey of College Graduates; see text for details. College quality defined following [Dillon and Smith \(2020\)](#). Controls include fixed effects for survey year, state, and cohort; indicators for race, sex, and parental education; and cohort FEs, race, sex, and parental education indicators interacted with the unemployment rate. Column headers indicate which type of postgraduate enrollment variable is considered in the given regression. Cell counts rounded following disclosure avoidance protocols.

Table 10: Earnings Results: Heterogeneity by Field

VARIABLES	(1) Earnings	(2) Earnings	(3) Earnings	(4) Earnings	(5) Earnings
CQ (SD)	3,277*** (386.0)	3,962*** (384.9)	3,781*** (382.3)	3,442*** (382.4)	4,046*** (384.8)
STEM BA	11,150*** (1,928)				
STEM BA X UR	-491.0* (285.7)				
Soc Sci BA		-931.3 (1,814)			
Soc Sci BA X UR		-712.4*** (267.7)			
Health BA			9,603*** (3,395)		
Health BA X UR			53.42 (493.1)		
Education BA				-15,820*** (3,031)	
Education BA X UR				1,280*** (450.0)	
Business BA					9,416*** (2,924)
Business BA X UR					-276.5 (444.9)
Observations	144000	144000	144000	144000	144000
R-squared	0.175	0.171	0.172	0.172	0.175

Notes: Standard errors clustered at the cohort-by-state-of-graduation level are in parentheses. *: $p < 0.1$. **: $p < .05$. ***: $p < 0.01$. Table reports estimate of Equation (2). Data from 2010, 2013, 2015, 2017 and 2019 Waves of the National Survey of College Graduates; see text for details. College quality defined following [Dillon and Smith \(2020\)](#). Controls include fixed effects for survey year, state, and cohort; indicators for race, sex, and parental education; and cohort FEs, race, sex, and parental education indicators interacted with the unemployment rate. Cell counts rounded following disclosure avoidance protocols.

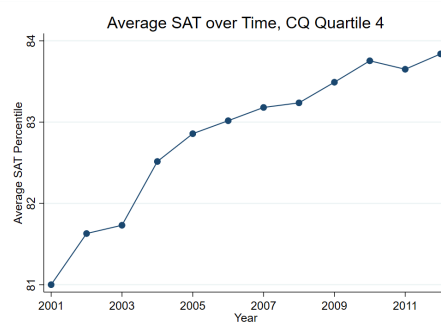
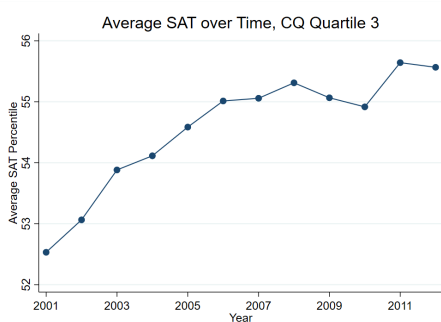
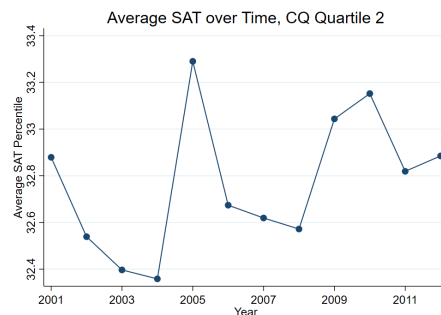
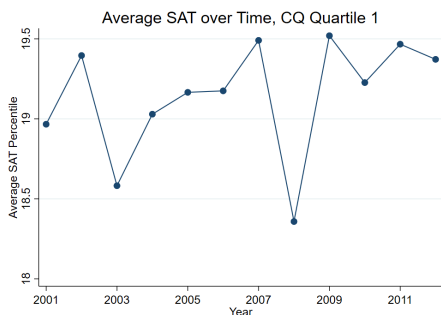
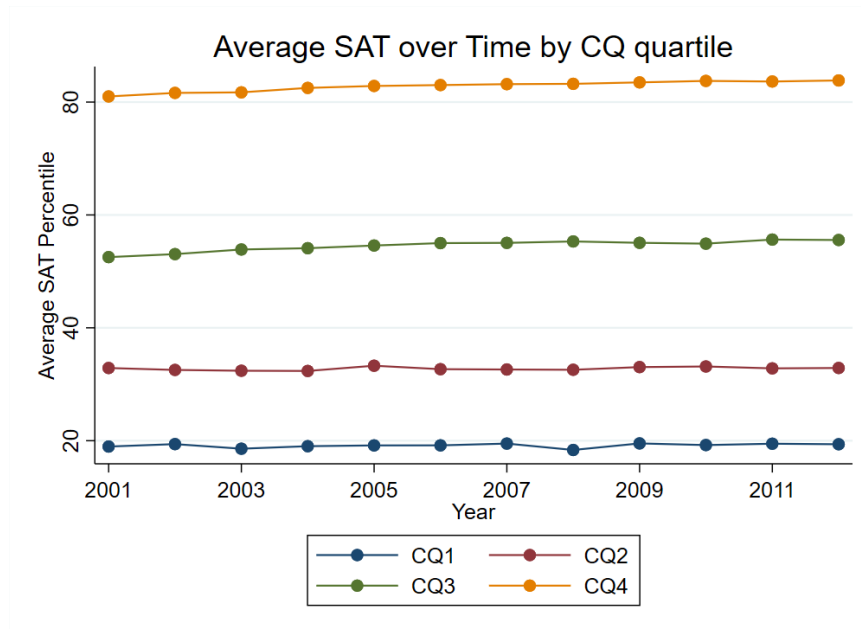
Figure 1: College Quality Returns by Graduation Cohort



Notes: Standard errors clustered at the cohort-by-state-of-graduation level; dotted lines represent 95% confidence intervals. Table reports estimate of Equation (2). Data from 2010, 2013, 2015, 2017 and 2019 Waves of the National Survey of College Graduates; see text for details. College quality defined following [Dillon and Smith \(2020\)](#). Controls include fixed effects for survey year, state, and cohort, as well as race and sex indicators, and indicators for parental education.

A Selection into College, 2000-2012

The following graphs show the mean of the 25th and 75th percentile of SAT scores of entering students over time, by college quality quartile as defined in [section 3](#). Although there is some variation over our time period, it is relatively small and does not appear to be systematically related to the business cycle.



B Weinstein (2022) Replication and Comparison

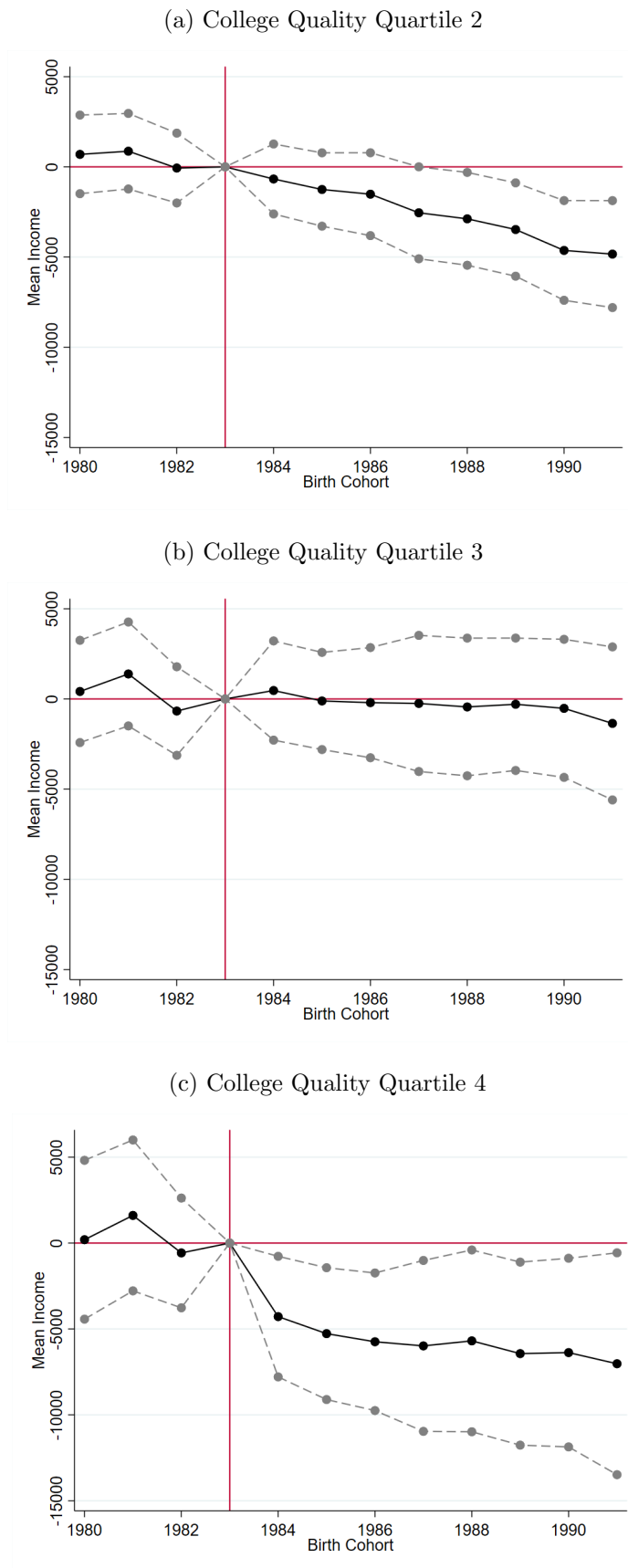
To illuminate why our results differ from those of [Weinstein \(2023\)](#), we conduct an exercise where we use the same data (mobility report card) and specification as Weinstein but change the college quality measure from Barron’s categories to our quartiles measure, use mean earnings as the outcome variable, and weight by institution size. Specifically, we replicate the following triple-difference event specification,

$$Y_{j_{ks}t} = \kappa_j + \beta_{st} + \gamma_{kt} + \lambda_{kt}Cohort_t * CollegeQuality_j * SevereRecession_{j_{ks}} \\ + \rho_{kt}Cohort_t * Z_{jt} * SevereRecession_{j_{ks}} + X_{jt}\delta + u_{jt}$$

where $Y_{j_{ks}t}$ is income measured in 2014 for graduates of university j , in birth cohort t , where university j is in college quality group k and commuting zone s . κ_j are university fixed effects, β_{st} are birth cohort-commuting zone fixed effects, and γ_{kt} are birth cohort-college quality group fixed effects. $SevereRecession_{j_{ks}}$ is an indicator for college j being located in a commuting zone with an above-median change in the unemployment rate between 2007 and 2009. Z_{jt} and X_{jt} are university-level controls for fraction of female students, log of students in the cohort, and several parental income variables. This specification is exactly the same as Weinstein’s, except we have changed the outcome to mean earnings, changed the college quality measure to our quartiles measure, and weighted by institution size.

Figure 3 shows the results, where the bottom quality quartile is the omitted category. The interpretation for subfigure (c) is the following: for birth cohorts who would have graduated after the Great Recession, the difference in mean incomes between graduates from the top-quality quartile and same-CZ bottom-quality quartile is an additional 5 to 8 thousand dollars less in high-recession shock versus low-recession shock CZs relative to the 1983 (base, following Weinstein) cohort.

Figure 3: Recession Effects by College Quality, Relative to College Quality Quartile 1: Triple Differences Model



Notes: Figure reproduces Figure 2 of [Weinstein \(2023\)](#) after (i) changing from Barron's tiers to our college quality measure, (ii) changing from log median income of positive earners to mean income, and (iii) weighting by institution size. The bottom quality quartile is the omitted category.

C Supplementary Tables

Table C.1: Results with Major Fixed Effects

Variables	(1) Earnings	(2) Earnings
CQ Q2		1,500 (2,883)
CQ Q3		8,218** (3,196)
CQ Q4		14,160*** (3,165)
CQ Q2 X UR at Graduation		-135.9 (426.4)
CQ Q3 X UR at Graduation		-587.9 (478.1)
CQ Q4 X UR at Graduation		-920.3* (491.4)
CQ (SD)	5,372*** (1,212)	
CQ (SD) X UR at Graduation	-283.5 (192.3)	
Observations	144000	144000
R-squared	0.198	0.198

Notes: Standard errors clustered at the cohort-by-state-of-graduation level are in parentheses. *: $p < 0.1$. **: $p < .05$. ***: $p < 0.01$. Table reports estimate of Equations (1) and (2) while including additional major fixed effects. Data from 2010, 2013, 2015, 2017 and 2019 Waves of the National Survey of College Graduates; see text for details. College quality defined following [Dillon and Smith \(2020\)](#). Controls include fixed effects for survey year, state, and cohort; indicators for race, sex, and parental education; and cohort FEs, race, sex, and parental education indicators interacted with the unemployment rate. Cell counts rounded following disclosure avoidance protocols.

Table C.2: Results for Earnings using National Unemployment Rate

VARIABLES	(1) Earnings	(2) Earnings	(3) Earnings	(4) Earnings
College Quality Q2			1,175 (1,024)	5,009 (3,479)
College Quality Q3			5,297*** (1,085)	15,070*** (3,694)
College Quality Q4			9,823*** (1,159)	24,280*** (3,616)
CQ Q2 X UR				-595.0 (484.4)
CQ Q3 X UR				-1,521*** (519.3)
CQ Q4 X UR				-2,253*** (514.5)
CQ (SD)	4,109*** (431.3)	9,471*** (1,327)		
CQ (SD) X UR		-836.4*** (194.6)		
Observations	126000	126000	126000	126000
R-squared	0.172	0.174	0.171	0.173

Notes: Standard errors clustered at the cohort-by-state-of-graduation level are in parentheses. *: $p < 0.1$. **: $p < .05$. ***: $p < 0.01$. Table reports estimate of Equations (1) and (2). Data from 2013, 2015, 2017 and 2019 Waves of the National Survey of College Graduates; see text for details. College quality defined following [Dillon and Smith \(2020\)](#). Controls include race and sex indicators, indicators for parental education, indicators for a STEM undergraduate degree, state fixed effects, and a quartic polynomial in experience. Cell counts rounded following disclosure avoidance protocols.

Table C.3: Results for Employment Variables using National Unemployment Rate

VARIABLES	Employed	NILF	Unemployed	Enrolled	NLFET	Hours	Work Outside Field
CQ (SD)	2.734*** (1.023)	-3.120*** (0.903)	0.386 (0.544)	-1.380* (0.742)	-1.767** (0.872)	37.58* (21.16)	-0.407 (1.462)
UR at Graduation X CQ (SD)	-0.427*** (0.156)	0.484*** (0.130)	-0.057 (0.089)	0.431*** (0.123)	0.180 (0.123)	-0.618 (3.205)	-0.095 (0.225)
Observations	126000	126000	126000	126000	126000	116000	116000
R-squared	0.025	0.031	0.011	0.040	0.042	0.058	0.019

Notes: Standard errors clustered at the cohort-by-state-of-graduation level are in parentheses. *: $p < 0.1$. **: $p < .05$. ***: $p < 0.01$. Table reports estimate of Equation (1) and (2). Data from 2013, 2015, 2017 and 2019 Waves of the National Survey of College Graduates; see text for details. College quality defined following [Dillon and Smith \(2020\)](#). Controls include race and sex indicators, indicators for parental education, indicators for a STEM undergraduate degree, state fixed effects, and a quartic polynomial in experience. NILF: not in labor force. Enrolled: currently enrolled in any graduate program. NLFET: not in the labor force and not enrolled in any graduate program. Work Outside Field: indicator variable for respondent working outside their field of undergraduate study. Cell counts rounded following disclosure avoidance protocols.

Table C.4: Impacts on Work/Enrollment Status

Variables	(1) W-E	(2) W-NE	(3) NW-E	(4) NW-NE
CQ (SD)	0.223 (0.641)	1.901* (1.007)	-0.769*** (0.268)	-1.354* (0.756)
CQ (SD) X UR at Graduation	0.118 (0.106)	-0.470*** (0.161)	0.239*** (0.0452)	0.113 (0.114)
Observations	144000	144000	144000	144000
R-squared	0.03	0.032	0.025	0.045

Notes: Standard errors clustered at the cohort-by-state-of-graduation level are in parentheses. *: $p < 0.1$. **: $p < .05$. ***: $p < 0.01$. Table reports estimate of Equations (1) and (2). Data from 2010, 2013, 2015, 2017 and 2019 Waves of the National Survey of College Graduates; see text for details. College quality defined following [Dillon and Smith \(2020\)](#). Controls include fixed effects for survey year, state, and cohort; indicators for race, sex, and parental education; and cohort FEs, race, sex, and parental education indicators interacted with the unemployment rate. W-E: working and enrolled in graduate program. W-NE: working and not in graduate program. NW-E: not working and enrolled in graduate program. NW-NE: not working and not enrolled in graduate program. Cell counts rounded following disclosure avoidance protocols.

Table C.5: Post-Graduation Summary Statistics

Years of Exp	1-3	4-6	7-9	10-12	13-15	16-19
Enrolled in Grad Program	0.29	0.23	0.13	0.08	0.06	0.04
Has Graduate Degree	0.13	0.29	0.44	0.57	0.57	0.53
N	7,400	33,000	44,500	32,000	18,500	8,600

Notes: Table presents summary statistics of graduate program enrollment and graduate degree attainment by years since first undergraduate degree attainment. Data from 2010, 2013, 2015, 2017 and 2019 Waves of the National Survey of College Graduates. See text for details. Cell counts rounded following disclosure avoidance protocols.

Table C.6: Major Choice by College Quality

Variable Quality Quartile	Mean/SD 1	Mean/SD 2	Mean/SD 3	Mean/SD 4
STEM BA	0.13 (0.34)	0.15 (0.35)	0.18 (0.39)	0.28 (0.45)
Soc Sci BA	0.12 (0.33)	0.14 (0.35)	0.18 (0.38)	0.25 (0.43)
Health BA	0.08 (0.27)	0.08 (0.27)	0.06 (0.24)	0.05 (0.21)
Education BA	0.14 (0.35)	0.12 (0.33)	0.09 (0.28)	0.04 (0.18)
Business BA	0.26 (0.44)	0.23 (0.42)	0.21 (0.41)	0.13 (0.34)
Observations	20000	28000	35000	60000

Notes: Data from 2010, 2013, 2015, 2017, and 2019 Waves of the National Survey of College Graduates; see text for details. Analysis sample contains individuals with undergraduate institutions that can be linked to IPEDS data. College quality defined following [Dillon and Smith \(2020\)](#). Cell counts rounded following disclosure avoidance protocols.

Table C.7: Migration Results

VARIABLES	(1) Migration	(2) Migration	(3) Migration
CQ Q2	0.281 (5.270)	-0.973 (7.608)	1.474 (6.393)
CQ Q3	5.554 (5.131)	8.044 (7.465)	4.011 (6.291)
CQ Q4	18.57*** (4.768)	22.23*** (6.934)	15.62** (6.543)
CQ Q2 X UR at Graduation	-0.733 (0.801)	-0.935 (1.122)	-0.649 (1.014)
CQ Q3 X UR at Graduation	-1.155 (0.774)	-2.119* (1.125)	-0.533 (0.976)
CQ Q4 X UR at Graduation	-1.111 (0.716)	-1.956* (1.044)	-0.455 (1.006)
Sample	All	Male	Female
Observations	144000	69000	75000
R-squared	0.113	0.114	0.125

Notes: Standard errors clustered at the cohort-by-state-of-graduation level are in parentheses. *: $p < 0.1$. **: $p < .05$. ***: $p < 0.01$. Table reports estimate of Equation (2). Data from 2010, 2013, 2015, 2017 and 2019 Waves of the National Survey of College Graduates; see text for details. College quality defined following [Dillon and Smith \(2020\)](#). Controls include fixed effects for survey year, state, and cohort; indicators for race, sex, and parental education; and cohort FEs, race, sex, and parental education indicators interacted with the unemployment rate. Migration indicates respondent living in a state other than the state in which they obtained their first BA.

Table C.8: Robustness of Results

VARIABLES	(1) Earnings	(2) Enrolled	(3) Earnings	(4) Earnings	(5) Earnings	(6) Earnings
CQ Q2		1,727 (3,650)		1,742 (2,921)		2,732 (3,101)
CQ Q3		11,900*** (3,668)		10,230*** (3,170)		9,014*** (3,371)
CQ Q4		12,300*** (3,918)		16,140*** (2,970)		15,760*** (3,300)
CQ Q2 x UR at Graduation		-250.5 (535.3)		-122.8 (415.7)		-286.0 (447.0)
CQ Q3 x UR at Graduation		-1,152** (535.6)		-744.5 (469.6)		-635.5 (494.9)
CQ Q4 x UR at Graduation		-775.5 (578.0)		-777.1* (442.1)		-1,069** (490.2)
CQ (SD)	5,012*** (1,430)		6,440*** (1,094)		5,861*** (1,246)	
CQ (SD) X UR at Graduation		-278.4 (214.5)		-277.0* (163.5)		-317.2* (188.9)
Observations	81000	81000	116000	116000	142000	142000
Sample	BA only	BA only	LF, not enr	LF, not enr	Baseline	Baseline
UR Measure	Baseline	Baseline	Baseline	Baseline	GOTG	GOTG
R-squared	0.163	0.163	0.202	0.202	0.169	0.169

Notes: Standard errors clustered at the cohort-by-state-of-graduation level are in parentheses. *: $p < 0.1$. **: $p < .05$. ***: $p < 0.01$. Table reports estimate of Equation (2). Data from 2010, 2013, 2015, 2017 and 2019 Waves of the National Survey of College Graduates; see text for details. College quality defined following [Dillon and Smith \(2020\)](#). Controls include fixed effects for survey year, state, and cohort; indicators for race, sex, and parental education; and cohort FEs, race, sex, and parental education indicators interacted with the unemployment rate. Enrolled: currently enrolled in any graduate program. BA only: excludes individuals who hold a graduate degree or are currently enrolled in a graduate program. LF, not enr: includes only individuals who are in the labor force and not enrolled in graduate school. GOTG: unemployment rate measured from Graduates On The Go data.

Table C.9: Alternate Earnings Results

VARIABLES	(1)	(2)	(3)	(4)	(5)
	Log(Earnings)	Log(Earnings+1)	Wage	Log(Wage)	Log(Wage+1)
CQ (SD)	0.109*** (0.0240)	0.232** (0.107)	3.159*** (0.558)	0.0992*** (0.0205)	0.125*** (0.0362)
UR at Graduation X CQ	-0.00686* (0.00366)	-0.0328* (0.0171)	-0.258*** (0.0824)	-0.00684** (0.00301)	-0.0137** (0.00564)
Observations	131000	144000	144000	131000	144000
R-squared	0.138	0.041	0.121	0.132	0.065

Notes: Standard errors clustered at the cohort-by-state-of-graduation level are in parentheses. *: $p < 0.1$. **: $p < .05$. ***: $p < 0.01$. Table reports estimate of Equation (2). Data from 2010, 2013, 2015, 2017 and 2019 Waves of the National Survey of College Graduates; see text for details. College quality defined following [Dillon and Smith \(2020\)](#). Controls include fixed effects for survey year, state, and cohort; indicators for race, sex, and parental education; and cohort FEs, race, sex, and parental education indicators interacted with the unemployment rate.

Table C.10: Probit Results

VARIABLES	(1) Employed	(2) NILF	(3) NLFET	(4) Enrolled
CQ (SD)	0.0158* (0.00921)	-0.0191** (0.00750)	-0.0104 (0.00694)	0.00167 (0.00661)
UR at Graduation X CQ	-0.00296** (0.00147)	0.00320*** (0.00116)	0.000551 (0.00111)	0.00217** (0.000980)
Observations	144000	144000	144000	144000

Notes: Standard errors clustered at the cohort-by-state-of-graduation level are in parentheses. *: $p < 0.1$. **: $p < .05$. ***: $p < 0.01$. Table reports estimate of Equation (2). Data from 2010, 2013, 2015, 2017 and 2019 Waves of the National Survey of College Graduates; see text for details. College quality defined following [Dillon and Smith \(2020\)](#). Controls include fixed effects for survey year, state, and cohort; indicators for race, sex, and parental education; and cohort FEs, race, sex, and parental education indicators interacted with the unemployment rate. NILF: not in labor force. Enrolled: currently enrolled in any graduate program. NLFET: not in the labor force and not enrolled in any graduate program.

Table C.11: Effects using Age-22 Unemployment Rate

Variables	(1) Earnings	(2) Earnings	(3) Earnings	(4) Earnings
CQ Q2		3,734 (3,391)		4,585 (5,345)
CQ Q3		15,360*** (3,562)		17,130*** (6,247)
CQ Q4		21,820*** (3,619)		22,230*** (6,958)
CQ Q2 X UR at Age 22		-334.9 (507.4)		
CQ Q3 X UR at Age 22		-1,287** (533.8)		
CQ Q4 X UR at Age 22		-1,550*** (547.3)		
CQ (SD)	8,421*** (1,225)		8,013*** (2,475)	
CQ (SD) X UR at Age 22	-519.2*** (184.4)			
CQ (SD) X UR at Graduation			-477.8 (335.5)	
CQ Q2 X UR at Graduation				-479.6 (798.3)
CQ Q3 X UR at Graduation				-1,559* (908.5)
CQ Q4 X UR at Graduation				-1,662* (977.9)
Observations	109000	109000	109000	109000
R-squared	0.189	0.188	0.174	0.173
Spec	Baseline	Baseline	IV	IV

Notes: Standard errors clustered at the cohort-by-state-of-graduation level are in parentheses. *: $p < 0.1$. **: $p < .05$. ***: $p < 0.01$. Table reports estimate of Equations (1) and (2) while also including unemployment rate at age 22 as a control. Data from 2010, 2013, 2015, 2017 and 2019 Waves of the National Survey of College Graduates; see text for details. College quality defined following [Dillon and Smith \(2020\)](#). Controls include fixed effects for survey year, state, and cohort; indicators for race, sex, and parental education; and cohort FEs, race, sex, and parental education indicators interacted with the unemployment rate. Cell counts rounded following disclosure avoidance protocols.

Table C.12: Impacts on Age of Graduation

Variables	(1) Age at Grad	(2) Age at Grad	(3) Age at Grad	(4) Age at Grad
CQ Q2			-1.280*** (0.337)	-0.603 (1.031)
CQ Q3			-2.649*** (0.289)	-3.690*** (0.907)
CQ Q4			-3.291*** (0.293)	-3.638*** (0.889)
CQ Q2 X UR at Graduation				-0.103 (0.16)
CQ Q3 X UR at Graduation				0.171 (0.148)
CQ Q4 X UR at Graduation				0.0565 (0.143)
CQ (SD)	-1.320*** (0.102)	-1.527*** (0.295)		
CQ (SD) X UR at Graduation		0.0339 (0.0494)		
Observations	144000	144000	144000	144000
R-squared	0.138	0.141	0.135	0.139

Notes: Standard errors clustered at the cohort-by-state-of-graduation level are in parentheses. *: $p < 0.1$. **: $p < .05$. ***: $p < 0.01$. Table reports estimate of Equations (1) and (2), with outcome variable defined as age at graduation. Data from 2010, 2013, 2015, 2017 and 2019 Waves of the National Survey of College Graduates; see text for details. College quality defined following [Dillon and Smith \(2020\)](#). Controls include fixed effects for survey year, state, and cohort; indicators for race, sex, and parental education; and cohort FEs, race, sex, and parental education indicators interacted with the unemployment rate.

Table C.13: Effects with Alternate Unemployment Measures

Variables	(1) Earnings	(2) Earnings	(3) Earnings	(4) Earnings
CQ Q2		319.5 (3,909)		3,566 (4,461)
CQ Q3		12,870*** (4,267)		12,690*** (4,767)
CQ Q4		21,260*** (4,113)		21,820*** (4,799)
CQ Q2 X UR at Graduation		-66.75 (446.5)		-348.1 (422.9)
CQ Q3 X UR at Graduation		-793.8* (473.5)		-868.0* (476.7)
CQ Q4 X UR at Graduation		-1,254*** (474.8)		-1,067** (448.9)
CQ Q2 X UR of Origin State		0.456 (364.4)		
CQ Q3 X UR of Origin State		-624.5 (394.1)		
CQ Q4 X UR of Origin State		-1,041*** (373.1)		
CQ (SD)	9,022*** (1,438)		8,160*** (1,619)	
CQ (SD) X UR at Graduation	-481.4*** (177.4)		-370.8** (172.3)	
CQ (SD) X UR of Origin State	-470.7*** (128.7)			
CQ (SD) X UR at HS Grad			-309.3 (258.4)	
CQ Q2 X UR at HS Grad				-192.6 (679.3)
CQ Q3 X UR at HS Grad				-337.8 (749.7)
CQ Q4 X UR at HS Grad				-1,053 (741.7)
Observations	114000	114000	117000	117000
R-squared	0.168	0.168	0.197	0.196

Notes: Standard errors clustered at the cohort-by-state-of-graduation level are in parentheses. *: $p < 0.1$. **: $p < .05$. ***: $p < 0.01$. Table reports estimate of Equations (1) and (2) while also including additional unemployment measures. Data from 2010, 2013, 2015, 2017 and 2019 Waves of the National Survey of College Graduates; see text for details. College quality defined following [Dillon and Smith \(2020\)](#). Controls include fixed effects for survey year, state, and cohort; indicators for race, sex, and parental education; and cohort FEs, race, sex, and parental education indicators interacted with the unemployment rate. Cell counts rounded following disclosure avoidance protocols.

Table C.14: Results with Alternate Weighting

Variables	(1) Earnings	(2) Earnings
CQ Q2		2,238 (2,651)
CQ Q3		8,019*** (2,800)
CQ Q4		13,900*** (2,800)
CQ Q2 X UR at Graduation		-176.8 (388.7)
CQ Q3 X UR at Graduation		-574.9 (414.2)
CQ Q4 X UR at Graduation		-867.4** (413.1)
CQ (SD)	5,289*** (1,015)	
CQ (SD) X UR at Graduation	-291.1* (154.9)	
Observations	144000	144000
R-squared	0.163	0.163

Notes: Standard errors clustered at the cohort-by-state-of-graduation level are in parentheses. *: $p < 0.1$. **: $p < .05$. ***: $p < 0.01$. Table reports estimate of Equations (1) and (2) while downweighting individuals who appear in sample multiple times. Data from 2010, 2013, 2015, 2017 and 2019 Waves of the National Survey of College Graduates; see text for details. College quality defined following [Dillon and Smith \(2020\)](#). Controls include fixed effects for survey year, state, and cohort; indicators for race, sex, and parental education; and cohort FEs, race, sex, and parental education indicators interacted with the unemployment rate. Cell counts rounded following disclosure avoidance protocols.

Table C.15: Difference-in-Differences Specification Results

VARIABLES	(1) Earnings	(2) Log(Earnings)	(3) Log(Earnings + 1)	(4) NILF	(5) Enrolled
Bad Shock X Post	1,882 (2,132)	0.0101 (0.0498)	0.252 (0.215)	-0.0112 (0.0161)	-0.0106 (0.0167)
CQ Q2	982.1 (1,026)	0.0306 (0.0242)	0.0298 (0.110)	-0.000145 (0.00913)	-0.00221 (0.00783)
CQ Q3	5,160*** (1,068)	0.101*** (0.0231)	0.157 (0.111)	-0.0114 (0.00856)	0.0121 (0.00764)
CQ Q4	9,695*** (1,114)	0.168*** (0.0245)	0.125 (0.115)	-0.00456 (0.00889)	0.0344*** (0.00796)
Bad Shock X Post X CQ Q2	-1,677 (2,369)	-0.0597 (0.0584)	-0.162 (0.242)	-0.00257 (0.0181)	0.0231 (0.0211)
Bad Shock X Post X CQ Q3	-2,630 (2,493)	-0.0437 (0.0555)	-0.150 (0.248)	0.0122 (0.0197)	0.00855 (0.0236)
Bad Shock X Post X CQ Q4	-5,915** (2,334)	-0.0819 (0.0552)	-0.437* (0.241)	0.0410** (0.0172)	0.0428** (0.0188)
Observations	144000	131000	144000	144000	144000
R-squared	0.164	0.134	0.038	0.029	0.041

Notes: Standard errors clustered at the cohort-by-state-of-graduation level are in parentheses. *: $p < 0.1$. **: $p < .05$. ***: $p < 0.01$. Table reports estimate of Equation (2). Data from 2010, 2013, 2015, 2017 and 2019 Waves of the National Survey of College Graduates; see text for details. College quality defined following [Dillon and Smith \(2020\)](#). Bad Shock is an indicator for graduating from a college in a state with an above median decline in the unemployment rate from 2007 and 2009. Post is an indicator for graduating in 2008 or later. Controls include state, cohort, and survey year fixed effects, race and sex indicators, and indicators for parental education. NILF: not in labor force. Enrolled: currently enrolled in any graduate program.