Access to workers and employers: An analysis of the spatial range of sources of agglomeration within urban areas. *

Mark Kutzbach †

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Abstract

I estimate the effect of access to workers and employers on the location of establishment births within urban areas. For a set of industries where place of residence data is available on a relevant, specialized labor force, and where output is sold on a national or international scale, I find that census tracts with better access attract more employment, indicating the presence of economies of agglomeration. This productivity benefit attenuates more rapidly with distance from employers than from workers, indicating that different sources of agglomeration may operate at different scales within cities. I also use census tract to census tract travel time as an alternate measure of access, and find workers requiring greater travel time to commute to a location contribute less to productivity benefits.

JEL Classification:

Keywords: Economies of Agglomeration; Labor Market Pooling; Commuting

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†University of California, Irvine, Department of Economics, 3151 Social Science Plaza, Irvine, CA 92697-5100, USA. E-mail address: kutzbach@uci.edu. Phone number: 773-936-5889.

1 Introduction

Empirical analyses of economies of agglomeration typically assume that establishments within a given area, such as a county or ZIP code, have access to one another and to each others' labor forces, thereby increasing productivity (Glaeser et al., 1992; Henderson et al., 1995; Ellison and Glaeser, 1997). Empirical research on the microfoundations of economies of agglomeration finds that thick labor markets within states, counties, and ZIP codes contribute significantly to industry clustering (Dumais et al., 1997; Rosenthal and Strange, 2001; Ellison et al., 2007; Kolko, 2008). However, economies of agglomeration attenuate rapidly over distance even within urban areas (Rosenthal and Strange, 2003, 2008; Van Soest et al., 2006; Graham, 2007), so access to labor markets may depend on commuting access to workers' places of residence. Metropolitan areas are large enough that commuting costs may limit worker access to some locations, yet ZIP codes are small enough that workers may be available from a sizable surrounding area. The present analysis investigates what ranges of proximity are necessary for an establishment to benefit from access to other establishments and to a potential labor force, and evaluates travel time and distance as measures of proximity.

Marshall (1920) identifies several mechanisms by which thick labor markets contribute to economies of agglomeration.[1] First, labor market pooling allows firms and workers to make better matches.[2] Second, labor market pooling reduces risk for firms of being without a critical type of skilled labor, and for workers, of being without employment.[3]

[1]See Rosenthal and Strange (2004) and Duranton and Puga (2004) for surveys of the literature on the empirical and theoretical microfoundations of economies of agglomeration.

[2]Bleakley and Lin (2007) find that in more dense urban areas, young workers switch jobs more rapidly and older workers switch less rapidly, possibly indicating a matching process whereby young workers rapidly identify superior industry and occupation matches and then stick with them. Fallick et al. (2006) and Freedman (2008) find evidence of high worker mobility in California's concentrated Silicon Valley computer industry. Andersson et al. (2007) estimate production functions using UK data on workers and firms to show that complementarities between worker and firm quality and assortative matching are important sources of the urban productivity premium.

[3]Simon (1988) finds that more specialized cities have higher unemployment rates. Diamond and

Third, a concentration of human capital and skills may improve productivity across firms and industries and play a role in knowledge spillovers.[4]

Analyses of the microfoundations of economies of agglomeration, using a variety of measures and geographic scales, have found an important role for thick labor markets (relative to other factors such as input sharing and natural advantages). One approach (Audretsch and Feldman, 1996; Rosenthal and Strange, 2001) is to estimate the effect of industry characteristics on the relative geographic concentration of industries. These studies find that industries with highly skilled and specialized labor forces are more likely be be geographically concentrated at the ZIP code, county, and state levels. Another approach (Dumais et al., 1997; Ellison et al., 2007; Kolko, 2008) is to estimate the effect of industry pair complementarities on coagglomeration of production among those industries. These studies find that industries with related labor forces (as measured by the occupation designations of workers) are relatively more concentrated at the ZIP code, county, and state levels.

However, these analyses assume that concentration of production and employment is a proxy for concentration of a relevant labor market, an assumption that may not be accurate in large, urban areas, where access to workers may vary depending on distance from workers' residential locations and commuting costs. Numerous studies of urban geography find that job housing balance is highly varied within a typical city.[5] Workers choose a residential location based on different characteristics than firms, and two worker households are constrained from locating optimally for both workers' employ-

Simon (1990) find that firms in more specialized cities must compensate workers for the higher risk of unemployment by offering higher wages.

[4]Rosenthal and Strange (2008) estimate the effect of high skill workers on wages using place of work census data for 2000. They find that proximity to high skill workers increases wages, while accounting for endogeneity of employment density using instrumental variables for the potential density of a location. Bacolod et. al (2008) find that cities concentrate employment of those with cognitive and people skills, generating higher wages for those with such skills.

[5]See Anas et. al (1998) for a survey of the literature on urban spacial structure.

ment locations (Freedman and Kern, 1997). Theoretical analyses suggest that employers must compensate workers for longer commutes (Mills, 1972), and empirical studies find that the urban wage gradient compensates for commuting cost even while controlling for worker characteristics (Timothy and Wheaton, 2001). Thus, new establishments selecting a location must balance economies of agglomeration derived from proximity to other employers and proximity to workers, as well as other location based benefits and costs.

In the present analysis, I estimate the spatial range of economies of agglomeration originating from proximity to employment and proximity to workers. I use microdata on employment aggregated to the census tract level and matched with census tract worker data for California. Following the methodology of Rosenthal and Strange (2003), I regress new establishment employment, for selected industries, on census tract characteristics including base year employment and worker totals within various distance and travel time ranges, as well as Metropolitan Statistical Area fixed effects. I find that both employers and workers contribute to economies of agglomeration, and that the effect of access to employers attenuates more rapidly. This difference in the rate of attenuation may explain why previous analysis, that do not distinguish between access to employers and workers, find that economies of agglomeration attenuate rapidly at first and more gradually thereafter. Furthermore, I find for some industries that workers accessible in less travel time contribute more to economies of agglomeration, suggesting that commuting costs play a distinct role in labor market pooling.

2 Methodology

Compared to methodologies for evaluating the effects of industry characteristics on spatial concentration, analyses of attenuation measure a productivity effect that is the source of agglomeration. Rosenthal and Strange (2003) estimate the effect of geographic charac-

teristics on the location choice of new establishments, as a proxy for productivity effects. I distinguish economies of agglomeration deriving from access to employers and access to workers by adding variables on worker place of residence to the regression specification of Rosenthal and Strange (2003).

In the present analysis, each census tract $j = 1, ..., J$ in a base year has characteristics y_j. New establishments have potential profitability, ϵ. Therefore, variation in characteristics across locations shifts the production function and changes the probability that an establishment is created at that location. New establishment employment at location j in a subsequent year is denoted $NewEmp_j$, and specified

$$NewEmp_j \;=\; \beta y_j \;+\; \gamma_m + \epsilon. \tag{1}$$

With the fixed effects γ_m controlling for the birth potential in metropolitan areas, and β, the coefficient of y_j, reflecting the effect of intra-urban economies of agglomeration.

In the present analysis, I distinguish between four, census tract specific, factors affecting economies of agglomeration. First, I follow Rosenthal and Strange (2003) and include localization effects, described by total own-industry employment within a distance range from a census tract d, specified $EmpLoc_{j,d}$. Second, I include urbanization effects, described by total non-industry employment within a distance range from a census tract d, specified $EmpUrb_{j,d}$. Third, I include the effect of a thick labor market, described by total workers relevant to the specialized needs of an industry, specified $WrkLoc_{j,d}$. Fourth, I include the effect of a thick labor market that may be less relevant to the specialized needs of an industry, specified $WrkUrb_{j,t,d}$. In summary, $y_j \in \{EmpLoc_{j,d}, EmpUrb_{j,d}, WorLoc_{j,d}, WrkLoc_{j,d}\}$, where d includes the ranges of 0 miles (census tract j itself), up 5 miles (excluding census tract j), and 5 to 10 miles.

This specification is written,

$$
\begin{aligned}
EmpNew_j \;=\; & C \\
& + \beta_1 EmpLoc_{j,0} + \beta_2 EmpLoc_{j,5} + \beta_3 EmpLoc_{j,10} \\
& + \beta_4 EmpUrb_{j,0} + \beta_5 EmpUrb_{j,5} + \beta_6 EmpUrb_{j,10} \\
& + \beta_7 WrkLoc_{j,0} + \beta_8 WrkLoc_{j,5} + \beta_9 WrkLoc_{j,10} \\
& + \beta_{10} WrkUrb_{j,0} + \beta_{11} WrkUrb_{j,5} + \beta_{12} WrkUrb_{j,10} \\
& + \gamma_m + \epsilon.
\end{aligned} \tag{2}
$$

One advantage of using new establishment employment as a dependent variable is that new establishments may take base year access to employers and workers as given when making a location choice. Existing establishments may not be able to expand even if they are in a high productivity location, thus, employment expansions may not be representative of productivity benefits. Furthermore, as much as two thirds of employment growth comes from new establishments, rather than the expansion of existing establishments (Neumark et al., 2007). Although this regression model excludes many locational characteristics such as land rent and infrastructure, density levels given by the urbanization effects may encompass some of these effects. One other limitation of the method is that it does not model the location choice of the labor force and of future new establishments. Because these location choice should reinforce economies of agglomeration, the present model may underestimate the full, long-run productivity benefits of access to employers and workers.

3 Data and Variables

3.1 Industries

Analyses of the attenuation of economies of agglomeration typically select a set of industries and separately estimate the effect of locational factors on economies of agglomeration for each industry, with jurisdictions as observations. Some analyses evaluate a diverse set of industries while controlling for various factors that attenuate with distance from each jurisdiction. For example, Graham (2007) uses manufacturing, construction, hotels & catering, transportation, storage & communication, real estate, information technology, banking, finance & insurance, business services, and public services. Van Soest et al. (2006) use consumer services, producer services, and manufacturing. In contrast, Rosenthal and Strange (2003) require that industry output be national or international, so that agglomeration reflects productivity advantages, rather than consumption advantages. They define a narrow set including software, food products, apparel, publishing & printing, fabricated metals, and machinery.

The present analysis combines the criteria of Rosenthal and Strange (2003) with the necessity that industries may be matched with relevant worker data. While employment data is available for detailed industry definitions, as discussed below, worker place-of-residence data is less detailed. I define a relevant labor force to be workers in a specialized occupation class that represents a critical component of the total labor force for an industry. As with analyses of coagglomeration of industry pairs, in which industries with broad overlap in the occupations of their workers tend to locate together, I focus on the occupation of workers, rather than worker industry. While such analyses can make use of national level microdata giving the detailed composition of occupations for an entire industry, census tract level population data is only publicly available at high levels occupational aggregation (at most 33 independent occupations). Nevertheless, some

occupation definitions are somewhat specialized and can be linked to specific industries.

I identify four, narrowly defined industries to match with potential labor forces that would be especially relevant for their productivity. Table 1 lists the proportion of workers in each industry by occupation group. The software publishing and computer programming industries (hereafter referred to as Software) are especially reliant on workers in mathematical and computer occupations; the motion picture and video production industry (Movie), on arts, design, entertainment, sports, and media occupations; the research and development industry (R & D), on life, physical, and social science occupations; and precision instruments industries (Instrument), on architecture and engineering occupations.[6] Employees in other occupations are less unique to each industry, and are thus less likely to drive location choices. For example, all four industries have a similar share of workers in sales and office occupations, such as administrative assistants.

Occupation	Software	Movie	R & D	Instrument
Management	0.18	0.12	0.15	0.15
Business Operations	0.03	0.02	0.03	0.03
Finance	0.02	0.02	0.01	0.02
Computer and Mathematical	0.51	0.02	0.08	0.09
Architecture and Engineering	0.03	0.01	0.12	0.20
Sciences	0.01	0.00	0.31	0.02
Arts	0.04	0.39	0.02	0.02
Other Professional	0.01	0.01	0.05	0.01
Service	0.00	0.11	0.02	0.01
Sales and Office	0.13	0.20	0.15	0.18
Other	0.04	0.10	0.05	0.29

Table 1: Occupational composition of industries in California.

One limitation of this approach is the limited selection of industries, which may limit the applicability of the results. While much of the literature on economies of agglomer-

[6]The industries are defined by NAICS codes as follows: Software includes establishments that design and publish software (511210) or provide custom computer programming services (541511); Movie includes establishments that produce and distribute (not retail businesses) motion pictures and videos (512110); R & D includes establishments specialized in biotechnology, as well as physical, engineering, and life sciences (541710); Instruments include establishments manufacturing measuring and controlling devices for medical, navigational, and other purposes (3345).

ation is focused on manufacturing industries, the highly aggregated occupation class of most workers in those industries, "production" (included with farming and construction as "Other" in Table 1), would make the place of residence of such workers meaningless as a driver of productivity advantages. This list also avoids industries with a large service or retail component, such as banking, consulting, or legal industries, even though workers in finance, business operations specialists, and legal occupations may be identified. However, the list is highly varied in industry sector (information, manufacturing, and professional service) and thus is representative of a wider set of industries.

3.2 Data

I set the base year at 2002, and examine the effect of base year, location characteristics on total employment in 2005, at establishments founded from 2003 to 2005. Setting the base year at 2002 allows for new establishments to locate during a period of overall growth. All observations are at the census tract level.

New establishment employment and base year employment in each census tract are aggregated from the National Establishment Time Series (NETS) for California. Walls & Associates compiles NETS from Dun & Bradstreet establishment level data for the years 1990 to 2007. Among other data, Dun & Bradstreet reports each establishment's address, industry code, and number of employees, as of January of each year. Neumark et al. (2007) compares the California, NETS extract to other employment data sources, such as County Business Patterns, and finds that the database has especially good coverage of small businesses and that employment trends track other aggregated measures. Establishments have a financial incentive to report to Dun & Bradstreet to receive lines-of-credit from suppliers and financial institutions. Dun & Bradstreet also uses independent sources to compile lists of businesses, including nonprofits and the pub-

lic sector. Dun & Bradstreet assigns a unique number to each business to track it from year to year. Thus, the year that establishments are born may be identified.[7] Based on geocoding of addresses, establishments are matched to year 2000 census tracts (courtesy of Neumark). Census tracts are typically smaller than ZIP codes (California has more than 7,000 census tracts and fewer than 2,000 ZIP codes), allowing for a fine level of spatial analysis.

Base year worker counts are from the year 2000 Census, which reports population data, by place of residence, aggregated to the tract level. The census long form, given to 1 in 6 respondents, reports the primary occupation of those 16 or older that are employed, or unemployed for less than 5 years. Long form responses are scaled up to represent the full population.

Table 2 summarizes census tract level data for 7,036 census tracts in California. Total, new establishment employment represents from 5.5 % to 19.5 % of each industry's own employment total. There are about 3 million more total employees than total workers. This discrepancy may be due to some workers holding multiple positions.

3.3 Access

For each census tract, I calculate base year access for three distance ranges. The ranges are defined by the great circle distance between census tract centroids. I include MSA fixed effects for the 10 largest MSAs (or groups of MSAs) in California, each with over 100 Census tracts.

In this model variation in the distribution of employers and workers provides identification. Table 3 evaluates correlations between the variables at different spatial scales. Although there is little correlation at the census tract level ($d = 0$), there is substantially

[7]The database also tracks establishment relocations, which may also respond to productivity advantages but are not studied here.

Industry	Variable	Total (000's)	Mean	Std. Dev.	No. > 0	Max.
Software	New establishment employees	18	2.5	13.7	1870	346
	Own industry employees	257	36.6	243.5	4006	6084
	Other employees	17266	2454.0	5240.4	6990	128123
	Relevant occupation workers	433	61.6	83.2	6097	1275
	Other workers	14192	2017	965.3	6973	11142
Movie	New establishment employees	23	3.3	20.1	3095	1013
	Own industry employees	124	17.6	327.2	2656	19137
	Other employees	17400	2473.0	5330.5	6990	131275
	Relevant occupation workers	399	56.7	76.2	6449	962
	Other workers	14226	2021.9	976.4	6973	11197
R & D	New establishment employees	9	1.2	10.2	1254	637
	Own industry employees	86	12.3	183.5	1717	9873
	Other employees	17437	2478.3	5325.6	6990	131074
	Relevant occupation workers	156	22.2	35.3	5070	915
	Other workers	14469	2056.4	993.3	6973	11340
Instrument	New establishment employees	6	0.9	12.6	302	465
	Own industry employees	108	15.3	144.6	1214	5000
	Other employees	17416	2475.3	5307.3	6990	131191
	Relevant occupation workers	363	51.6	60.3	6195	839
	Other workers	14262	2027.0	974.5	6972	11122

Table 2: Summary Statistics for 7,036 census tracts in California.

more correlation between industry distribution and relevant worker distribution in the range of 5 miles from a census tract, excluding the census tract's own levels ($d = 5$). Correlations for the 5 to 10 mile range ($d = 10$) are similar, but smaller. One rational for the high correlation is that workers and establishments have already coagglomerated in some locations.

	$EmpLoc_{j,0}$			$EmpLoc_{j,5}$		
Industry	$EmpUrb_{j,0}$	$WrkLoc_{j,0}$	$WrkUrb_{j,0}$	$EmpUrb_{j,5}$	$WrkLoc_{j,5}$	$WrkUrb_{j,5}$
Software	0.53	0.23	0.03	0.47	0.84	0.35
Movie	0.10	0.20	0.02	0.45	0.80	0.41
R & D	0.24	0.10	0.010	0.41	0.63	0.31
Instrument	0.44	0.14	0.03	0.29	0.68	0.22

Table 3: Correlation of access variables.

4 Results

For each industry, regressions in Table (4) report economies of localization, based on own industry employment and labor. All regressions include urbanization variables alongside own employment or own labor access variables, as well as MSA fixed effects. The regressions in Table (4) use a Tobit specification of Equation 2, with census tracts having zero or positive new establishment employment. OLS specifications yield similar results.

	Software		Movie		R & D		Instrument	
Variable (000's)	1	2	3	4	5	6	7	8
$EmpLoc_{j,0}$	25.3***	24.4***	19.0***	16.0***	31.1***	30.0***	25.3***	21.6***
$EmpLoc_{j,5}$	0.7***	0.0	1.0***	-0.0	2.3***	0.1	3.5***	0.7
$EmpLoc_{j,10}$	0.5***	0.2*	0.1***	-0.1***	0.4**	-0.5**	2.1**	0.5
$EmpUrb_{j,0}$	1.2***	1.2***	1.2***	1.1***	1.0***	1.0***	2.5***	2.6***
$EmpUrb_{j,5}$	-0.0***	0.0*	-0.0***	-0.0***	-0.0	0.0	-0.0***	-0.0
$EmpUrb_{j,10}$	-0.0***	0.0	-0.0***	0.0	-0.0	0.0	-0.0	-0.0
$WrkLoc_{j,0}$		35.9***		81.5***		58.8***		75.6*
$WrkLoc_{j,5}$		0.7***		1.1***		2.8***		1.4
$WrkLoc_{j,10}$		0.1		0.4***		0.9***		1.6*
$WrkUrb_{j,0}$		3.6***		3.2***		2.0***		2.0
$WrkUrb_{j,5}$		0.1***		-0.0***		-0.0***		-0.1*
$WrkUrb_{j,10}$		-0.0		-0.0**		-0.0		-0.0

Note: Includes constant term and MSA fixed effects for the 10 largest urban areas in California.
J = 7,036 census tracts.
* Significant at 10 % level.
** Significant at 5 % level.
*** Significant at 1 % level.

Table 4: Regression (Tobit) of new establishment employment on base year census tract access to employers and workers.

First note that in regressions with only employment characteristics (odd numbered columns), economies of localization and urbanization tend to diminish with distance (Rosenthal and Strange, 2003). Census tract economies of localization are also positive and significant for all industries, suggesting that immediate proximity is especially important for agglomeration in these industries. Economies of localization from surrounding Census tracts are positive and significant, but decline with distance. An additional 1000 Movie industry employees in a census tract would induce new establishments to create 19

Movie industry jobs there. In census tracts within 5 miles, the same number of employees would only induce 1 Movie industry job.

For all industries, urbanization of a census tract has a positive and significant effect on new establishment employment. This effect may differentiate census tracts which are largely residential from those that have significant commercial or industrial real estate. However, urbanization in nearby census tracts actually reduces new establishment employment, possibly indicating a high price of commercial real estate in that area.

In regressions that include variables for access to workers (even numbered columns), both own industry employment and relevant workers contribute to economies of agglomeration. Economies of localization within a Census tract fall in all industries, but remain significant. In contrast, economies of localization decline by a large magnitude for the 5 mile and 5 to 10 mile ranges in almost every industry. This result suggests that some of the economies of agglomeration attributed to employment density may actually derive from proximity to a potential labor force. It is surprising that workers within a census tract contribute so much more to establishment births than workers 5 miles away. One explanation would be that workers in some of these innovative industries start small businesses from their homes. Results are similar across the industries, except that Instruments industries do not benefit as significantly from access to workers. This result may be due to the wide variety of specializations within Architecture and Engineering occupations.

5 Conclusion

In conclusion, this analysis estimates the effect of access to employers and workers on new establishment employment growth and finds that proximity to a labor force contributes to economies of agglomeration and that productivity benefits from access to a labor force

attenuate more gradually than do benefits from proximity to employers. One implication of these results, is that establishments should gradually cluster in an area of a city with good access to where a relevant labor force resides. Such clustering would benefit both workers and businesses. In the industries examined, access to existing employment is more highly correlated with the residential location of relevant workers than with workers overall.

This draft does not include the evaluation of the effect of travel time as a measure of access. Regressions including this measure partition the distance ranges into sets of census tracts accessible within 20 minutes and those not accessible in 20 minutes. The result is that workers accessible within a shorter travel time contribute more to economies of agglomeration.

Future work on this topic could make greater use of the year to year tracking of establishments in the data set. One reason for the persistence of economies of agglomeration within small areas may be that new establishments simply occupy the vacated facilities, and hire the workers of establishments that have closed. Examining the correspondence of establishment deaths and births would help to explain this persistence.

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