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Math skills and labor-market outcomes: Evidence from a resume-based field experiment

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ABSTRACT

We examine the link between math skills and labor-market outcomes using a resume-based field experiment. Specifically, we send fictitious resumes in response to online job postings, randomly assigning some resumes to indicate stronger math skills, and measure employer responses. The resumes that are randomly assigned to indicate stronger math skills receive more interest from employers than the comparison resumes. Our findings add to the body of evidence showing that stronger math skills positively affect labor-market outcomes.

1. Introduction

We evaluate the effects of math skills on labor-market outcomes using a field experiment. Our methodology is similar to the one used by Bertrand and Mullainathan (2004) in their work on employer discrimination: we send fictitious resumes in response to online job postings, randomly assigning some resumes to indicate stronger math skills, and measure responses from employers. We send resumes to job postings in three occupational categories: clerical/administrative, customer service (including cashiering), and sales. These occupational categories include some of the largest occupations in the United States.[1]

Our study adds to a large literature in economics relating math skills to labor-market outcomes, and offers two unique contributions. First, by virtue of the occupational categories that we focus on in our experiment, we isolate the effects of stronger math skills for moderately skilled workers. Moderately skilled workers make up a substantial fraction of the workforce but have received little direct attention in prior work.[2] Second, we randomly assign math

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[1] See the Occupational Employment Statistics provided by the Bureau of Labor Statistics (BLS) for more information. For example, in May of 2009, the 15 largest occupations in the United States as reported by the BLS included retail salespersons, cashiers, office clerks, customer service representatives and secretaries. All of these occupations are represented in our study (see http://www.bls.gov/oes/current/largest_occs.htm). Also, among the major occupational groups as defined by the BLS, the two largest groups are "Office and Administrative Support Occupations" and "Sales and Related Occupations" (see http://www.bls.gov/oes/current/oes_nat.htm).

[2] Several studies estimate math-skill effects on wages for the general population (see, for example, Altonji, 1995; Murnane, Willett, & Levy, 1995; Rose & Betts, 2004), but it is difficult to determine how the results from these studies apply to specific subgroups of workers. Joensen and Nielsen (2009) and Tyler (2004) provide some insight by estimating

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skills to resumes. This allows us to avoid the serious econometric challenges related to the endogenous formation of math skills in real data. It is also of interest that we performed our experiment during a period of high unemployment in the United States (the spring and summer of 2010).

For individuals seeking sales positions, we find that stronger math skills positively affect employer interest. We also find some evidence of a positive math-skill effect for prospective clerical workers, but we do not find any evidence that stronger math skills are important for individuals seeking employment in customer-service positions. Stronger math skills do not decrease employer interest in any of the occupational categories that we examine.

2. Motivation

Consider the following empirical model based on Mincer (1958), augmented for the purposes of this study to include a measure of observable math skills:

$$y = \gamma E + \lambda EXP + \delta MS + \varepsilon \quad (1)$$

In (1), y is a labor-market outcome (such as log-wages), E measures education, EXP measures work experience and MS measures math skills. The key empirical challenge in estimating Eq. (1) is that individuals' observable skills are likely to be endogenously determined. There is a large literature in economics that discusses the endogeneity problem in models similar to Eq. (1), mostly focusing on the endogeneity of education and experience. For the same reasons that education and experience are likely to be endogenous, other measures of observable skills are also likely to be endogenous.[3]

In our experiment, we distinguish math skills across individuals by assigning math-specific and non-math-specific qualifications to resumes (we provide details about these qualifications in Section 3). The field-experiment design offers the important advantage that we can randomly assign qualifications to resumes, obviating the concern that the accumulation of math-specific and non-math-specific skills is endogenous. For example, with real data we might worry that unobserved factors encourage individuals to pursue math-specific skills and also push them to search for employment more diligently. In the absence of an exogenous source of variation that affects the accumulation of math skills this would make causal inference difficult. But by virtue of the random assignment in our study, we can be confident that our findings will not be driven by any such confounding factors.

This benefit of our research design gives us a high degree of confidence in our results. However, while we are quite comfortable assigning a causal interpretation to our findings, we note that our experiment cannot be used to answer another important question: namely, where we find non-zero impacts of stronger math skills, we cannot separate out the relative importance of the effects of signaling and human capital (Spence, 1973). Instead, we rely on other studies in the literature to provide insight, noting that in analyses where signaling and human-capital effects can be distinguished, researchers consistently find that the human-capital-based returns to observable skills are larger than the signaling-based returns (e.g., see Ishikawa & Ryan, 2002; Kane & Rouse, 1995; or, for international evidence, see Boissiere, Knight, & Sabot, 1985).[4]

3. Study design

3.1. Resume construction

We followed a procedure similar to the one used by Bertrand and Mullainathan (2004) to construct the resumes for our experiment. We began by finding real resumes that were posted online by job seekers in one of the occupational categories of interest in either Kansas City or St. Louis. At the onset of the project we identified four occupational categories: cashiering, clerical/administrative, customer service and sales.

Within each occupational category and labor market we found four resumes and grouped them into two matched pairs based on educational attainment—one pair of high-education (HE) resumes, and one pair of low-education (LE) resumes. We established the education levels that determined the HE and LE designations based on what we observed in the pools of real resumes within each occupational category. For the clerical resumes, the HE resumes had Associate's degrees and the LE resumes did not. For the other job categories, the HE resumes had at least some experience at a four-year college and the LE resumes had no more than an Associate's degree.[5] All of the resumes were adjusted to indicate that the individual had at least graduated from high school, even when this was not the case.

After identifying the matched pairs of resumes we switched their labor markets. That is, the resumes for job seekers in St. Louis were moved so that they would apply to jobs in Kansas City, and vice versa. The labor-market switches required that we "reconstruct" each resume to

math-skill effects for highly skilled workers and high-school dropouts, respectively. The only study of which we are aware that separately estimates effects for workers who are likely to be moderately skilled is Levine and Zimmerman (1995). They evaluate wage outcomes and do not find a link, but their estimates are imprecise enough that they cannot rule out non-zero effects (their IV estimates are particularly noisy). Kukla-Acevedo (2009) finds some evidence that elementary-school teachers with stronger math skills perform better in the classroom.

[3] For brevity we avoid a lengthy discussion of this important but already well-understood problem. The interested reader can find detailed discussions in Altonji (1995), Behrman and Rosenzweig (1999), Cawley, James, and Edward (2001), Joensen and Nielsen (2009), Levine and Zimmerman (1995), and Tyler (2004), among others.

[4] The consistency of this finding in the literature makes it noteworthy; however, we are not aware of any studies that separate signaling and human-capital effects specifically for moderately skilled workers. This leaves open the possibility that our findings are driven more by signaling than is the case in other studies.

[5] Although a handful of the real resumes indicated attendance at a well-known four year university, this was uncommon. Examples of the universities listed on the final resumes include Webster University, American Intercontinental University, Rockhurst University and the directional state universities in Missouri.