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The lifetime earnings premia of different majors: Correcting for selection based on cognitive, noncognitive, and unobserved factors

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HIGHLIGHTS

- This paper estimates lifetime earnings premia for various college majors.
- Results are presented with and without a variety of selection corrections.
- There is substantial heterogeneity in lifetime premia across the major categories.
- Business and STEM fields have the highest returns, Arts/Humanities majors the lowest.
- I find moderate convergence in the various major premia across birth cohorts.

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ABSTRACT

This paper constructs a simulation approach to estimate the lifetime returns to various college majors. I use data from the 1979 cohort of the National Longitudinal Survey of Youth and American Community Survey to estimate the parameters which form the backbone of the simulation. I address selection into both higher education and specific major categories using measures of cognitive and noncognitive ability. Additionally, I present the lifetime premia under various assumptions regarding the magnitude of unobservable sorting.

I find substantial heterogeneity in the returns to each educational outcome, ranging from $700,000 for Arts/Humanities majors to $1.5 million for Science Technology Engineering or Math (STEM) graduates (each premium is relative to high school graduates with no college experience). The differentials are larger when search behavior (allowing for differential unemployment probabilities across majors) is taken into account. Finally, I estimate the major premia separately across three birth cohorts to account for the changing nature of selection into both college and majors over time.

1. Introduction

With average U.S. college tuition continuing to rise at a rate roughly 3.5 percentage points faster than inflation (Ehrenberg, 2012), graduating high school seniors face the prospect of taking on substantial student loan debt only to be confronted with an uncertain and turbulent labor market after graduating from college. It is therefore more important than ever for students to have accurate information not just about the value of a generic college degree, but also about the relative economic returns to different majors.

Recent work has focused on the role that students' expectations play in the decision of whether to attend and what to study in college. While there is certainly a large literature devoted to estimating the college premium after controlling for unobserved ability, the results are typically focused on an economy-wide average or a point in the life-cycle estimate (e.g. age 30) rather than on the lifetime earnings premium. This is an important distinction as education-specific earnings profiles differ across age groups. I also document the importance of accounting for job search behavior (differential unemployment across majors). Finally, to the best of my knowledge the lifetime college premium (adjusting for ability sorting) has never been broken down across majors.[2]

I use data from the National Longitudinal Study of Youth 1979 cohort (NLSY) and the American Community Survey (ACS) to construct lifetime earnings trajectories for individuals in several different degree categories (Social Sciences, Science/Technology/Engineering/Math, Arts and Humanities, and Business), as well as those with only a high school diploma or some college experience but no 4-year degree. The trajectories are generated from a simulation approach which combines lifecycle

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[2] See Walker and Zhu (2011) for an excellent example of lifetime earnings decomposed by major without accounting for endogenous major choice.

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earnings paths and degree choice (NLSY) with current degree premia (ACS). Since there is a high degree of selection associated with both educational attainment and degree choice, I use a method employed by Taber (2001) to infer the magnitude of selection bias for each major category at all points of the life-cycle. The simulated earnings trajectories are then adjusted to account for the magnitude of self-selection. Additionally, I employ a bounding method proposed by Altonji et al. (2005) to evaluate various assumptions regarding the degree of selection on unobservables of major choice.

Taber's method for backing out the selection bias is relatively straightforward: Estimate an earnings premium (Taber considered the premium to having a college diploma using the NLSY) either unconditionally or controlling only for basic demographic characteristics. Next, estimate the premium while controlling for ability and factors which might drive selection (Test scores, mother's education, etc.). The difference between the two earnings premia is an estimate of the degree of self-selection. I make use of the often-studied Armed-Forces Qualification Test (AFQT) score from the NLSY, as well as the noncognitive ability measures including the Rotter Scale and Rosenberg Self-Esteem Score, to estimate the degree of self selection for each field of study. Furthermore, I utilize the cognitive and noncognitive ability measures to separately address several types of selection (selection into attending college, selection into major, time to completing the degree, and probability of completing the degree).

I find that accounting for selection substantially alters the expected lifetime earnings premia associated with each education group examined. I estimate significant heterogeneity in the return to various majors after accounting for observable selection through cognitive and noncognitive ability. I find that Arts/Humanities graduates receive on average $700,000 more than high school graduates with no college experience over the course of their lifetimes holding cognitive and noncognitive ability measures constant. Social Science graduates receive an analogous premium of $1.05 million, Business majors receive a premium of about $1.4 million, and STEM graduates realize the largest premium of $1.5 million. Each premium varies with the inclusion or exclusion of job search behavior, with STEM graduates having the greatest likelihood of being employed full-time throughout an entire year. Furthermore, I find that this heterogeneity in returns persist under plausible magnitudes of unobservable selection.

Finally, by imposing an assumption on the shape of lifecycle earnings, I can estimate the returns to each major separately across three birth cohorts (1955–64, 1965–74, and 1975–84). I find that there has been a moderate convergence over time in the return to the various major categories.

From a policy perspective, this work has implications in several fields. In the student loan literature, a more detailed understanding of the economic returns to different majors can inform how interest rates are set and how loans are subsidized by the government. Additionally, there has been a recent push in some state legislatures (e.g. Florida and North Carolina) to explore charging differential tuition by major at public universities. The lifetime premium to different majors should certainly enter into the equation which universities use to determine how to set these tuition levels.

The paper is constructed as follows. Section 2 discusses the previous literature. Section 3 describes the data used to construct the lifetime earnings trajectories. Section 4 details the empirical methodology used in the simulations. Section 5 provides a discussion of the findings and their implications, and Section 6 concludes.

2. Background

Estimating the returns to education is one of the oldest and most detailed literatures in empirical economics (see Card (1999) for a review). In accordance with the nonlinear impact of years of education on earnings, many studies have focused on the returns specific to discrete units of schooling such as a high school diploma or a 4-year college degree (Averett and Burton (1996); Brewer et al. (1999); Goldin and Katz (2008); Grogger and Eide (1995); Dillon (2012) to name just a few). For an extensive review of the curriculum and college major choice literatures, see the excellent article by Altonji et al. (2012).

Much of the literature on college major choice focuses on the role of expected earnings in students' decisions. While the general consensus is that expected future earnings play a large part in major choice, a variety of different methods are used to arrive at this conclusion. Berger (1988) uses a Heckman selection framework to control for self-selection into majors and produces an estimate of the short-term expected future earnings from each degree. He uses family background characteristics as exclusion restrictions from the earnings equation. The predicted earnings from the Heckman model is then included in a conditional logit model of college choice, and is found to be a significant factor in students' decisions.

Using a dynamic discrete-choice framework, Arcidiacono (2004) finds that expected earnings play a role in major choice, although less than that found in Berger (1988). Furthermore, Arcidiacono (2004) finds evidence that the exclusion restrictions used in Berger (1988) may be invalid. In a more recent study of Duke University undergraduates, Arcidiacono et al. (2012) concludes that much of the selection into majors is due to comparative advantage (i.e. students choose the major which maximizes future earnings subject to their unique mix of skills, as in a standard Roy model framework; Roy (1951)). Montmarquette et al. (2002) find a strong impact of expected earnings upon graduation from college (which accounts for both the earnings of recent graduates and the probability of completing a given degree) in their model of major choice, which also accounts for relative major premia and the likelihood of completing a given major.

Another branch of the college premium literature focuses on the differential returns to specific skills learned in college rather than majors. Grogger and Eide (1995) document the growing importance of math ability in explaining earnings differences, decomposing this effect into both the return to math ability and the change in the composition of college graduates' field of degree. Hamermesh and Donald (2008) demonstrate that holding college major constant, there are substantial returns to taking upper-division science and math courses. This work is particularly relevant to the current study, as it provides evidence of differential human capital growth across majors, and thus a clear mechanism to explain differential lifetime earnings premia across college majors.

Robst (2007) provides evidence that there can be significant wage penalties for workers employed in fields different from their college major. This could lead to differences in the returns to college majors if there are differential shifts in the supply/demand for each major, thus forcing some majors to work in outside fields more than others.

In sum, the literature suggests that there will be differential lifetime wage premia to different degrees. However, the size of such premia and the importance of selection is unknown. The analyses performed in this paper serve as an important complement to this growing literature on major choice and the differential returns to majors.

3. Data

I use two datasets used to construct the lifetime earnings trajectories in this study, the 1979 cohort of the National Longitudinal Survey of Youth (NLSY) and the American Community Survey (ACS).

The NLSY is a panel dataset which began surveying 12,686 individuals annually between 1979 and 1994 and biennially between 1994 and the present. All respondents were between the ages of 14 and 22 during the initial survey year of 1979. The NLSY is quite broad in its scope of survey questions, and has been used countless times in the economics literature. It was designed in part to track the transition from school to work, and thus is well-suited for the current study. One of the most appealing attributes of the NLSY is the availability of cognitive ability measures. The Armed Forces Qualification Test (AFQT) is a composite percentile rank of four subsections of the