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Institution, Major, and Firm-Specific Premia: Evidence from Administrative Data

Ben Ost, Weixiang Pan and Douglas Webber

Abstract

We examine how a student's field of degree and institution attended contribute to the labor market outcomes of young graduates. Administrative panel data that combines student transcripts with matched employer-employee records allow us to provide the first decomposition of premia into individual and firm-specific components. We find that both major and institutional premia are more strongly related to the firm-specific component of wages than the individual-specific component of wages. On average, a student's major is a more important predictor of future wages than the selectivity of the institution attended, but major premia (and their relative ranking) can differ substantially across institutions, suggesting the importance of program-level data for prospective students and their parents.

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Introduction

Though there is an extensive literature documenting the importance of firm-specific premia in the labor market, there is very limited research on the extent to which the returns to education operate through access to higher paying firms. In other words, are the earnings gains associated with these treatments primarily due to high productivity skills which are portable across firms, or access to top employer networks? Pan (2017) examines the impact of associates degrees on firm-level premia, and Engbom and Moser (2017) describes differences across education levels in firm-premia. Our study contributes to this literature by providing the first descriptive evidence on how firm-premia vary by a student's college and major. Describing the degree to which major and institutional premia operate through person or firm-based channels is important because it provides a foundation for understanding *why* different majors and institutions yield such different returns.

In addition to providing the first evidence on how firm-premia vary by major and institution, we provide a more detailed analysis of how earnings vary across majors and institutions. Specifically, we consider how major premia vary across different institutions and the relative importance of what a student majors in and which school they attend. This is of clear importance to students and parents as they make educational decisions and it has implications for policy debates such as the allocation of taxpayer resources, the optimal design of institutional accountability policies, and the importance of different types of information provided to students (e.g. are school-level outcomes sufficient?).

We use rich administrative data from the state of Ohio to examine these questions. Our data consists of transcript-level data from every public postsecondary institution in Ohio, matched with linked employer-employee records which cover nearly the universe of employment outcomes in the state. We find that on average a student's major is a more important predictor of future wages than the selectivity of the institution attended (at least among Ohio public schools). Major premia (and their relative ranking) can differ substantially across institutions, suggesting the importance of program-level data for prospective students and their parents.

Decomposing wages into individual and firm-specific components, we find several interesting relationships. First, despite large selectivity differences across schools, the individual-specific component of wages (which includes time-invariant ability) has a modest relationship to the institution attended, with relatively small differences between institutions. Second, the firm-specific component of wages is on average more strongly related to both major and institution attended than individual-specific factors. Across institutions, the firm-specific component accounts for roughly two thirds of the entire institutional premium. Finally, STEM (24 percentage points) and Business (17 percentage points) graduates are the only students which receive a meaningful boost to the likelihood of finding work at a top-paying firm (defined as being in the top 10 percent of all firms in the state of Ohio).

The remainder of the paper is organized as follows. Section 2 surveys the recent literature on returns to majors and institutional quality. Sections 3 and 4 respectively describe the data and empirical strategies employed in this study. Section 5 presents the results, and Section 6 concludes.

Literature Review

This paper contributes to three active literatures within the field of labor economics: the returns to college quality, the returns to different majors, and wage decomposition into person and firm-specific components.

College “quality” can be measured in many different ways. Differences based on type of school (e.g. public/private/2-year/4-year) flagship status, student quality (typically proxied by test scores), or spending per student. Although a large literature examines how these college characteristics relate to academic outcomes,[1] a smaller literature examines the degree of heterogeneity across institutions in terms of their labor market outcomes.

Most studies find positive labor market returns to their measure of college quality using a variety of different identification strategies (Brewer, Eide and Ehrenberg, 1999; Black and Smith, 2004; Black and Smith, 2006; Hoekstra, 2009; Griffith and Rask, 2016; Andrews, Li and Lovenheim, 2016; Goodman, Hurwitz, and Smith, 2017; Canaan and Mouganie, 2018). Notable exceptions to this general finding are (Dale and Krueger, 2002, 2013) which find no returns on to college quality on average, but large returns only to students from low-income backgrounds.

The causes and consequences of major choice have been active literatures in recent years, see Altonji, Arcidiacono and Maurel (2016) for an excellent recent summary of research in these fields. Recent work on major choice can be categorized into three distinct identification strategies: structural/discrete choice modeling (Arcidiacono, 2004; Arcidiacono, Hotz,, and Kang, 2012), selection on detailed observable characteristics (Walker and Zhu, 2011; Webber, 2014; Webber, 2016), and identification based on cutoff rules for admission into certain majors (Hastings, Nielson and Zimmerman 2013; Kirkebøen, Leuven and Mogstad, 2016; Andrews, Imberman and Lovenheim 2017). While each methodology has a unique set of benefits and drawbacks, there is remarkable consistency across approaches of large differences in the returns to various majors.

[1] See Webber and Ehrenberg (2010), Cohodes and Goodman (2014), or Jacob, McCall and Stange (2018) for reviews of this literature.

The current manuscript also adds to the large body of work aimed at decomposing wages into firm and worker-specific components, pioneered by the seminal work of Abowd, Kramarz, and Margolis (1999). A large literature within labor economics has focused on the estimation of models with high-dimensional fixed effects, and subsequently investigating the distributions of each set of effects and their correlation with important labor market features such as inequality, job referral networks, the gender wage gap, and compensating differentials (Card, Heining, and Kline, 2013; Schmutte, 2015; Card, Cardoso, and Kline, 2015; Lavetti and Schmutte, 2016). Pan (2017) examines the impact of an associates degree on firm-level premia using a novel difference-in-differences identification strategy, and finds a large firm-premium for these graduates. Engbom and Moser (2017) documents differences across multiple education levels in the importance of firm-level factors.

Relative to the above literatures, we make several contributions. First and foremost, we are the first to decompose college major and institutional premia into firm and individual-level components. Second, we simultaneously estimate returns to major and institution, which allows us to assess the importance of each dimension and also avoids confounding institutional quality with variation in majors offered. Finally, we are the first to consider the intersection of institution and major premia and we show that the rank ordering of major premia varies substantially across institutions.

Though we extend these literatures on several dimensions, there are several limitations to our study. First, we measure outcomes for relatively young individuals so we cannot assess the effect of educational inputs on mid-career outcomes. Second, we only have data for public institutions from Ohio, so our data do not cover the very top of the college selectivity distribution. Finally, like Engbom and Moser (2017), our analysis is descriptive in nature so it is not possible to make causal statements based on our results.

Data

We use administrative transcript-level data for every Ohio public university student linked to Unemployment Insurance (UI) earnings records from the same state. The transcript data span the academic years starting in 2000-2017 while the UI earnings data includes weekly earnings from 2001-2017. These data are made available to researchers by the Ohio Educational Research Center (OERC) and include data from the Ohio Longitudinal Data Archive (OLDA).[2]

The earnings data come from the Ohio Department of Job and Family Services. The higher education data includes the universe of 2- and 4-year public college enrollment in Ohio, though in this study, we focus on 4-year institutions.[3] The UI data covers the universe of workers in Ohio with the exception of federal workers and the self-employed. The UI data allow us to follow both firms and workers over time, with quarterly observations on employment and earnings.

We restrict the UI earnings data to payments of at least $500 per quarter and focus on each worker's primary employer for each quarter as measured by total quarterly pay from each

[2] The Ohio Longitudinal Data Archive is a project of the Ohio Education Research Center (oerc.osu.edu) and provides researchers with centralized access to administrative data. The OLDA is managed by The Ohio State University's Center for Human Resource Research (chrr.osu.edu) in collaboration with Ohio's state workforce and education agencies (ohioanalytics.gov), with those agencies providing oversight and funding. For information on OLDA sponsors, see http://chrr.osu.edu/projects/ohio-longitudinal-data-archive

[3] The institutions we study are: University of Akron, Bowling Green State University, University of Cincinnati, Cleveland State University, Central State University, Kent State University, Miami University, Ohio State University, Ohio University, Shawnee State University, University of Toledo, Wright State University, and Youngstown State University

employer. This is done because the UI data include any payment from a firm to an individual, even in cases where that payment would not constitute what we normally think of as an employment relationship (e.g. legal payment).[4] Furthermore, since earnings are measured quarterly, we only examine employment spells which span at least three quarters, discarding the first and last quarters of a spell which would understate an employee's quarterly earnings if they began/ended their work at any time other than the first/last day of the quarter.

We are unable to observe enrollment at any private institutions or at public institutions outside of the state of Ohio. One comparison group that we examine is the set of individuals who started at an Ohio public institution, but never graduated. In these analyses, our major and institutional premia are biased downward to the extent that some of these students either transferred to a private college or completed their degree out of state and then returned to Ohio. We are able to track students if they transfer to any of the 38 2- or 4-year colleges in the state of Ohio and these institutions represent more than 75% of students in the state. We are also not able to distinguish between unemployment, lack of labor force participation, federal employment, self-employment and leaving the state of Ohio. For this reason, we limit our analysis to earnings conditional on having a UI earnings record. As the focus of this paper is on the return to undergraduate credentials, we remove any individual from the sample who attended any form of graduate school at a public institution within the state of Ohio.

Academic majors are only recorded in the data for conferred degrees and are identified by the Classification of Instructional Programs (CIP) code. In order to avoid small sample sizes for individual majors, all degrees are categorized as one of the following: arts/humanities, business,

[4] See Ost, Pan, and Webber (2018) for a deeper discussion of the associated with the benefits and drawbacks associated with both administrative datasets used in this study.

education, health, social sciences, STEM, or other. The “other” category encompasses the many majors which do not fit into a broader category and is included in regression models in order to make the set of major categories collectively exhaustive.

One major drawback inherent in many studies which utilize UI data to analyze labor market outcomes is that basic worker demographics are typically not available. However, in our data, we have demographic information for any individual who appears in the higher education portion of our data. For this reason, we restrict all analyses to only those individuals whom we observe enrolled at some point in an Ohio public institution. This is a desirable restriction for two important reasons. First, knowing an individual’s age is key to this study. Since our data window allows us to study roughly the first 10 years of earnings post-college, we would likely get a significantly downward-biased estimate of the returns to college if age were not included as a control and our comparison group included the entire working population (while the treatment group was limited to young workers). Furthermore, by including only workers who at some point enrolled in college we partially deal with selection concerns inherent to any returns to college paper. We also restrict our sample to individuals who were under age 30 at the time they first appeared in the higher education sample. Only employment which occurs after a student left school is included in the final sample.

Table 1 presents summary statistics for both the whole sample (workers who at some point enrolled in any Ohio postsecondary institution), and those with degrees from one of Ohio’s 13 public four-year institutions.

Empirical Strategy

We first estimate a series of regression models which allows us to evaluate the degree to which major and institutional factors play a role in future labor market outcomes. We present various specification similar to Equation (1)

$$Y_{ijt} = \alpha + X_{ijt}\beta + Major_i\gamma + Institution_i\delta + \varepsilon_{ijt} \qquad (1)$$

Y denotes the log earnings of person i at firm j in quarter t, X is a vector of control variables which includes age, experience, gender, indicator variables for race and year fixed effects. Major is a set of mutually exclusive and collectively exhaustive indicator variables for major categories (arts/humanities, business, education, health, social sciences, STEM, and other). Institution is a set of dummy variables comprising each of Ohio's 13 public four-year institutions.

The second set of analyses conducted in this paper concerns the impact of majors and institutions on person and firm-specific components estimated using the Abowd, Kramarz, and Margolis (1999) (AKM) two-way fixed effects model. Figure 1 illustrates how we can conceptualize firm and worker components of the returns to education. Point A represents an individual with low education working at a low-paying firm. When an individual obtains education, they improve their skill level and thus move up in the payscale at their current firm (Point B). They also may gain access to placement services, peer networks, or other non-human capital assets that allow them to shift from a low-paying firm to a high paying firm (Point C). To estimate these effects it is first necessary to estimate the AKM decomposition to identify the firm and worker specific components of wages. Specifically, we estimate Equation (2)

$$Y_{ijt} = \alpha + X_{ijt}\beta + \eta_i + \theta_j + \varepsilon_{ijt} \qquad (2)$$

Where Y denotes the log earnings of person i at firm j in time t, X is a vector of time-varying control variables (e.g. quadratics of tenure and experience[5]), along with a set of person and firm fixed effects. For the main set of analyses, the worker and firm effects are estimated from the full Ohio workforce dataset, regardless of whether an individual appears in the higher education component of our data.

As a robustness check, we also estimate the AKM model using only workers who attended a public higher education institution within Ohio. A benefit of this approach is that we have information on workers' ages, but a significant drawback is that the interpretation of our results is limited to only those who have some postsecondary schooling experience. Although the results are similar, we focus on the outcomes from the full AKM estimation to maximize generalizability (e.g. firm effects apply to entire worker population rather than just college educated population) and precision of our estimates.

As noted in Abowd, Creecy, and Kramarz (2002), the magnitudes of worker and firm effects can only be compared against each other if they are part of the same connected set. We thus limit our analysis to the largest connected set of workers and firms of our sample. This restricted sample represents 99.8% of the worker-firm-quarters, 99.6% of the workers, and 95.2% of the firms from the full Ohio sample.

While the relationship between the person effects and major/institution indicators is not causal (e.g. higher ability students sort into higher quality schools), this type of wage decomposition is still inherently important. Regardless of the mechanism (e.g. human capital,

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[5] In-sample experience is used for all workers. This means that for workers who are employed in Ohio prior to 1995 their tenure/experience is likely understated. We re-ran models which excluded workers who were working in the first period of our sample (and thus were likely working in earlier periods) and found no discernable difference in the results.

innate ability), the person-specific component represents productivity which is portable across the labor market. It is informative to examine how individual-specific premia differ across majors and institutions in a descriptive way, even if they cannot be interpreted causally. It is important to note that there are several reasons our results should only be interpreted descriptively. There is self-selection into the major, self-selection into the institution attended, as well as self-selection into persistence/graduation from college.

Below we lay out the specific identification conditions related to models with person and firm effects as dependent variables so the reader can assess the degree to which our results represent causal effects or non-causal associations. Though it cannot be estimated, it is informative to rewrite Equation (2), separating observable and unobservable firm and individual time-invariant factors.

$$Y_{ijt} = \alpha + X_{ijt}\beta + p_i\gamma + q_j\delta + \phi_i + \xi_j + \varepsilon_{ijt} \qquad (3)$$

As above, X represents time-varying characteristics of workers and firms. Unlike equation (2), we have separately written time-invariant observable (p and q respectively for person and firm) and time-invariant unobservable characteristics ϕ_i and ξ_j. Hence, the estimates of the person and firm effects from our AKM estimation can instead be defined as

$$\eta_i = p_i\gamma + \phi_i \qquad (4)$$

$$\theta_j = q_j\delta + \xi_j \qquad (5)$$

A regression of the person-specific effect on time-invariant personal characteristics (such as major or school attended) could only be interpreted as fully causal if these variable were uncorrelated with all other unobservables at the person level. This assumption is certainly violated. Regressions of firm-specific premia on person-level variables however would not suffer from any such bias as all individual-specific factors have been partialled out. An exception to this logic arises if the true data generating process of wages includes not only additive worker and firm effects, but also interactions between these two sets of variables. In other words, the quality of the match between workers and firms could be considered an omitted variable in our setting (Jackson, 2013).

Results

We first present a baseline analysis, similar to that of past work that documents major and institutional premia. We then assess whether the major premia vary by institution and the degree to which major and institutional premia operate through firm or individual components of wage.

Table 2 presents the major and institutional premia college graduates receive relative to workers who attended but did not graduate from an Ohio public college. STEM and Business, majors each receive premia of roughly 55 log points (73%), and graduates with degrees in Health fields receiving only a slightly lower 60% earnings boost. Other fields have sharply lower rates of return: Social Sciences (23%), Arts/Humanities (11%), and Education (17%). The institutional premia range from a low of 25% to a high of 60%, but are mostly clustered together around a 35% premium.

Though suggestive, these results do not necessarily point to majors being a stronger predictor of future earnings than institutions. First, while Ohio does have a diverse collection of postsecondary institutions, the entire distribution of college quality in the nation is larger, particularly when low-performing for-profits are considered. In other words, the average graduate at each school in our data tends to perform well in the labor market, but this might not be the case if we had access to data comprising all of postsecondary education. Second, Table 2 presents estimates of major and institutional premia from separate regressions so some of the differences in institutional premia could be due to some schools having a larger composition of certain majors. To address this concern, in Table 3, we present a specification with a full set of major and institution variables. In this specification, we focus only on college graduates, with the omitted categories being education majors from School 13. The same pattern from above holds in this set of specifications, with majors seeming to account for a greater fraction of the variance in earnings across individuals than the institution attended.

Our first key contribution is assessing the degree to which major premia vary across schools. In other words, is knowing the average institutional outcomes (available for instance from the Department of Education's College Scorecard tool), and knowing the average returns to a given major sufficient to predict outcomes at the school-major level? Table 4 separately estimates major premia for each four-year public school in Ohio. The comparison group is constant across each model, and represents the entire "some college" population from public Ohio institutions.

A brief glance at Table 4 reveals that major and institution effects are clearly not additive/rank-preserving. The top major premia at six schools is STEM, with Business claiming the top spot at five schools and Health graduates performing the best at the remaining two. At school 3, Arts/Humanities majors have a relative premium of 3.3 log points over Social Science graduates, while at school 5 there is a deficit of 22.6 log points with the same comparison. Figure 2 illustrates the results from Table 4 graphically. Although there is a clear divergence between the top three (STEM, Business, Health) and bottom three (Arts/Humanities, Social Sciences, Education) major categories, it is visually clear that the relative major premia differ considerably across institutions (e.g. the lines are not parallel).

These findings suggest a clear policy recommendation, that program-level data on student outcomes (as opposed to the current institution-level averages) be made available to prospective students. Although we cannot evaluate what specifically makes the premia differ by institution (e.g. professor quality, career placement service, selection etc.) it is clear that labor market prospects depend heavily not just on major and institution, but on the major-institution match.

Tables 5 and 6 report the decomposition of major/institutional premia into person (Table 5) and firm (Table 6) specific components. As before, the comparison group is workers who attended, but did not graduate, from an Ohio public college. Similar to the overall wage premia, the person-specific component varies more across majors than institutions. Coefficients range from lows of 0.02 (Arts/Humanities), 0.04 (Social Sciences), to highs of 0.12 (Health), 0.13 (STEM), 0.15 (Education), and 0.19 (Business). By contrast, there was a spread of 11 log points (0.06 to 0.17) between the coefficients on the top (School 7) and bottom (School 3) institutions.

As discussed above, these estimates are not causal, and instead represent a mix of sorting based on innate ability/family background and human capital accumulation. As we restrict our analyses to workers after they receive their Bachelor's degree, it is not possible to disentangle these factors. The relationship between majors and firm-specific premia is largely similar to that of the individual-specific wage component: -0.05 (Education), 0.04 (Arts/Humanities), and 0.13 (Social Sciences) to highs of 0.36 (STEM), 0.25 (Health), and 0.29 (Business).

Interestingly, the firm-specific components of wages appear to account for a much larger share of the total wage premia among institutions. This likely points to something specific that institutions are providing their students in terms of job placements (simple name recognition by employers of a given school would be contained in the individual-specific component as it is carried by workers wherever they go). Potential mechanisms include alumni network effects, strong career/job preparation services offered by schools (e.g. interviewing or negotiation skills), or arrangements such as internships. Future research should explore this mechanism in greater detail, possibly estimating the degree to which programs such as internships contribute to the above results.

Finally, as much of the literature on firm-specific wage premiums focuses on "superstar firms" (those near the top of the distribution) we examine the probability that a given individual finds work at a firm in the top 10% of the firm-specific premia distribution by major and institution. Relative to individuals with "some college", a STEM graduate has a 24 percentage point greater likelihood of working at a top-paying firm, followed by Business graduates with a 17 percentage point boost. All other majors lag further behind, with Social Sciences, Arts/Humanities, Health, and Education having respectively 6, 4, -2, and -5 percentage point increases. The most notable contrast with our other results is that of health majors, which fared much better when examining average premia. This leads to the interesting (though certainly not surprising) conclusion that graduates of health-related majors enjoy high average wages, but there is a smaller variance in outcomes so they are not more likely to be at a top firm.

One important caveat to keep in mind is that the populations being compared in the above analyses are a subset of all workers. Namely, each premium is in comparison to workers who attended, but did not graduate, from an Ohio public institution. Setting aside that it is possible they transferred to a private or out-of-state school before returning to Ohio, many workers are still excluded. The dominant reason this comparison group was chosen is because we lack demographic information on any individual who never enrolled in an Ohio public school during our sample frame, most importantly their age. Given that we only observe the first decade or so of college graduates' working lives, it would not be a fair comparison to have mid or late-career workers in the comparison group in such a way that we could not control for age/experience effects.

Conclusion

As the price of attending college has steadily risen in recent decades, it has become increasingly important for both policymakers and researchers to understand at a deeper level the mechanisms through which postsecondary education increases earnings. In this paper we seek to shed light on the relative importance of majors and the institution a student attends, and to examine the mechanisms through which they relate to future earnings.

We leverage rich administrative panel data from the state of Ohio which combines transcript-level student information with matched employer-employee records. We find that on average a student's major is a more important predictor of future wages than the selectivity of the institution attended among Ohio public institutions. Major premia (and their relative ranking) can differ substantially across institutions, suggesting the importance of program-level data when prospective students and their parents.

Decomposing wages into individual and firm-specific components, we find several interesting relationships. First, despite large selectivity differences across schools, the individual-specific component of wages (which includes time-invariant ability) has only a modest relationship to the institution attended, with relatively small differences between institutions. Second, the firm-specific component of wages is on average more strongly related to both major and institution attended than individual-specific factors. Across institutions, the firm-specific component comprises roughly two thirds of the entire institutional premium. Finally, STEM (23 percentage points) and Business (16 percentage points) graduates are the only students which receive a meaningful boost to the likelihood of finding work at a top-paying firm (defined as being in the top 10 percent of all firms in the state of Ohio).

References

Abowd, John M., Robert H. Creecy, and Francis Kramarz. Computing person and firm effects using linked longitudinal employer-employee data. No. 2002-06. Center for Economic Studies, US Census Bureau, 2002.

Abowd, John M., Francis Kramarz, and David N. Margolis. "High wage workers and high wage firms." Econometrica 67.2 (1999): 251-333.

Andrews, Rodney J., Scott A. Imberman, and Michael F. Lovenheim. *Risky Business? The Effect of Majoring in Business on Earnings and Educational Attainment*. No. w23575. National Bureau of Economic Research, 2017.

Andrews, Rodney J., Jing Li, and Michael F. Lovenheim. "Quantile treatment effects of college quality on earnings." Journal of Human Resources 51.1 (2016): 200-238.

Black, Dan A. and Jeffrey A. Smith. "How Robust is the Evidence on the Effects of College Quality? Evidence from Matching." Journal of Econometrics 121.1 (2004): 99-124.

Black, Dan A., and Jeffrey A. Smith. "Estimating the Returns to College Quality with Multiple Proxies for Quality." Journal of Labor Economics 24.3 (2006): 701-728.

Brewer, Dominic J., Eric R. Eide, and Ronald G. Ehrenberg. "Does it Pay to Attend an Elite Private College?" The Journal of Human Resources 34.1 (1999): 104-123.

Canaan, Serena, and Pierre Mouganie. "Returns to education quality for low-skilled students: Evidence from a discontinuity." Journal of Labor Economics 36.2 (2018): 395-436.

Card, David, Ana Rute Cardoso, and Patrick Kline. "Bargaining, sorting, and the gender wage gap: Quantifying the impact of firms on the relative pay of women." *The Quarterly Journal of Economics* 131.2 (2015): 633-686.

Card, David, Jörg Heining, and Patrick Kline. "Workplace heterogeneity and the rise of West German wage inequality." *The Quarterly journal of economics* 128.3 (2013): 967-1015.

Cohodes, Sarah R., and Joshua S. Goodman. "Merit aid, college quality, and college completion: Massachusetts' Adams scholarship as an in-kind subsidy." American Economic Journal: Applied Economics 6.4 (2014): 251-85.

Dale, Stacy Berg, and Alan B. Krueger. "Estimating the payoff to attending a more selective college: An application of selection on observables and unobservables." The Quarterly Journal of Economics 117.4 (2002): 1491-1527.

Dale, Stacy B., and Alan B. Krueger. "Estimating the effects of college characteristics over the career using administrative earnings data." Journal of Human Resources 49.2 (2014): 323-358.

Engbom, Niklas, and Christian Moser. "Returns to Education through Access to Higher-Paying Firms: Evidence from US Matched Employer-Employee Data." *American Economic Review: Papers and Proceedings.* 107.5 (2017): 374-78.

Goodman, Joshua, Michael Hurwitz, and Jonathan Smith. "Access to 4-year public colleges and degree completion." Journal of Labor Economics 35.3 (2017): 829-867.

Griffith, Amanda L., and Kevin N. Rask. "The effect of institutional expenditures on employment outcomes and earnings." *Economic Inquiry* 54.4 (2016): 1931-1945.

Hastings, Justine S., Christopher A. Neilson, and Seth D. Zimmerman. *Are some degrees worth more than others? Evidence from college admission cutoffs in Chile*. No. w19241. National Bureau of Economic Research, 2013.

Hoekstra, Mark. "The effect of attending the flagship state university on earnings: A discontinuity-based approach." The Review of Economics and Statistics 91.4 (2009): 717-724.

Jacob, Brian, Brian McCall, and Kevin Stange. "College as Country Club: Do Colleges Cater to Students' Preferences for Consumption?." Journal of Labor Economics 36.2 (2018): 309-348.

Jackson, C. Kirabo. "Match quality, worker productivity, and worker mobility: Direct evidence from teachers." *Review of Economics and Statistics* 95.4 (2013): 1096-1116.

Kirkeboen, Lars J., Edwin Leuven, and Magne Mogstad. "Field of study, earnings, and self-selection." *The Quarterly Journal of Economics* 131.3 (2016): 1057-1111.

Lavetti, Kurt, and Ian M. Schmutte. "Estimating compensating wage differentials with endogenous job mobility." (2016).

Ost, Ben, Weixiang Pan, and Douglas Webber. "The returns to college persistence for marginal students: regression discontinuity evidence from university dismissal policies." *Journal of Labor Economics*, Forthcoming.

Pan, Weixiang. "Firm-Specific Pay Premia and the Returns to Higher Education: Evidence from Community College", (2018).

Schmutte, Ian M. "Job referral networks and the determination of earnings in local labor markets." *Journal of Labor Economics* 33.1 (2014): 1-32.

Walker, Ian, and Yu Zhu. "Differences by degree: Evidence of the net financial rates of return to undergraduate study for England and Wales." *Economics of education review* 30.6 (2011): 1177-1186.

Webber, Douglas A. "The lifetime earnings premia of different majors: Correcting for selection based on cognitive, noncognitive, and unobserved factors." *Labour economics* 28 (2014): 14-23.

Webber, Douglas A. "Are college costs worth it? How ability, major, and debt affect the returns to schooling." *Economics of Education Review* 53 (2016): 296-310.

Webber, Douglas A., and Ronald G. Ehrenberg. "Do expenditures other than instructional expenditures affect graduation and persistence rates in American higher education?." Economics of Education Review 29.6 (2010): 947-958.

Figure 1: College Premium and Worker/Firm Components

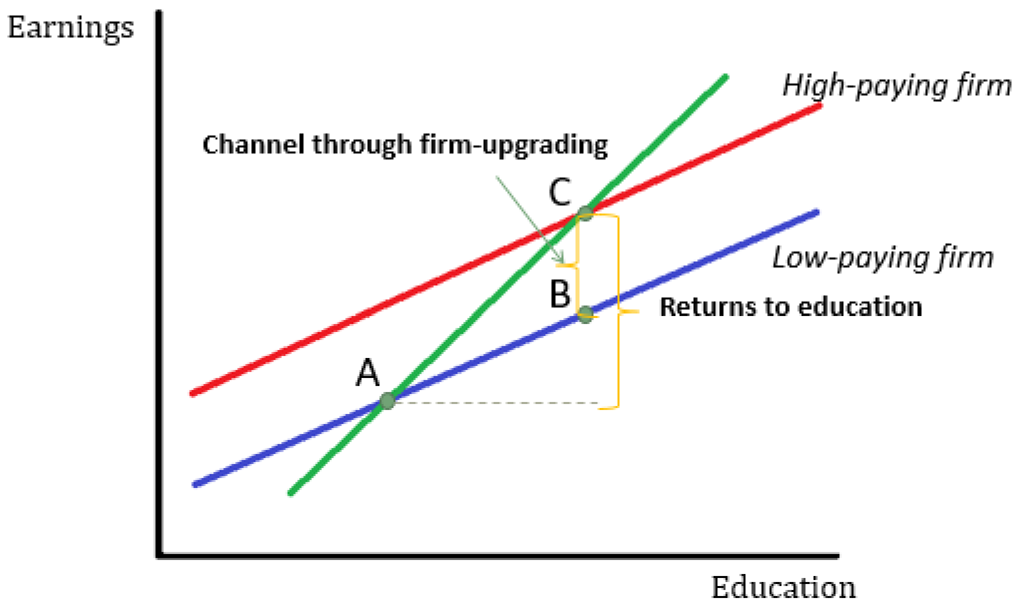

Figure 2: Major Premia by Institution

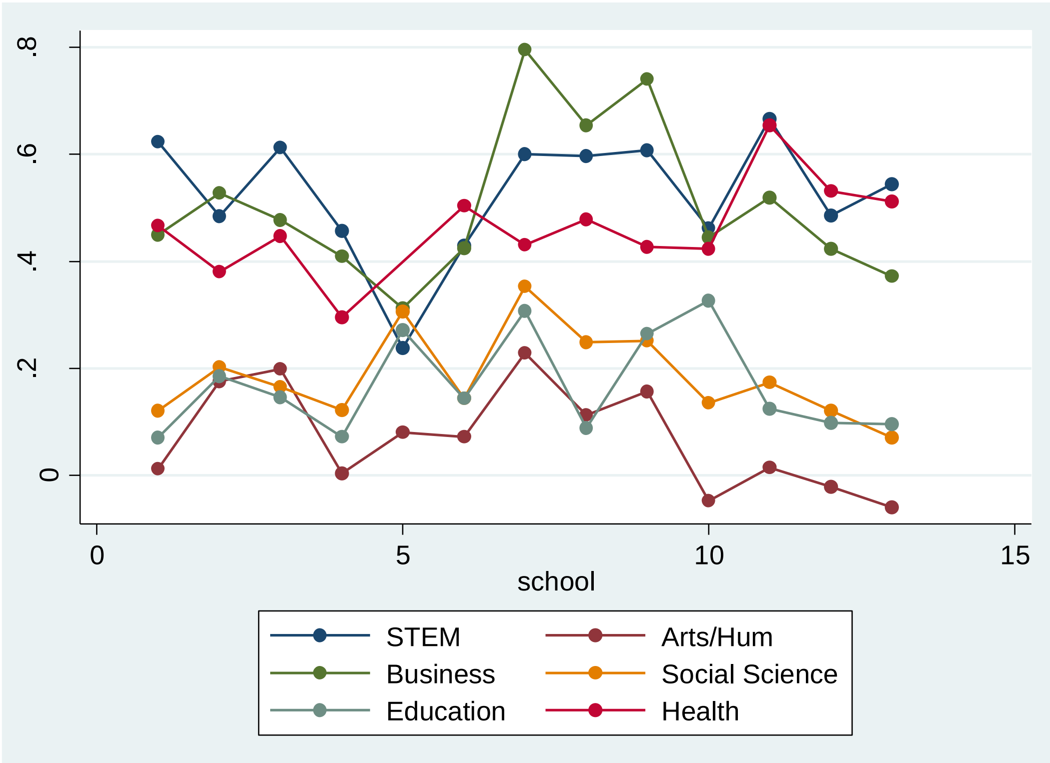

Table 1: Summary Statistics

Variables	**Full Sample**	**College Graduate Sample**
Female	.534	.590
Black	.123	.053
Age	26.3	26.6
STEM	.029	.126
Arts/Humanities	.028	.122
Business	.045	.200
Social Sciences	.028	.125
Education	.023	.139
Health	.031	.090
GPA	-	2.70
Quarterly earnings	7656	9677
Unique individuals	1,182,981	260,423
Observations	18,988,033	3,106,633

Note: The full sample is comprised of all individuals for whom we observe enrollment in a public Ohio institution and subsequent employment (subject to sample restrictions described in the Data section). The college graduate sample is comprised of only those students eventually graduate with a degree from a public Ohio institution.

Table 2: Impact of Majors/Institutions on Wages

	Majors			Schools	
Major			**School**		
STEM	0.719***	0.570***	1	0.379***	0.299***
	(0.005)	(0.005)		(0.007)	(0.007)
Arts/Hum	0.166***	0.107***	2	0.293***	0.272***
	(0.005)	(0.005)		(0.006)	(0.006)
Business	0.634***	0.550***	3	0.432***	0.345***
	(0.004)	(0.004)		(0.006)	(0.006)
Social Sci	0.259***	0.204***	4	0.341***	0.227***
	(0.005)	(0.005)		(0.009)	(0.009)
Education	0.183***	0.155***	5	0.188***	0.235***
	(0.005)	(0.005)		(0.033)	(0.035)
Health	0.466***	0.473***	6	0.301***	0.274***
	(0.005)	(0.005)		(0.005)	(0.005)
			7	0.514***	0.471***
				(0.007)	(0.007)
			8	0.436***	0.357***
				(0.004)	(0.004)
			9	0.431***	0.382***
				(0.005)	(0.005)
			10	0.356***	0.264***
				(0.023)	(0.023)
			11	0.459***	0.402***
				(0.007)	(0.007)
			12	0.355***	0.278***
				(0.007)	(0.007)
			13	0.258***	0.242***
				(0.010)	(0.010)
Controls	No	Yes	Controls	No	Yes
Observations	18,988,033	18,988,033	Observations	18,988,033	18,988,033
R-Squared	0.037	0.174	R-Squared	0.029	0.168

Note: The above table presents estimates from regressions of log wage on major and institution dummy variables. The omitted group in each panel is students who attended an Ohio public college, but never graduated. Controls refer to: sex, race, age, experience, and school district/year fixed effects. Standard errors are clustered at the individual level. * p<0.10, ** p<0.05, *** p<0.01

Table 3: Impact of Majors/Institutions on Wages

Major/School				
STEM	0.536***		0.523***	0.429***
	(0.007)		(0.007)	(0.007)
Arts/Hum	-0.016**		-0.032***	-0.066***
	(0.007)		(0.007)	(0.007)
Business	0.452***		0.443***	0.418***
	(0.006)		(0.006)	(0.006)
Social Sci	0.077***		0.051***	0.037***
	(0.007)		(0.007)	(0.007)
Health	0.283***		0.280***	0.304***
	(0.007)		(0.007)	(0.007)
1		0.122***	0.112***	0.070***
		(0.012)	(0.012)	(0.014)
2		0.036***	0.104***	0.138***
		(0.012)	(0.011)	(0.013)
3		0.174***	0.159***	0.149***
		(0.012)	(0.011)	(0.014)
4		0.083***	0.083***	0.010
		(0.014)	(0.013)	(0.015)
5		-0.069**	-0.061*	-0.024
		(0.034)	(0.035)	(0.038)
6		0.043***	0.063***	0.066***
		(0.011)	(0.011)	(0.012)
7		0.256***	0.265***	0.283***
		(0.012)	(0.012)	(0.014)
8		0.179***	0.209***	0.197***
		(0.011)	(0.010)	(0.013)
9		0.173***	0.223***	0.216***
		(0.012)	(0.011)	(0.013)
10		0.099***	0.125***	0.099***
		(0.026)	(0.025)	(0.028)
11		0.202***	0.163***	0.177***
		(0.013)	(0.012)	(0.014)
12		0.097***	0.087***	0.073***
		(0.013)	(0.012)	(0.015)
Controls	No	No	No	Yes
Observations	3,762,503	3,762,503	3,762,503	3,762,503
R-Squared	0.044	0.005	0.049	0.196

Note: The above table presents estimates from regressions of log wage on major and institution dummy variables. The omitted group in each panel is Education majors from School 13. Controls refer to: sex, race, age, experience, and school district/year fixed effects. Standard errors are clustered at the individual level. * p<0.10, ** p<0.05, *** p<0.01

Table 4: Individual School Major Premia

	School												
Major	1	2	**3**	4	5	6	7	8	9	10	11	12	13
STEM	0.623***	0.484***	0.613***	0.457***	0.238**	0.429***	0.601***	0.597***	0.608***	0.462***	0.666***	0.486***	0.544***
	(0.016)	(0.019)	(0.014)	(0.024)	(0.117)	(0.017)	(0.019)	(0.010)	(0.016)	(0.058)	(0.013)	(0.019)	(0.026)
Arts/Hum	0.012	0.176***	0.198***	0.003	0.080	0.072***	0.229***	0.112***	0.157***	-0.048	0.014	-0.022	-0.062**
	(0.025)	(0.014)	(0.015)	(0.027)	(0.098)	(0.015)	(0.018)	(0.011)	(0.015)	(0.074)	(0.030)	(0.023)	(0.030)
Business	0.450***	0.528***	0.477***	0.409***	0.312***	0.425***	0.796***	0.654***	0.740***	0.445***	0.519***	0.424***	0.372***
	(0.015)	(0.013)	(0.013)	(0.018)	(0.054)	(0.011)	(0.011)	(0.009)	(0.012)	(0.048)	(0.013)	(0.013)	(0.021)
Soc-Sci	0.121***	0.202***	0.165***	0.122***	0.306***	0.143***	0.353***	0.249***	0.251***	0.135***	0.173***	0.121***	0.078**
	(0.024)	(0.018)	(0.019)	(0.019)	(0.083)	(0.016)	(0.016)	(0.008)	(0.013)	(0.041)	(0.028)	(0.018)	(0.036)
Educ	0.070***	0.185***	0.146***	0.072**	0.272**	0.144***	0.308***	0.088***	0.264***	0.327***	0.124***	0.098***	0.095***
	(0.018)	(0.012)	(0.019)	(0.030)	(0.108)	(0.014)	(0.016)	(0.016)	(0.014)	(0.043)	(0.021)	(0.019)	(0.021)
Health	0.466***	0.381***	0.448***	0.295***	0.000	0.504***	0.431***	0.479***	0.427***	0.424***	0.654***	0.531***	0.512***
	(0.018)	(0.021)	(0.017)	(0.024)	(.)	(0.012)	(0.030)	(0.013)	(0.016)	(0.125)	(0.016)	(0.020)	(0.029)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	15490783	15566016	15551860	15382559	15232677	15668196	15498794	16105350	15647000	15248432	15475661	15460731	15366334
R-Squared	0.151	0.150	0.152	0.149	0.148	0.150	0.153	0.158	0.153	0.148	0.152	0.150	0.149

Note: The above table presents estimates from regressions of log wage on major dummy variables run separately by school. The omitted group in each panel is students who attended an Ohio public college, but never graduated. Controls refer to: sex, race, age, experience, and school district/year fixed effects. Standard errors are clustered at the individual level. * p<0.10, ** p<0.05, *** p<0.01

Table 5: Majors/Institutions and the Person-Specific Wage Component

Major	Majors		School	Schools	
STEM	0.222***	0.131***	1	0.128***	0.081***
	(0.001)	(0.003)		(0.005)	(0.005)
Arts/Hum	0.058***	0.017***	2	0.119***	0.094***
	(0.001)	(0.004)		(0.005)	(0.005)
Business	0.242***	0.185***	3	0.086***	0.055***
	(0.001)	(0.003)		(0.005)	(0.005)
Social Sci	0.070***	0.035***	4	0.099***	0.058***
	(0.001)	(0.004)		(0.007)	(0.007)
Education	0.167***	0.145***	5	-0.000	0.067**
	(0.001)	(0.004)		(0.030)	(0.028)
Health	0.110***	0.123***	6	0.115***	0.090***
	(0.001)	(0.004)		(0.004)	(0.004)
			7	0.203***	0.172***
				(0.005)	(0.005)
			8	0.154***	0.103***
				(0.003)	(0.003)
			9	0.163***	0.123***
				(0.004)	(0.004)
			10	0.251***	0.164***
				(0.020)	(0.020)
			11	0.190***	0.142***
				(0.006)	(0.005)
			12	0.132***	0.085***
				(0.006)	(0.006)
			13	0.151***	0.108***
				(0.007)	(0.007)
Controls	No	Yes	Controls	No	Yes
Observations	18,988,033	18,988,033	Observations	18,988,033	18,988,033
R-Squared	0.021	0.156	R-Squared	0.017	0.153

Note: The above table presents estimates from regressions of the person-specific component from an AKM estimation on major and institution dummy variables. The omitted group in each panel is students who attended an Ohio public college, but never graduated. Controls refer to: sex, race, age, experience, and year fixed effects. Standard errors are clustered at the individual level. * p<0.10, ** p<0.05, *** p<0.01

Table 6: Majors/Institutions and the Firm-Specific Wage Component

	Majors			Schools	
Major			**School**		
STEM	0.407***	0.359***	1	0.173***	0.165***
	(0.001)	(0.003)		(0.005)	(0.005)
Arts/Hum	0.054***	0.038***	2	0.081***	0.094***
	(0.001)	(0.004)		(0.004)	(0.004)
Business	0.306***	0.287***	3	0.251***	0.216***
	(0.001)	(0.003)		(0.004)	(0.004)
Social Sci	0.143***	0.125***	4	0.193***	0.147***
	(0.001)	(0.003)		(0.006)	(0.006)
Education	-0.060***	-0.047***	5	0.179***	0.119***
	(0.001)	(0.003)		(0.024)	(0.026)
Health	0.233***	0.253***	6	0.113***	0.126***
	(0.001)	(0.003)		(0.004)	(0.004)
			7	0.240***	0.225***
				(0.005)	(0.005)
			8	0.217***	0.189***
				(0.003)	(0.003)
			9	0.176***	0.169***
				(0.004)	(0.004)
			10	0.065***	0.054***
				(0.015)	(0.015)
			11	0.186***	0.185***
				(0.005)	(0.005)
			12	0.148***	0.136***
				(0.005)	(0.005)
			13	0.046***	0.091***
				(0.007)	(0.007)
Controls	No	Yes	Controls	No	Yes
Observations	18988033	18988033	Observations	18988033	18988033
R-Squared	0.029	0.104	R-Squared	0.018	0.094

Note: The above table presents estimates from regressions of the firm-specific component from an AKM estimation on major and institution dummy variables. The omitted group in each panel is students who attended an Ohio public college, but never graduated. Controls refer to: sex, race, age, experience, and year fixed effects. Standard errors are clustered at the individual level. * p<0.10, ** p<0.05, *** p<0.01

Table 7: Impact of Majors/Institutions on Probability of Top 10% Firm Component

	Majors			Schools	
Major			**School**		
STEM	0.263***	0.240***	1	0.084***	0.083***
	(0.000)	(0.003)		(0.004)	(0.004)
Arts/Hum	0.047***	0.044***	2	0.039***	0.045***
	(0.000)	(0.002)		(0.003)	(0.003)
Business	0.184***	0.174***	3	0.129***	0.121***
	(0.000)	(0.002)		(0.003)	(0.003)
Social Sci	0.061***	0.058***	4	0.079***	0.062***
	(0.000)	(0.002)		(0.005)	(0.004)
Education	-0.057***	-0.047***	5	0.033*	0.040**
	(0.000)	(0.001)		(0.019)	(0.019)
Health	-0.031***	-0.018***	6	0.044***	0.048***
	(0.000)	(0.002)		(0.002)	(0.002)
			7	0.132***	0.129***
				(0.004)	(0.004)
			8	0.106***	0.100***
				(0.002)	(0.002)
			9	0.095***	0.093***
				(0.003)	(0.003)
			10	0.025**	0.022**
				(0.011)	(0.011)
			11	0.071***	0.068***
				(0.004)	(0.004)
			12	0.049***	0.055***
				(0.003)	(0.003)
			13	0.026***	0.031***
				(0.004)	(0.004)
Controls	No	Yes	Controls	No	Yes
Observations	18988033	18988033	Observations	18988033	18988033
R-Squared	0.035	0.060	R-Squared	0.015	0.044

Note: The above table presents estimates from linear probability model of the probability of an individual being employed at a firm with a firm-specific wage component in the top 10% of the empirical distribution. The omitted group in each panel is students who attended an Ohio public college, but never graduated. Controls refer to: sex, race, age, experience, and year fixed effects. Standard errors are clustered at the individual level. * p<0.10, ** p<0.05, *** p<0.01