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An Empirical Test of Urban Labor Matching

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Abstract

This study tests for the labor matching efficiency of cities by examining the relationship between urbanization and the skills variation of public school principals. The results imply larger urban labor markets are generally more efficient at matching the skills of residents to the skills required by employers. The variation in labor skills among school principals is found to decrease with urban size, which is evidence that urbanization fosters more efficient labor matches.

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I. Introduction

Cities expand the choices open to participants in the labor market. The resulting efficiency of urbanization arises from, among other factors, tighter labor market matches (Kim, 1990; Sato, 2001; Wheeler, 2001). If cities produce more efficient labor matches, urbanization should decrease the variation in skills across employees in a specific occupation. If a job calls for a specific set of labor skills, urban areas should be more able to provide laborers with those skills. This study tests the matching efficiency of cities by examining the relationship between urbanization and the heterogeneity in skills among public school principals. Matching efficiency grows in theory with urban size and density - the primary measures of urbanization - if job search exhibits increasing returns (Sato, 2001). A reduction in skills heterogeneity among school principals in more urbanized areas would reflect an increase in matching efficiency in the local labor markets.

The public school principal is examined for a number of reasons. It is an occupation whose required skills primarily involve experience in one field - grade-school education. School principal is a reasonably well-defined occupation compared to, for example, school teacher, which can vary by subject taught and grade level. The demand for public school principals over space is largely exogenous to the geographic distribution of required labor skills. This is important because an area may produce close employment matches for a particular occupation not because of its level of urbanization but due to its specialization in a particular sector and concentration of specific labor skills. Grade-school education is a service whose per capita demand does not dramatically vary over geography, and which is largely not exported.

The decision to hire a school principal is normally made by the local school district. The level of urbanization will determine, in theory, the fit between the district's skills requirements and the skills of principals actually employed. This paper examines the spatial variation in two skills: grade-school teaching experience and previous experience as principal for a sample employed during the 1990's.

The hypothesized relationship between urbanization and labor matching assumes the market for principals is primarily local, at least at the level of the metropolitan area, and survey evidence suggests it largely is. The 1993-94 Schools and Staffing Survey, which sampled approximately nine thousand school principals, found that over sixty percent of those who changed schools remained within the same school district. And among those who moved across districts, over three-quarters remained within-state. Although the survey data excludes first time principals, the sample evidence supports the premise of a local labor market.¹

Empirical studies of labor matching have lagged in development behind the theory. A microeconomic empirical literature has recently developed testing the quality of labor matches by defining an efficient match as one in which the productivity of the employer corresponds with that of the hired worker (Abowd et al. 2004; Abowd, Kramarz and Margolis, 1999; and Andersson, Burgess and Lane, 2004). Given that a labor match takes place at a particular geographic location, a separate literature has developed examining the interaction between labor matching and space. The effect labor sorting has on spatial wage inequality has been studied by Combes, Duranton and

¹ Even if the market for principals typically extended beyond the metropolitan area, larger urbanized areas may still generate smaller skills variation. Consumption amenities in larger areas may draw a larger pool of applicants for every job opening, resulting in tighter final labor matches. See Glaeser, Kolko and Saez (2001) for a discussion of the role urban amenities may play in attracting high skilled labor.

Gobillon (2005) and Wheeler (2001). Baumgardner's (1988) finding that physicians in larger market areas are more likely to specialize is evidence of the effect local market size has on labor match quality. The study stands out as an effort to relate characteristics of the local geographic market with the quality of labor matches. This study's examination of the skills variation of principals provides new evidence, using a different empirical approach, on the relationship between urbanization and labor matching.

II. The School District's Employment Decision

The school district is assumed to search for principals who fit a predetermined set of required skills. The particular skills sought may reflect characteristics of the individual district, such as the proportion of its student body in poverty, as well as its hiring objectives. The Tiebout hypothesis suggests economic efficiency considerations should at least partially determine the criteria for hiring school administrators. The economic relationship estimated in this paper requires only that the school district is consistent in its hiring decisions over the time period studied.

The local labor pool from which the school district hires can be defined by a uniform distribution of skills. Suppose the school district's optimal choice in the distribution is a principal with q_k skills. It however incurs search costs in finding q_k . The difference between the desired q_k and the skills of the principal actually hired is represented by (1) $D = |q_k - q|$. The cost, in economic terms, of employing a principal with a skill level less than q_k would be the particular school's inefficiency in producing education. Also, plausibly, a district may perceive an applicant whose skills exceed q_k as less likely to remain on the job for an extended period. An overqualified principal who finds a closer job match soon after accepting a school district's job offer will generate

future search costs for the school district. This possibility also exists for an underqualified principal.

The expected skills mismatch, D , is determined by the function (2) $D = f(t, x, z)$ where t is the number of discrete time periods of search, x is a vector of labor market characteristics and z represents characteristics of the individual school district. Search time, t , is the school district's only choice variable. If the school district evaluates a random sample from the skills distribution in each period, a larger t would imply an increased probability of observing a potential school administrator whose skills fall within an arbitrarily small D .

The labor market variables in x , primarily urban size and density, can be considered endowments to the district. At a given period, a greater density or total urban population will produce a larger number of potential matches, resulting in a smaller predicted skills mismatch, a smaller D (see Wheeler, 2001). Differences in D within an individual school district may partially reflect differences in the criteria the school district uses to hire administrators for its schools. The school district characteristics in z measure within-district heterogeneity and are included to capture possible variation in q_k in equation 1.

The hiring process involves trading off expected mismatch and search costs. Given an optimal search effort by the school district, characteristics in the local labor market will partially determine the quality of the matches, which can be measured by the variation in labor skills among the hired principals.

III. Sample and Skills Measure

The primary data source is the 1999-2000 Schools and Staffing Survey produced by the National Center for Education Statistics. The survey collected personal information for a sample of principals and the schools they administered. The survey data also records the geographic location of the schools, allowing for identification of the corresponding local school district. The constructed sample in this study includes principals with various tenure lengths and from across grade school levels, including high school. The sample is limited, however, to those principals hired during the 1990's; this was done to reduce problems arising from possible changing hiring criteria over time for school administrators. The variation in principals' skills within school districts could be calculated only for those districts with multiple observations. The sample includes only those school districts with at least four observed principals.² This restriction eliminated all but a handful of non-metropolitan school districts; the final sample of one hundred and ninety-four school districts is limited to metropolitan areas.

The constructed skills measures should reflect the standards school districts use to hire principals. Years of schooling, a natural selection criterion, suffers as a skills indicator because the measure does not appreciably vary across the sample. Most states mandate a master's degree as the minimum required education for principal; eighty-seven percent of the sampled principals had either a master's or a professional education degree beyond the master's but below the level of the doctorate. The survey data includes two continuous measures of experience in grade school education that vary substantially

² Appendix B illustrates the distribution of the number of principals sampled across school districts in the data used in the regression models.

across the sample: years teaching and previous years as principal.³ The mean teaching experience calculated for the sample (fourteen years) is substantially higher than the minimum mandated by the states (which averaged three years) which suggests the measure is used by school districts as a hiring criterion.⁴

IV. Empirical Models of Skills Variation

Table 1 describes the heterogeneity over geography in the previous experience of principals as well as their years teaching; table 2 illustrates regression specifications determining the variation in skills. The skills measures used in all the empirical specifications represent the skills level at the time the principal was hired. The spatial variation in the two skills measures are calculated in table 1 by their sum of squares. The unit of observation in table 1 is the individual principal, each of whom is employed by a district that records at least four in the data.

The unit of observation for the regression models in table 2 is the school district. The models are represented by (3) $y_i = \alpha + x_i\beta + z_i\gamma + \varepsilon_i$ where y_i is the standard deviation in years teaching experience calculated across schools within each sampled school district. The right-hand-side covariates are split into metropolitan area characteristics, x_i and those representing the school districts, z_i .

The primary urbanization variables are total population and density of the metropolitan area. The vector x_i also includes the proportion of the adult population in the metropolitan area with at least a master's degree. The variable represents the share of those in the local labor market with the minimum education qualification for principal.

³ Most of the skills variables compiled in the Schools and Staffing Survey are qualitative, indicating whether the principal had any previous experience in specific occupations such as vice principal or school counselor.

⁴ For information on state certification standards for principals, see J. Tryneski (1993). See appendix A for summary statistics for the skills variables.

As discussed in section II, the level of urbanization increases the efficiency of employment matches, decreasing the skills variation of principals. The final urbanization characteristic, the number of school districts by metropolitan area, is modeled to determine match efficiency through Tiebout competition. Depending on the number of alternatives, residential mobility could give rise to inefficiently administered school districts declining in student population.⁵

The z_i covariates, district student size and percent non-white, are included to capture possible heterogeneity within school districts. Both variables should be positively correlated with the dependent variable. The mean skills level by district is also included as a covariate to account for whether the mean administrator quality the school district seeks also determines skills heterogeneity.

Metropolitan area density, population size and the proportion over age twenty-five with at least a master's are taken from the 1990 US Census. Population density is calculated as total population in the metropolitan area divided by total land area. The 1997 Census of Governments provides data on the number of school districts by county, which were aggregated to the metropolitan area. Among the school district characteristics, the number of students in 1990 (district size) and the percent non-white are taken from the National Center for Education Statistics, which also produced the Schools and Staffing Survey (SASS). Mean teaching experience is calculated by school district only for the principals sampled in this study and comes from the SASS data.

⁵ Hoxby (2000) finds Tiebout competition induces greater education productivity among school districts.

V. Empirical Results

The heterogeneity in principals' skills across geography is evaluated first and is shown in table 1. To illustrate the differences across geographic strata, the sum of squares in years teaching and previous experience is calculated and recalculated after differencing the data along successively narrower levels of geography. The descriptive statistics in table 1 indicate school principals become more homogeneous as the level of geography narrows, although substantial variation remains within school districts. After differencing the data by the state mean, the variation in each skill falls by just under ten percent relative to the level calculated for the undifferenced data. Although minimum qualification standards for principals are set primarily by the states, over ninety percent of the total variation in both skills originates within-state. Mean differences across metropolitan areas account for approximately five percent of the residual variation in the two skills. Further differencing the variables by school district cumulatively decreases variation in teaching experience by nineteen percent and previous principal experience by twenty-two percent. Approximately eighty percent of the total variation in the two skills exists within the school districts, indicating the degree of possible labor mismatch in the market for principals.

Regression models are used to test for the determinants of the skills mismatch. Table 2 presents three models in which the standard deviation in teaching experience within school districts is regressed on metropolitan area and school district characteristics. Models estimating the heterogeneity in previous principal experience were found statistically insignificant and are not shown.⁶ Model I is distinguished from II in table 2 by the covariate measuring district-wide mean teaching experience. Model

⁶ Models estimating composite measures of skills were also insignificant.

III adds state fixed effects. The log-log specification for each model generates point elasticity estimates.

The empirical relationship between the variation in skills and urbanization characteristics is the test for the matching efficiency of urban areas. The results indicate metropolitan area population significantly determines the variation in teaching experience among principals, and the direction of its estimated effect is intuitive. Models I and II indicate that as urban population increases, principals become more homogeneous within school districts. This is consistent with the hypothesis that larger markets increase the chance an employer will find closer labor matches (Wheeler, 2001).

In models I and II, a ten percent increase in population decreases predicted variation in skills by 1.1% to 1.3%. If the actual size distribution of urban areas is considered, the evidence suggests the urbanization effect is substantial. Table 3 illustrates the predicted variation in teaching experience calculated from model I for various urban sizes. A metropolitan area at the 20th percentile in population has an expected skills variation approximately 32% higher than that for an area at the 80th percentile. The efficiency gains with urban size are more pronounced for smaller metropolitan areas. Moving from the 5th percentile to the median population decreases predicted skills variation by 30% - a difference substantially larger than the difference in predicted skills variation between the median and the 95th percentile.⁷ Urban size may largely account for differences over geography in the matching efficiency for school principals.

⁷ Models in which urban population was entered quadratically performed no better than the non-quadratic specifications.

The urbanization effect is insensitive to the inclusion of the mean skills level by school district as an explanatory variable. The positive estimated elasticity for the covariate implies matching efficiency decreases as the average skill level of principals rises.⁸ This effect on skills variation is strong - the comparison of R^2 in models I and II suggests the covariate accounts for over half the explained variation in the dependent variable. The point estimate and standard error of the urban size effect, however, changes very little across the two specifications.

Controlling for school district characteristics helps identify the effect urbanization has on the quality of the final labor matches. The statistically significant effect school district size has on skills variation contrasts intuitively with the effect urban size is found to have. While the scale of the local labor market is hypothesized to decrease skills disparities, school district size, measuring within-district heterogeneity, is hypothesized to increase skills variation. The results indicate larger school districts employ a more heterogeneous set of principals, while larger labor markets induce greater homogeneity. The proportion of students non-white, a more specific indicator of student district heterogeneity, however, is not found to be a significant determinant.⁹

Population density, a second standard measure of urbanization, is found insignificant across models. The proportion of adults with an advanced degree significantly determines the variation in teaching experience but the direction of its effect is counterintuitive. Its positive estimated effect suggests labor match efficiency decreases as the proportion of the urban population with minimum education qualifications

⁸ The estimated elasticity less than one implies the coefficient of variation in teaching experience would be inversely related to the mean skills level by school district. This is confirmed in models (not shown) estimating the coefficient of variation in skills.

⁹ The proportion of the student body in poverty was also tested in the regression models with similar insignificant results.

increases. The variable is a measure of the pool of potential candidates for principal and was expected to increase labor match efficiency. The hypothesis that matching efficiency could be influenced by Tiebout-type competition between school districts is not supported by the data. Results across specifications in table 2 indicate the number of school districts in the metropolitan area does not significantly determine the variation in teaching experience.

Model III controls for state level fixed effects.¹⁰ Public grade schools are financed and regulated primarily at the state level where minimum qualifications for principals are set. The point estimate of the effect population size has on skills variation decreases dramatically in the model although the standard error is largely unchanged; the covariate turns statistically insignificant. The results imply the level of urbanization determines skills variation across school districts but cannot be used to explain, at standard significance levels, strictly within-state variation. The two school district characteristics, student size and mean principal quality, remain significant after controlling for the fixed effects.

VI. Conclusion

This study uses an intuitive implication of the standard labor matching hypothesis to examine the effect urbanization has on matching efficiency. Urbanization is found to foster more efficient labor matches in the market for public school principal. The heterogeneity in teaching experience among school principals is found to decrease with urban size. The effect appears to be large. Although the variation in other skills measures, primarily previous principal experience, could not be explained by urban

¹⁰ The sample for Model III is smaller than in models I or II because those states that had only one school district in the data were taken out.

characteristics, experience through teaching should be for most school districts an important required skill for the job of principal. This paper supports the implications of theoretical work on the relationship between urbanization and labor matching and suggests an alternative empirical methodology in testing for labor matching in urban areas.

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Table 1

Variation in Skills by Level of Geography

	Sum of Squares	Percent Decrease in Variation	Cumulative Decrease
Undifferenced Years of Teaching Experience	80800.06		
Skill Measure Differenced by:			
State	73627.46	0.09	0.09
State-Metropolitan Area	70944.33	0.04	0.12
State-Metropolitan Area-School District	65317.86	0.08	0.19
Undifferenced Years of Previous Principal Experience	52199.28		
Skill Measure Differenced by:			
State	48259.75	0.08	0.08
State-Metropolitan Area	45756.94	0.05	0.12
State-Metropolitan Area-School District	40619.39	0.11	0.22

The unit of observation is the individual principal; the sample size is 1,605. The sample includes those principals within school districts that record at least four within the data.

Table 2

Regression Models for the Determinants
Of Variation in Teaching Experience For Principals

Variable	<i>Model I</i>	<i>Model II</i>	<i>Model III</i>
Constant	0.313 (0.499)	1.496* (0.418)	-1.163* (0.519)
Metropolitan Area Characteristics			
Population	-0.126* (0.047)	-0.113* (0.050)	-0.060 (0.047)
Population Density	0.059 (0.050)	0.065 (0.051)	0.002 (0.045)
Percent Advanced Degree	0.119** (0.061)	0.116** (0.066)	0.058 (0.062)
Number of Districts	0.004 (0.022)	-0.010 (0.023)	0.017 (0.020)
School District Characteristics			
District Size	0.133* (0.039)	0.126* (0.045)	0.102* (0.041)
Percent Nonwhite Students	0.010 (0.028)	0.027 (0.031)	-0.005 (0.027)
Mean Teaching Experience	0.482* (0.106)		0.291* (0.106)
State Fixed Effects			
	No	No	Yes
Observations	197	197	191
R-Square	0.2543	0.1338	0.1223
Adjusted R-Square	0.2267	0.1064	0.0887
F-Statistic	9.21	4.89	3.64

*Significant at the 5% level; ** Significant at 10% level. Standard errors are heteroskedasticity-consistent.

Table 3

Predicted Skills Variation
by Urban Size*

Metropolitan Area Percentile Distribution (Population)	Predicted Variation in Teaching Experience	% Difference from the Predicted Variation at the Median Population
5 th (116,638)	7.71	30.11
20 th (275,257)	6.92	16.77
40 th (684,075)	6.17	4.11
50 th (942,091)	5.93	0
60 th (1,178,410)	5.76	-2.78
80 th (2,463,953)	5.25	-11.41
95 th (5,899,345)	4.70	-20.64

* Skills variation was predicted using the regression Model I, in which all independent variables (except metro area population) were evaluated at their means.

Appendix A

Summary Statistics

	Mean	Standard Deviation
Skills Measures (in years)		
Teaching Experience	14.12	7.10
Principal Experience	3.98	5.70
Standard Deviation in Teaching Experience	6.34	1.85
Metropolitan Area Characteristics		
Population (in 1000's)	1,600.648	2,892.523
Population Density	411.262	408.158
Percent Advanced Degree	7.51	2.72
Number of Districts	38.78	88.24
School District Characteristics		
Number of Students (in 1000's)	55.958	105.569
Percent Nonwhite Students	35.07	27.13
Mean Teaching Experience	13.86	3.18

The teaching and principal experience variables refer to the individual principal data used to create table 1, the remaining variables correspond to the regression model.

Appendix B

Distribution of the Number of Observations of School Principals across School Districts

Number of Principals Observed in School District	Frequency of School Districts
4	61
5	32
6	24
7	14
8	12
9	12
10	5
11	9
12	5
13	4
14	2
15	4
16 to 64	13

The total number of school districts in the data is 197.

The total number of principals is 1,571.