



Agglomeration and job matching among college graduates



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ARTICLE INFO

Article history:

Received 4 June 2013

Received in revised form 1 December 2014

Accepted 7 December 2014

Available online 12 December 2014

JEL classification:

J24

J31

I21

R23

Keywords:

Agglomeration

Labor market matching

Productivity

Underemployment

Urban wage premium

ABSTRACT

We examine job matching as a potential source of urban agglomeration economies. Focusing on college graduates, we construct two direct measures of job matching based on how well an individual's job corresponds to their college education. Consistent with matching-based theories of urban agglomeration, we find evidence that larger and thicker local labor markets increase both the likelihood and quality of a job match for college graduates. We then assess the extent to which better job matching of college-educated workers increases individual-level wages and thereby contributes to the urban wage premium. We find that college graduates with better job matches do indeed earn higher wages on average, though the contribution of such job matching to aggregate urban productivity appears to be relatively modest.

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1. Introduction

The agglomeration of economic activity provides significant productivity advantages to firms and workers. Estimates of the magnitude of such urban agglomeration economies suggest that doubling the size or density of an urban area is associated with a 2 to 8% increase in productivity.¹ Explanations of the underlying causes of these productivity benefits have evolved from Marshall's (1890) classic ideas about the sources of agglomeration related to input sharing, labor market pooling, and knowledge spillovers to Duranton and Puga's (2004) more formal exposition of these micro-foundations based on increasing returns arising from sharing, matching, and learning externalities. While the magnitude of urban agglomeration economies is well established, empirically identifying the underlying sources of these productivity benefits has proven to be more difficult. As a result, little is currently known about the importance of these micro-foundations.

In this paper, we study one potential source of urban agglomeration economies: better job matching. Economists have long believed that

large and dense urban environments help facilitate matching between workers and firms. This is because more agglomerated local labor markets lower the costs associated with job search and provide a wider variety of job opportunities. As a result, workers in big cities are more likely to match their human capital to a job in which their skills are put to their most productive use. Indeed, the matching-based models of urban agglomeration that have been developed predict that more agglomerated local labor markets enhance productivity by improving both the likelihood of matching and increasing the quality of these matches (Helsley and Strange, 1990; Sato, 2001; Berliant et al., 2006).

Recently, a small body of literature has begun to provide evidence consistent with matching-based theories of urban agglomeration. These empirical studies have found that larger and thicker urban labor markets enhance worker productivity by allowing for a greater specialization of professional activities (Baumgardner, 1988; Garicano and Hubbard, 2007); helping to solve dual-career problems (Costa and Kahn, 2000); improving matching between workers and firms (Andersson et al., 2007; Andini et al., 2013); enhancing the efficiency of job search (Yankow, 2009; Di Addario, 2011), and reducing labor market churn (Wheeler, 2008; Bleakley and Lin, 2012). While this work has improved our understanding of the benefits of urban agglomeration, the empirical evidence surrounding job matching as a source of urban agglomeration economies remains, so far, largely indirect in nature.

By indirect, we mean that most existing studies do not explicitly look at the nature of job matches, but rather infer that better job matching

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¹ Rosenthal and Strange (2004), Puga (2010), and Combes and Gobillon (forthcoming) provide comprehensive reviews of the empirical evidence on urban agglomeration economies, while Melo et al. (2009) provide a meta-analysis of study characteristics affecting the magnitudes of existing estimates of agglomeration effects.

has occurred based on a secondary observation. A recent example of this approach is [Bleakley and Lin \(2012\)](#), who find that workers change occupations and industries less frequently in more densely populated areas, and attribute this outcome to enhanced job matching facilitated by dense urban environments. A more direct approach would compare the amount and types of skills a worker possesses relative to the job performed to determine the extent of a job match, and examine how matches vary across the urban spectrum. No doubt, taking such a direct approach has been hampered by difficulties associated with defining what constitutes a match and limitations posed by available data that make it difficult to measure the human capital possessed by workers and compare this to the skills necessary to perform the job a worker holds.

To close this gap in the existing literature, we utilize newly available data to construct two measures of job matching for college graduates based on how well their job corresponds to their college education. As such, we build from the broader labor economics literatures analyzing the match between an individual's education and job (see, e.g., [Hersch, 1991](#); [Robst, 2007](#)), as well as the role of job search and occupational choice in forming job matches (see, e.g., [Miller, 1984](#); [Neal, 1999](#); [Shimer, 2007](#)). Job search and matching has also proven to be important in the process of human capital accumulation (see, e.g., [Bowlus and Liu, 2013](#)). However, these broader literatures have largely ignored how local labor market conditions influence the job matching process.

Our first matching measure, which we refer to as a *College Degree Match*, determines whether a college graduate is working in an occupation that requires a college degree. Our second measure, which we refer to as a *College Major Match*, gauges the quality of a job match by determining how well an individual's college major corresponds to that person's occupation. Thus, by utilizing both measures, we are able to analyze how the likelihood and the quality of job matching among college graduates vary across the urban spectrum.

Our main empirical analysis examines the extent to which larger and denser urban environments facilitate job matching among college graduates. We estimate probit models of the determinants of job matching for college graduates located in metropolitan areas. Consistent with matching-based theories of agglomeration, we find evidence that larger and thicker local labor markets help college graduates find better jobs by increasing both the likelihood and quality of a match. Although the marginal effects we estimate are small, the difference in match probability between large and small-to-medium metropolitan areas or between dense and sparse metropolitan areas is economically important.

The estimation approach used for this analysis addresses a number of challenging identification issues that may arise in estimating the relationship between job matching and urban agglomeration. Perhaps most fundamentally, biases may result if either the workers or job opportunities in large and dense urban areas are systematically more or less conducive to job matching. Indeed, recent research indicates that it is important to account for worker characteristics and metropolitan area composition effects in studies of the effects of urban agglomeration ([Combes et al., 2008, 2010](#); [Abel et al., 2012](#)). As such, we include a wide array of worker characteristics, including each individual's college major, and account for differences in the economic structure and performance of metropolitan areas in all of our models. In addition, to allay concerns about more traditional urban agglomeration endogeneity issues, such as simultaneity or omitted variables, we show that our results are robust to standard instrumental variables estimation.

As an extension to our main empirical analysis, we then assess the extent to which better job matching of college graduates increases individual-level wages and thereby contributes to the urban wage premium. We find that college graduates, on average, earn a significant wage premium when working in a job related to their college education. Further, we provide evidence that supports the idea that better job matching contributes to the urban wage premium. Thus, these results provide direct evidence that better job matching is a source of urban

agglomeration economies, though the contribution of job matching to aggregate urban productivity appears to be relatively modest.

2. Measuring job matching among college graduates

The primary dataset used in our analysis is the 2010 American Community Survey (ACS), a nationally representative 1% sample of the U.S. population ([Ruggles et al., 2010](#)). These data include a variety of economic and demographic information for individuals, including a person's occupation, wage, and level of education. Of particular use for our purposes, the ACS recently began to include detailed information on an individual's undergraduate degree major. Given our focus on college graduates, we limit our sample to working-age individuals (i.e., aged 16 to 64) with at least a Bachelor's degree who are in the civilian labor force, and located in metropolitan areas, since this geography is a good proxy for local labor markets. The full sample contains nearly 360,000 observations representing more than 36 million college graduates.²

We combine these micro data with other sources of information to develop two measures of job matching among college graduates. Our first measure, which we refer to as a *College Degree Match*, utilizes data from the U.S. Department of Labor's Occupational Information Network (O*NET) to determine whether a college graduate is working in an occupation that requires a college degree. The O*NET system contains occupation-level data for hundreds of detailed occupations, collected via interviews of incumbent workers and input from professional occupational analysts, on a wide array of job-related requirements.³ We use the following question from the O*NET Education and Training Questionnaire to determine whether an occupation requires a college degree: "If someone were being hired to perform this job, indicate the level of education that would be *required*?" (emphasis added). Respondents can then select from the following twelve education levels: "Less than a High School Diploma, High School Diploma, Post-Secondary Certificate, Some College Courses, Associate's Degree, Bachelor's Degree, Post-Baccalaureate Certificate, Master's Degree, Post-Master's Certificate, First Professional Degree, Doctoral Degree, and Post-Doctoral Training." We considered a college education to be a requirement for a given occupation if more than 50% of the respondents working in that occupation indicated that at least a Bachelor's degree was necessary to perform the job.⁴ We then merged these data on educational requirements for each occupation to individual workers and their actual occupations from the ACS. An individual matches if they are working in an occupation that requires a college degree. Unemployed workers, by definition, are a non-match.⁵ We find that about 62% of the college graduates in our sample work in a job that requires a college degree.

Our second measure of job matching, which we refer to as a *College Major Match*, gauges the quality of a job match by determining if an individual's college major is related to the job that person is performing. The ACS recently began to identify an individual's undergraduate college major, classifying them into one of 171 detailed degree fields. Our strategy to estimate a College Major Match is to determine whether a person's major is related to the occupation in which they are currently working. We determine whether such a connection exists using an occupational crosswalk provided by the Department of Education's

² We apply the nationally representative ACS sample weights in all of our analysis.

³ We use O*NET Version 15 for our analysis, see <http://www.onetcenter.org/> for more information. The O*NET database is discussed in detail by [Peterson et al. \(2001\)](#).

⁴ We selected this threshold because it indicates that the majority of respondents believe that at least a Bachelor's degree is required to perform a given job. In practice, however, few occupations are clustered around the 50% threshold. For most occupations, respondents either overwhelmingly believe that a Bachelor's degree is required for the job or not. Nonetheless, we performed sensitivity analysis using both 40% and 60% thresholds. While the share of graduates with a College Degree Match increases or decreases slightly using these alternative thresholds, the main job matching results presented in the paper are not sensitive to our choice of threshold.

⁵ We also analyzed a restricted sample consisting of only employed individuals. While eliminating unemployed individuals increased the raw match rates somewhat, our empirical results were nearly identical to those presented in the paper that use the full sample.

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