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Returns to Education through Access to Higher-Paying Firms: Evidence from US Matched Employer-Employee Data[†]

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While pay differences between education groups are sizable in the United States, their origins remain elusive. Becker's (1962) human capital model of wages posits that education is a valuable input to the production process, hence reflected in wages. By contrast, in the signaling theory of Spence (1973) a degree may be inherently unproductive yet facilitate access to superior, otherwise unavailable employment opportunities.

Classical empirical wage models that incorporate years of schooling (Mincer 1974; Card 2001) provide little guidance on the sources of inter-degree wage differentials. Yet the distinction is essential to understand trends in returns to education over time (Autor, Katz, and Kearney 2008), reasons for why returns vary with economic conditions (Kahn 2010), the efficiency of educational investments (Altonji and Zimmerman forthcoming), and the contribution of human capital to cross-country income differences (Manuelli and Seshadri 2014).

As part of a larger research agenda linking firms to earnings inequality, this paper sheds light on the microfoundations of reduced-form returns to education. Specifically, we ask: are more advanced higher education degrees associated with increased earnings *within* employers or higher average pay *across* employers? And to the extent that sorting across firms matters, what parts of the employer pay distribution are higher degrees differentially represented in?

Our approach is motivated by recent evidence that employer identity matters for pay (Card, Heining, and Kline 2013; Cardoso et al. 2014; Barth et al. 2016; Alvarez et al. 2016; Song et al. 2016). We use administrative US matched employer-employee data merged with detailed information on individuals' academic records, including degree, graduating institution, coursework leading up to their field of study, and grades received. This unusually rich dataset allows us to link higher educational attainment to subsequent employer choice and other labor market outcomes. By comparing degree-specific distributions across estimated firm fixed effects in pay, we assess the extent to which returns to education are mediated by sorting of workers across firms, consistent with Spence's (1973) view of education as a signal.

We present three results. First, we confirm findings in the earlier literature of large pay differences across degrees. Second, we show that up to one quarter of pay premiums for higher degrees are explained by between-firm pay differences. Third, higher education degrees are associated with greater representation at the best-paying firms. We conclude that employer heterogeneity is an important factor in mediating the returns to education.

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I. Data Description

We use two datasets on recent higher education graduates as well as the population of employees in Ohio between 2003 and 2012. The joint data have two key advantages for the purposes of our study. First, they contain detailed information on educational achievement for a large population of graduates. Second, they track individuals after graduation and across employers over time, allowing us to distinguish between firm-specific and worker-specific pay components.

We obtain matched employer-employee earnings data from the Ohio Unemployment Insurance (UI) system available from the Ohio Longitudinal Data Archives (OLDA). The data are available quarterly from 1995:II to 2013:I for private sector, nonfederal state, and local public employees subject to UI contributions in Ohio. We focus on the main employer in a given quarter, which we define as a worker's highest-paying employer during that period.[1] We convert reported weekly earnings into real 2014:IV US dollars using the Cleveland-Akron, Ohio, Consumer Price Index for All Urban Consumers.

We complement the matched employer-employee data with a dataset covering all Ohio public higher education graduates from the OLDA. These data consist of course-level records for anyone enrolled at a public higher education institution in Ohio together with information on what degree—if any—they graduated with, in what year they graduated, average grade point average (GPA) at graduation, degree-granting institution, and field of study.

The final sample we analyze consists of men and women who graduated with a higher education degree at age 20–35 from an Ohio public higher education institution between 1999 and 2011 and had positive earnings in at least one of the subsequent eight quarters. We focus on the period 2003:I—2012:IV for which weekly earnings data are available. We also drop individual quarters with missing values on key variables or if weekly earnings are less than one quarter of the federal minimum wage multiplied by 30 hours over 12 weeks. Finally, for all matched data analysis, we restrict attention to private sector firms that hire at least five graduates over the period we study.

Table 1 presents summary statistics on the final sample by type of higher education degree. A few points are noteworthy. First and most importantly, higher degree graduates earn substantially more. While average weekly wages of workers with an associate's (bachelor's) degree are \$800 (\$900), a graduate with a master's degree earns on average close to \$1,300 a week, which is 63 (44) percent more and those with a PhD/JD/MD earn over \$1,800 a week, meaning 125 (100) percent more. Second, weeks worked per quarter rises with education level, indicating more stable employment. Third, women make up the majority of graduates across all degrees but are, like African American graduates, relatively more concentrated at the associate's degree level. Finally, higher degree graduates tend to have higher GPAs.

Overall, the data contain over 4.7 million individual-quarter observations for more than 315,000 unique workers and 22,000 unique employers.

II. The Role of Firms in Mediating the Returns to Education

A. *Econometric Framework*

We investigate pay differences across higher education degrees by considering the following econometric specification for weekly wages of individual i at time t:

$$(1)\quad y_{it} = \sum_d \beta_d \mathbf{1}\left(\text{degree}_{it} = d\right) + \alpha_{J(i,t)} + \mathbf{X}_{it}\gamma + \delta_t + \varepsilon_{it},$$

where y_{it} is log real weekly wages, β_d is an intercept specific to higher education degree d, $\alpha_{J(i,t)}$ is a fixed effect for firm $j = J(i,t)$ at which worker i is employed at time t, the vector $\mathbf{X}_{it}$ contains worker controls discussed in detail below, δ_t is a year-quarter dummy, and ε_{it} is an orthogonal error.

We focus on estimates of coefficients β_d in equation (1), which we include in all specifications and interpret as conditional pay premiums for higher degrees of education relative to associate's degrees. We estimate the equation

[1] The "firm" concept in the data is that of an Employer Identification Number, which lies between a firm and an establishment identifier. See Song et al. (2016) for further discussion.

Table 1—Summary Statistics on Final Sample by Higher Education Degree

	Associate (1)	Bachelor (2)	Master (3)	PhD/MD/JD (4)
Weekly wage	802	906	1,281	1,831
	(785)	(966)	(1,253)	(1,896)
Weeks worked per quarter	11.93	11.92	12.10	12.18
	(2.34)	(2.36)	(2.14)	(2.08)
Graduation age	25.41	24.04	27.35	27.79
	(4.20)	(2.60)	(3.33)	(2.84)
GPA	3.02	3.08	3.45	3.29
	(1.26)	(1.42)	(0.93)	(1.17)
Fraction female	0.66	0.54	0.60	0.56
Fraction African American	0.07	0.07	0.06	0.04
Observations (millions)	1.35	2.82	0.46	0.10
Unique workers	84,760	193,659	31,314	7,119
Unique employers	6,407	13,835	1,702	486

Notes: Ohio Longitudinal Data Archive 2003–2012. Standard deviations in parenthesis. See text for details.

stepwise, gradually adding to the degree indicators the following controls: (i) time effects; (ii) worker observables, including quarterly experience dummies by gender and race, a linear GPA term interacted with experience dummies as well as dummies for graduation age, field of study, and academic institution; (iii) three-digit North American Industry Classification System (NAICS) indicators; and (iv) firm fixed effects instead of sector controls.

We are interested in how estimated degree premiums $\widehat{\beta_d}$ change as we introduce additional controls in the above specification. If higher education augments human capital that is valued equally at any firm then we expect degree premiums to be unaffected by introducing firm controls in the wage equation. Conversely, if a higher degree acts solely as a door opener for higher-paying firms then we expect all the degree premium to vanish once we control for workplace. In reality, a mix of the two stories is likely at work.

The above analysis does not control for sorting of workers across firms based on unobserved but time-invariant worker characteristics. To this end, one could estimate a two-way fixed effects model incorporating worker and firm dummies in the spirit of Abowd, Kramarz, and Margolis (1999) and then examine the link between firm effects and degree attainment in the resulting estimates. We think this exercise could be fruitful and leave it for future work.

B. *Results*

Table 2 presents degree premiums in weekly wages as a result of estimating equation (1) via ordinary least squares. Column 1 shows that bachelor's degrees earn 10.4 log points more (11 percent) in weekly wages than associate's degrees, master's degrees 43.2 log points more (54 percent) and PhDs/MDs/JDs 81.9 log points more(127 percent).

Column 2 demonstrates that accounting for differences in worker characteristics and educational records has substantial effects on estimated degree pay premiums. This is primarily because associate's degrees and doctoral degrees are concentrated in relatively high-paying fields of study. Accounting for such heterogeneity, the pay premium associated with a bachelor's degree goes up to 24.4 log points, that for a master's degree goes up to 50.7 log points, and that for doctoral degrees declines to 76.9 log points. Controlling for sectors in column 3 has only a moderate effect on the estimated degree premiums while adding substantial explanatory power with the R^2 increasing from 0.269 to 0.365.

Column 4 accounts for workplace heterogeneity by adding firm fixed effects, which shrinks degree pay premiums substantially. Relative to the specification with sector controls, the premium for bachelor's degrees falls by 26 percent to 16.2 log points and that for master's degrees declines by 20 percent to 36.8 log points. The

TABLE 2—DIFFERENCES IN WEEKLY WAGE FROM MAIN EMPLOYER BY DEGREE

	Raw (1)	Mincer (2)	Sector (3)	Firm (4)
Bachelor	0.104	0.244	0.220	0.162
	(0.003)	(0.004)	(0.004)	(0.004)
Master	0.432	0.507	0.458	0.368
	(0.004)	(0.005)	(0.005)	(0.005)
PhD/MD/JD	0.819	0.769	0.773	0.759
	(0.008)	(0.009)	(0.009)	(0.008)
Observations (millions)	4.74	4.74	4.71	4.74
R^2	0.052	0.269	0.365	0.502

Notes: Standard errors are clustered at the individual level. See text for details.

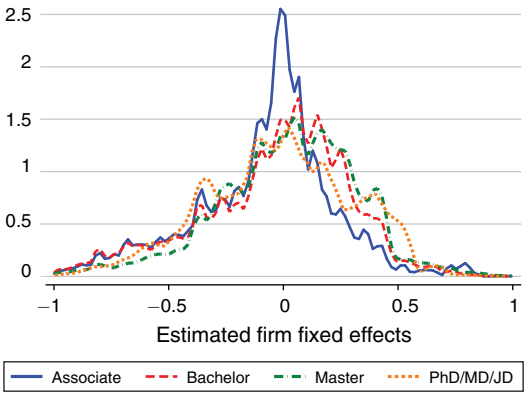

FIGURE 1. DENSITY OF ESTIMATED FIRM EFFECTS BY DEGREE

premium for doctoral degrees falls more moderately by 2 percent to 75.9 log points. Note also that the R^2 increases substantially to 0.502, meaning that firms also explain substantial within-degree pay variation.

How does the employer fixed effect distribution depend on higher education degree attainment? Figure 1 plots the distribution of estimated firm effects $(\hat{\alpha}_{J(i,t)})$ by degree type. Relative to associate's degrees, the firm component in pay is on average 4 log points higher for bachelor's degrees, 10 log points higher for master's degrees, and 7 log points higher for doctoral degrees. Relative to the associate level, higher education degrees are less concentrated in the middle of the firm effects distribution and more at the top. Hence it appears that getting hired at some of the best-paying firms requires a minimum educational qualification.

Our analysis suggests that sorting of workers across firms explains a substantial part of the pay premium for bachelor's and master's degrees, but to a lesser extent for doctoral degrees. Thus, consistent with Spence's (1973) view of education as a signal, returns to bachelor's and master's degrees are partially mediated by differential access *across* firms. On the other hand, doctoral degrees primarily command a pay premium *within* firms, in line with Becker's (1962) human capital model of wages.

III. Conclusions

Higher education degrees command large pay premiums in the US labor market, yet their origins remain elusive. We link this debate back to whether higher education increases human capital or acts as a signal in the labor market. The quantitative relevance of these two hypotheses is central to the efficiency of education and labor market policies as well as macroeconomic considerations. We contribute to this fundamental area by studying the extent to which higher education degrees facilitate sorting toward high wage firms. To this end, we combine matched employer-employee data together with detailed higher education information from the US state of Ohio.

We find that where you work mediates a substantial share of returns to education at the bachelor's and master's level, and to a lesser degree among doctorates. Our results suggest that part of the value of academic degrees derives from their function as a door opener to higher-paying employers.

In ongoing research, we examine to what extent the returns to other dimensions of educational achievement—including field of study, grades, and academic institution—as well as worker demographics—including race, gender, and labor market experience—are mediated by employer heterogeneity. Studying the role of firms can help us quantify the effects of policies on earnings inequality along these dimensions, as shown in the context of the minimum wage by Engbom and Moser (2016). A fruitful avenue for future research will be to extend this analysis to other social, education, and labor market policies.

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