Urban Productivity Advantages from Job Search and Matching*

BY JEFFREY LIN

Densely populated areas tend to be more productive. Of course, the cost of living and producing in these locations is higher because congestion raises the cost of scarce fixed resources such as land. But despite the higher prices, many people and businesses continue to live and work in these areas. Why? One explanation is that these locations have natural advantages, such as proximity to a river. Another says that this concentration of households and businesses by itself generates productivity advantages in the form of agglomeration economies. In studying these agglomeration economies, economists have pursued two other questions. Do agglomeration economies exist and how big are they? And what are the precise sources of these agglomeration economies? In this article, Jeffrey Lin describes the evidence for agglomeration economies from job search and matching and then asks whether it may be large enough to offer meaningful explanations for differences in productivity and density.

Why do people in densely populated areas tend to be more productive? In countries like the U.S., places dense in workers, machines, firms, and households also tend to be places where people are able to produce more things. Of course, these places are also usually more expensive to produce in and to live in because congestion raises the price of scarce fixed resources such as land. Despite these high prices, many businesses and people continue to choose these locations.

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A typical first explanation is that these densely populated areas enjoy intrinsic natural advantages, such as Philadelphia's proximity to a navigable waterway and a relatively deep harbor. Advantages like these can reduce the costs of shipping and the price of traded goods, attracting both businesses and households. This story can often be compelling, even though, today, many people in the Philadelphia region do not experience direct benefits from the Delaware River. An intriguing alternative explanation is that bringing together workers, businesses, and households can, by itself, generate these productivity advantages. These kinds of advantages are often called agglomeration economies, and they describe situations in which geographic concentrations of economic activity allow businesses and households to save on the costs of transporting people, materials, and ideas.

Urban economists have pursued two related research questions. First, do these agglomeration economies exist, and, if so, how big are they? Second, what are the precise sources of these agglomeration economies?

Many researchers have already discovered evidence that these agglomeration economies do exist and that they are big enough to offer meaningful explanations of present-day differences in productivity and density. For example, in an attempt to answer the first question, economists Antonio Ciccone and Robert Hall, using data for U.S. states, found that a doubling of employment density increased average labor productivity by about 6 percent. Although other studies have provided different estimates of the exact mag-

nitude of this effect, many have noted that agglomeration economies make an important contribution to differences in productivity across locations.[1] In addition, research by Satyajit Chatterjee (discussed in his 2003 *Business Review* article) also suggests that agglomeration economies play some explanatory role in these differences, even after accounting for natural advantages.

For both academic and policy reasons, an important next step is to investigate the specific *sources* of agglomeration economies. In this article, I will discuss some of my recent research on one potential source: opportunities to better match workers' skills to job requirements. Dense urban areas have thick labor markets —– that is, markets with many different kinds of workers and jobs —– and might therefore benefit from improved job search and matching. This idea — that markets with more participants can offer better matches — is typically attributed to Alfred Marshall, and the idea was formalized in economist Peter Diamond's "coconut" model. (If consumers have tastes for a particular variety of "coconut," they are more likely to find the one they prefer in a large market where more types of coconuts are sold.) Intuitively, we know that workers have varying skills and jobs have varying skill requirements. From the perspective of a worker, searching for a suitable job may be easier in a large city with many potential employers. Put another way, workers in large cities may find a job that is better matched to their talents, for the same search costs. This is a potential source of agglomeration economies; geographic concentration increases productivity because workers need not let their acquired skills lapse by taking less-suitable jobs.

It is important to note that, in theory, there are a number of different sources of agglomeration economies. In a 2005 *Business Review* article, Jerry Carlino discusses a few of the many possible economic mechanisms responsible for agglomeration economies. His 2001 *Business Review* article talks about one possible mechanism — knowledge spillovers — related to the increased production and flow of (new) ideas and information in dense cities. In a later *Business Review* article (2009), he describes his paper in which he evaluates another potential mechanism: Urban population density may increase the amount and variety of goods and services available for households to consume. As another example, I show evidence for yet another mechanism in a recent working paper: Geographic concentrations of skilled workers and potential users of new products or processes can increase the rate of adaptation to new technologies. In general, as explained by Gilles Duranton and Diego Puga, agglomeration economies might arise from mechanisms related to sharing, learning, or matching. Sharing refers to advantages that arise from distributing the costs of large indivisible investments across many producers or consumers, as might be the case with a large factory or consumption amenities, as in Carlino's article. Learning refers to advantages in either the creation of new technologies, as described by Jane Jacobs; the formation of human capital, as described by Edward Glaeser and David Maré; or adaptation to new technologies, as in my working paper.

In order to evaluate alternative proposals, policymakers concerned with city growth, the productivity of local workers, or the welfare of local residents need to understand the specific economic forces that generate productivity advantages and attract businesses and households to certain places. Should local leaders sponsor arts and cultural programs or invest in transportation infrastructure? What kinds of businesses should cities be interested in attracting? The answer to these questions depends on the relative strength of different kinds of agglomeration economies. In other words, for both intellectual and practical reasons, it is useful to know what is happening inside the "black box" of agglomeration economies.

However, finding evidence that distinguishes one kind of agglomeration economy from another can be challenging. Different mechanisms often have similar predictions for aggregate city-level data. For example, most (if not all) kinds of agglomeration economies predict higher wages and higher land prices in denser cities.

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[1] See the paper by Gerald Carlino and Richard Voith; the recent working paper by Morris Davis, Jonas Fisher, and Toni Whited; and the 2004 article by Stuart Rosenthal and William Strange.

(These facts are in line with conventional wisdom and easily confirmed using aggregate census data.) Therefore, looking inside the "black box" of agglomeration economies often requires creative research strategies. Recent work in this area, including my own, has been made possible by the increasing availability of large data sets that contain detailed information at the plant, household, or worker level. Using micro-data, it is sometimes possible to test predictions that are unique to one kind of agglomeration economy and not associated with another kind. In this way, it becomes possible to highlight variables that should be of interest to policymakers.

I will describe the evidence for agglomeration economies from job search and matching using just such a strategy. An important caveat is that the research strategy described here does not rule out other sources of agglomeration economies. Instead, I evaluate whether there is evidence for this source of agglomeration economies and then ask whether it may be large enough to offer meaningful explanations for differences in productivity and density.

JOB SEARCH AND MATCHING IN CITIES

In my recent working paper with Hoyt Bleakley, we test for agglomeration economies from job search and matching. The intuition for our test is as follows. Consider a worker in a small city who loses her job. She has some specialized skills (either innate or gained through experience) suited to the activities she performed or the output she produced in her previous job. If the separation from her previous job is permanent, the worker now faces a choice: She could wait a long time before finding employment performing similar tasks but at a different firm. Or, because waiting is costly, it may make more sense to accept a job elsewhere in the local economy that is less suited to her unique skill set. (Alternatively, she might choose to move to a location where there is greater demand for her skills, but of course, moving is also costly.) Since her skills are less suited to this job, some of her skills go unused, and she may be less productive.

This worker, in a small city, faces a "small numbers" problem: She happens to be without a job, but does there happen to be another firm that needs a worker with her skill set? On the other hand, workers in dense cities benefit from market thickness: They are less likely to be in a narrow labor market at a moment in which their skills are in excess supply. This potential source of agglomeration economies yields an interesting, and potentially unique, prediction: Workers should choose to eschew their specialized skills *less frequently* in large, dense cities, where they are more likely to find job openings suited to their talents.

We evaluate this prediction by examining the likelihood that workers change *occupations* or *industries*. These job classifications, characterizing either the tasks or activities performed or the kinds of output produced, have been used in a number of labor-market studies on specific human capital.[2] We expect that in the presence of agglomeration economies from job search and matching, workers should choose to change occupations and industries less frequently in denser labor markets.

Further, this agglomeration economy should also affect workers' early decisions about skill specialization. In separate studies, economists Kevin Murphy and Sunwoong Kim have proposed how density might change the market for specialized skills. In Kim's model, sparsely populated areas have fewer firms in each sector, and therefore, a worker might have invested less in narrow skills because she anticipated that there would be fewer potential employers in the event of a separation.[3] Therefore, in large cities, workers choose to invest more in specialized skills, making it even less likely that they would want to change occupations or industries in dense cities and compounding density's effect on productivity.[4]

Using data from the decennial U.S. census and the monthly Current Population Survey (CPS), Bleakley and I confirm this prediction. We find that workers are less likely to change occupation or industry in metropolitan areas with high population density (Figure 1). The data are at the worker level, and the key outcome of interest is a change in each worker's reported occupation or industry.[5] Respondents to the 1970 census reported these changes for 1965 and 1970. The CPS samples in the 1990s and 2000s reported these changes for individual workers, both for the year of the survey and up to three years earlier. The key explanatory variable is local population density, measured for each worker's metropolitan area of residence. Figure 1 summarizes our main result. Here, each point represents a metropolitan

[2] For example, see the study by Derek Neal and the one by Daniel Parent on industry-specific skills; see Gueorgui Kambourov and Iourii Manovskii's recent paper on occupation-specific skills.

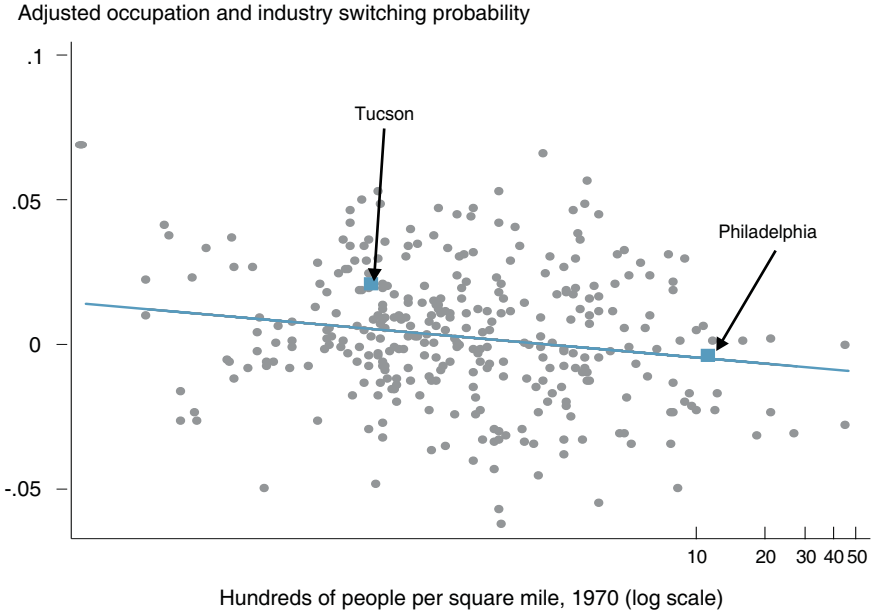
[3] Alternatively, workers in small cities with specialized skills might choose to move to denser cities.

[4] For example, James Baumgardner found that doctors are more specialized in big cities; similarly, Luis Garicano and Thomas Hubbard found more specialization among lawyers in larger markets.

[5] We obtain similar results whether our outcome of interest measures a change in each worker's reported occupation, a change in reported industry, or a change in either reported occupation or reported industry.

FIGURE 1

Occupation and Industry Switching and Local Population Density



Source: Author's calculations and the 1970 U.S. census

area or a group of co-terminous counties in 1970, and population density is measured on the horizontal axis. The vertical axis measures the probability that a worker in each location changed either occupation or industry between 1965 and 1970. The fitted line shows that workers in locations with higher population densities are less likely to switch occupations or industries. Further, the magnitude of this thick-market effect is large enough to be relevant in understanding differences across locations. For example, a change in density from, say, Tucson, Arizona, to Philadelphia, is associated, on average, with a decrease of 1 percent in occupation or industry switching over a five-year period.

This negative correlation between switching and local population density supports the existence of agglomeration economies in job search and matching. But we also rule out other important alternative explanations. For example, we compare similar workers by controlling for characteristics such as gender, age, race, ethnicity, and educational attainment, and whether or not they have moved recently. We also control for fixed characteristics of a worker's previous occupation and industry, so that our comparison is among workers sharing the same initial occupation and industry. Jobs in different occupations and industries may require different levels of specialized skills. If we control for previous occupation and industry, the results do not simply reflect differences in the composition of occupation or industry across cities. The graph in Figure 1 already controls for all of these effects.

Metropolitan areas are also different along a lot of other dimensions. We control for other characteristics of cities, such as industry composition (e.g., the relative size of the manufacturing sector), average educational attainment, and climate, with little impact on our main result. There is an additional issue of potential measurement error associated with using metropolitan-area-level population density. Since metropolitan areas are based on county boundaries, we are more likely to mis-measure local density in western states that feature relatively large counties. For example, the Los Angeles metropolitan area includes counties that stretch to the Arizona and Nevada borders, including desert lands that are sparsely populated. Our results are similar when we adjust our density measure using census tract data.

Another story to consider is that changing jobs or employers by workers (as opposed to changing occupation or industry) may also depend on the size of the local labor market. Other studies have found mixed evidence of density's effect on job switching.[6] One way we can check to see how this might affect our results is to use information available in the U.S. CPS supplements. This is the survey conducted every month to estimate important statistics such as the unemployment rate. In addition, the CPS also periodically includes supplemental questions of interest to researchers or policymakers. In January and February, these supplements usually include questions related to job changing. In these supplements, the CPS reports workers' reasons for changing jobs; many lost their jobs because their plant or firm closed. Thus, increased opportunities due to population density probably did not cause them to change jobs, since they lost their jobs involuntarily. These workers also change occupation or industry less frequently in larger cities, so job

[6] See the papers by Bruce Fallick, Charles Fleischman, and James Rebitzer; Jeffrey Groen; Guido de Blasio and Sabrina Di Addario; and Jeremy Fox for conflicting evidence on this question.

changing is probably not an important explanation of our main result.

Some workers may have innate specialized skills and may also "sort" themselves into large metropolitan areas. The fact that they have innate specialized skills implies that they may choose to switch occupations or industries less frequently. However, in this story, these workers choose to live in large labor markets for reasons other than improved opportunities for job search and matching. For example, they may be interested in the consumption amenities available in such cities. If this is an important explanation for our main result, workers whose location choice is not influenced by such considerations should not experience a similar pattern relating density to occupation or industry switching. In fact, using information on workers' places of birth, we find that our results are similar for those workers whose choice of location was influenced by the state in which they were born. Taking all of these pieces of evidence together, we argue that agglomeration economies from job search and matching are the likeliest explanation for our results.

YOUNGER WORKERS

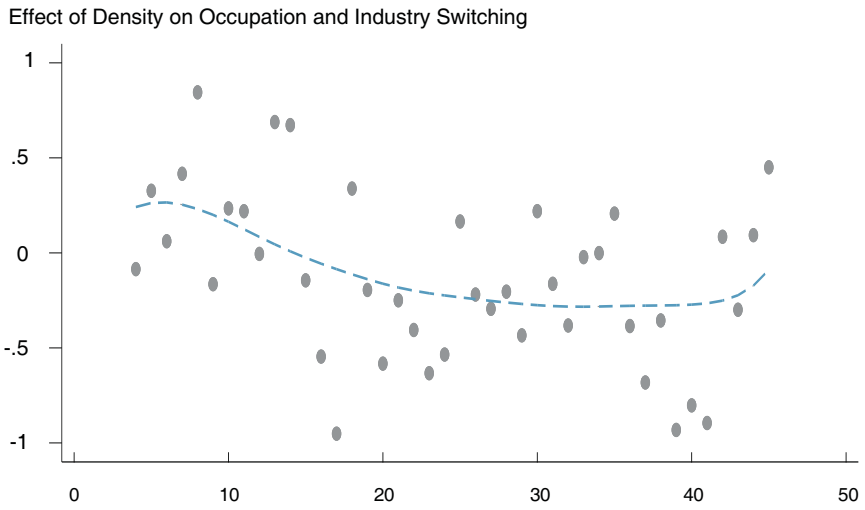
An additional piece of evidence weighs in favor of agglomeration economies from job search and matching. If job searching is less costly in large cities, we can make another interesting prediction: People may find it easier to shop around for a good occupation or industry match in a dense city. Of course, it makes sense to do this for younger workers who are just starting their careers: They have fewer specialized skills accumulated, and they have the rest of their careers to gain from great matches. In contrast, older workers have spent many more years accumulating specialized skills: Instead of sampling different occupations, these workers choose jobs more closely matched to their existing skills.

Following this logic, the correlation between changing occupation and industry and population density may depend on workers' potential experience. (Potential experience measures how long workers have potentially been in the labor market: their age, minus the number of years they spent in school, minus six, the number of years between birth and school.) We find that this is indeed the case. Figure 2 shows the effect of density on occupation and industry switching for different levels of potential labor market experience.

For young workers with less than 10 years of potential experience, being in a large city actually increases the likelihood that they will change occupations or industries. (In Figure 2, this can be seen in the positive estimated effect of density on occupation and industry switching.) In contrast, for older workers, density lowers the likelihood of such changes. (On average, the effect due to older workers dominates the overall effect seen in Figure 1, since older workers constitute much of the total workforce.) This positive effect of density on switching early in workers' careers provides further support for the thick-market matching hypothesis, but it is harder to reconcile with other stories of how density might affect occupation and industry switching. If there are benefits from matching in dense cities, workers could take advantage of low search costs to search more intensively for the right occupation or industry match. This occupation and industry shopping could potentially be greater than the negative effect of density on switching shown in the previous section (and thus be, on net, positive). However, since search intensity is like an investment whose gains are realized throughout the working lifetime, this new, positive effect should be strongest at younger ages. Compare this with a story in

FIGURE 2

Effect of Density on Occupation and Industry Switching Depends on Potential Experience



Source: Author's calculations and the 1970 U.S. census

which workers in dense cities are more specialized for some other reason (not better job search and matching), such as faster learning or greater returns to specialization because of improved opportunities for the division of labor. If there are no differences in search costs across cities, it is unlikely that we would observe more occupation and industry switching in dense cities among the youngest workers.

POTENTIAL IMPLICATIONS FOR PRODUCTIVITY AND WAGES

Finally, our estimated differences in occupation and industry switching could be large enough to offer meaningful explanations of differences in productivity. We can get a feel for what our estimates might mean for the relationship between density and wages by doing some quick calculations. First, in small cities, specialized skills fall into disuse faster, as workers churn through more occupations and industries. There are earlier estimates by Derek Neal (1995) and Daniel Parent (2000) on how much of a worker's wage is due to industry-specific skills. Neal estimates that 10 percent of income is derived from industry-specific skills for men with 10 years of experience; Parent estimates that 10 to 20 percent of workers' income is derived from industry-specific skills. To span the range of likely possibilities, say that the fraction is somewhere between 5 and 25 percent. We multiply this by our own estimates of density-driven differences in industry switching — approximately 0.6 percent measured over a five-year horizon or about 4.8 percent over a 40-year career. These calculations suggest that, over 40 years, a doubling of labor market density implies somewhere between 0.2 percent and 1.2 percent higher wage growth through this mechanism. In comparison, the extra growth in wages in dense areas, in the same units, is about 2 percent over 40 years.

Second, in small cities, workers might be less inclined to invest in specialized skills. Note that the previous calculation does not account for differences in behavior that might result from expectations about the usefulness of specialized skills in big cities. Calculating the potential effect on wages is difficult, since it depends on how costly it is to acquire specialized skills and how quickly those skills fall into disuse, even without changing occupation or industry. In our related working paper, we find that, for reasonable values of these variables, this mechanism can explain nearly all of the observed differences in productivity levels across locations. To sum up, our back-of-the-envelope calculations suggest that the relationship between density and occupation and industry switching can account for most of the differences across cities in workers' income growth and nearly all of the differences in income levels.

> Overall, workers in metropolitan areas with lower population density tend to be more likely to change occupations.

PHILADELPHIA AND THE THIRD FEDERAL RESERVE DISTRICT

These differences in occupation changing can be seen even among the handful of metropolitan areas within the Third District. The Table displays population density, taken from recent U.S. Census Bureau estimates, and occupation switching in Third District and selected nearby metropolitan areas, calculated using recent samples from the CPS. Overall, workers in metropolitan areas with lower population density tend to be more likely to change occupations. (Of course, these are raw numbers, without some of the controls for other factors that vary across cities used in creating Figure 1.) For example, in our District, the Altoona, Vineland–Millville–Bridgeton, and Johnstown metropolitan areas have the highest average occupation-changing rates and also relatively low population densities. In contrast, the Trenton–Ewing metropolitan area has both the lowest rate of occupation changing and the highest population density of any metropolitan area in the Third District. Even within our region, some of the differences in density and productivity seem to be related to differences in the accumulation and preservation of specialized skills.

CONCLUSION

In this article, I have discussed new evidence for one potential source of agglomeration economies: better job search and matching. The broader agenda for this kind of work is to provide support for appropriate local policy choices. If urban productivity advantages are due mostly to job matching advantages, that may suggest that local development strategies that don't take advantage of these thick-market effects may not be effective. An important caution is that policy effects are likely to be small relative to the magnitudes needed for noticeable changes in local productivity. This can be seen in the persistence of city characteristics: Places that are densely populated or that have highly educated workforces also had similar characteristics in decades or even centuries past.

Finally, an important further step is to understand the relative importance of different sources of agglom-

TABLE

Occupation Switching in Third District Metropolitan Areas, 2005-2009

	Persons per square mile, 2007	Percent of workers switching occupations last year, 2005-2009 average
Third District Metropolitan Areas		
Trenton-Ewing, NJ	1,617.5	6.4
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	1,258.8	10.9
Allentown-Bethlehem-Easton, PA-NJ	550.8	10.4
Atlantic City, NJ	482.4	8.8
Reading, PA	468.0	9.6
Harrisburg-Carlisle, PA	324.7	13.9
Vineland-Millville-Bridgeton, NJ	317.9	14.6
Scranton-Wilkes-Barre, PA	314.6	11.4
Lancaster, PA	267.4	8.7
Dover, DE	258.2	10.0
Altoona, PA	238.7	15.4
Johnstown, PA	210.7	14.3
Metropolitan Areas Outside the Third District		
New York-Northern New Jersey Long Island, NY-NJ-PA	2,797.6	10.1
Boston-Cambridge-Quincy, MA-NH	1,278.3	10.3
Cleveland-Elyria-Mentor, OH	1,045.9	9.1
Baltimore-Towson, MD	1,022.6	9.7
Washington-Arlington-Alexandria, DC-VA-MD-WV	943.0	10.5
Cincinnati-Middletown, OH-KY-IN	485.1	11.1
Pittsburgh, PA	446.2	12.7

Source: Author's calculations, U.S. Census Bureau, and the 2005-09 Current Population

eration economies. Stuart Rosenthal and William Strange, in their 2001 study, and Glenn Ellison, Edward Glaeser, and William Kerr have some intriguing early results in this area. Using industry locations as observations, Rosenthal and Strange compare a measure of spatial concentration with industry-location characteristics that proxy for the presence of knowledge spillovers, input sharing, natural advantages, and other types of agglomeration economies. Their results indicate that industry concentrations are correlated with a number of these measures, in particular, measures related to labor market concentration. Ellison, Glaeser, and Kerr adopt a similar methodology but use industry pairs as the unit of observation. Their results suggest that linkages between industries are an important reason for co-location patterns. Despite these early efforts, much remains unknown about this important question. One of the priorities for future work should be to assess the relative importance of different mechanisms.

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