2003

Agglomeration, Labor Supply, and the Urban Rat Race

Stuart S. Rosenthal
Syracuse University. Center for Policy Research, ssrosent@maxwell.syr.edu

William C. Strange
University of Toronto, Rotman School of Management

ISSN: 1525-3066

Center for Policy Research
Working Paper No. 57

AGGLOMERATION, LABOR SUPPLY, AND THE URBAN RAT RACE

Stuart Rosenthal and William C. Strange

Center for Policy Research
Maxwell School of Citizenship and Public Affairs
Syracuse University
426 Eggers Hall
Syracuse, New York 13244-1020
(315) 443-3114 | Fax (315) 443-1081
e-mail: ctrpol@syr.edu

September 2003

$5.00

CENTER FOR POLICY RESEARCH – Fall 2003

Timothy Smeeding, Director
Professor of Economics & Public Administration

Associate Directors

Margaret Austin
Associate Director,
Budget and Administration

Douglas Holtz-Eakin
Professor of Economics
Associate Director, Center for Policy Research

Douglas Wolf
Professor of Public Administration
Associate Director, Aging Studies Program

John Yinger
Professor of Economics and Public Administration
Associate Director, Metropolitan Studies Program

SENIOR RESEARCH ASSOCIATES

Dan Black ..... Economics
Stacy Dickert-Conlin ..... Economics
William Duncombe ..... Public Administration
Gary Engelhardt ..... Economics
Deborah Freund ..... Public Administration
Madonna Harrington Meyer ..... Sociology
Christine Himes ..... Sociology
William C. Horrace ..... Economics
Bernard Jump ..... Public Administration
Duke Kao ..... Economics
Eric Kingson ..... Social Work
Thomas Kniesner ..... Economics
Jeff Kubik ..... Economics
Andrew London ..... Sociology
Len Lopoo ..... Public Administration
Jerry Miner ..... Economics
John Moran ..... Economics
Jan Ondrich ..... Economics
John Palmer ..... Public Administration
Lori Ploutz-Snyder .. Health and Physical Education
Jeff Racine ..... Economics
Grant Reeher ..... Political Science
Stuart Rosenthal ..... Economics
Ross Rubinstein ..... Public Administration
Michael Wasylenko ..... Economics
Janet Wilmoth ..... Sociology

GRADUATE ASSOCIATES

Anna Amirkhanyan ..... Public Administration
Beth Ashby ..... Economics
Dana Balter ..... Public Administration
Gabby Chapman ..... Economics
Yong Chen ..... Economics
Christopher Cunningham ..... Economics
Ana Dammert ..... Economics
Tae Ho Eom ..... Public Administration
Val Episcopo ..... Sociology
Mike Eriksen ..... Economics
Kate Farrar ..... Public Administration
Garey Fuqua ..... Public Administration
Jose Galdo ..... Economics
Andrzej Grodner ..... Economics
Glenda Gross ..... Sociology
Anil Kumar ..... Economics
Kristina Lambright ..... Public Administration
Xiaoli Liang ..... Economics
Liqun Liu ..... Economics
Joseph Marchand ..... Economics
Cristian Meghea ..... Economics
Desmond Nation ..... Public Administration
Emily Pas ..... Economics
Seth Richards ..... Public Administration
Cynthia Searcy ..... Public Administration
Claudia Smith ..... Economics
Sara Smits ..... Sociology
Adriano Udani ..... Public Administration
Wen Wang ..... Public Administration
Bo Zhao ..... Economics
Na Zhao ..... Sociology

STAFF

Kelly Bogart ..... Administrative Secretary
Martha Bonney ..... Publications/Events Coordinator
Karen Cimilluca ..... Librarian/Office Coordinator
Kim Desmond ..... Administrative Secretary
Kati Foley ..... Administrative Assistant, LIS
Kitty Nasto ..... Administrative Secretary
Candi Patterson ..... Computer Consultant
Mary Santy ..... Administrative Secretary
Mindy Tanner ..... Admin. Secretary/Receptionist

Agglomeration, Labor Supply, and the Urban Rat Race

Stuart S. Rosenthal
Department of Economics
Syracuse University
Syracuse, NY 13244-1020
USA
Phone: (315) 443-3809
ssrosent@maxwell.syr.edu
www-cpr.maxwell.syr.edu/faculty/rosenthal/

and

William C. Strange
RioCan Real Estate Investment Trust
Professor of Real Estate and Urban Economics
Rotman School of Management
University of Toronto
105 St. George Street
Toronto, ON M5S 3E6
Canada
Phone: (416) 978-1949
wstrange@rotman.utoronto.ca
www.rotman.utoronto.ca/~wstrange/

September 26, 2003

*We gratefully acknowledge the financial support of the Center for Policy Research at Syracuse University, the Connaught Fund at the University of Toronto, and the Social Sciences and Humanities Research Council of Canada. We are also grateful to Dan Black, Jan Brueckner, Dennis Epple, Kevin Lang, Rob McMillan, Philip Oreopoulos, and Jim Rebitzer for their helpful comments. For their suggestions, we also thank seminar participants at the New York Federal Reserve Bank, University of California-Berkeley, Michigan State University, the University of Toronto, Case Western Reserve, the CEPR Conference, "The Economics of Cities," at LSE, and the NBER. Any errors are ours alone. Excellent research assistance has been provided by Jerry Kalarickal.

Abstract

This paper establishes the existence of a previously overlooked relationship between agglomeration and hours worked. Among non-professionals, hours worked decrease with the density of workers in the same occupation. Among professionals, a positive relationship is found. This relationship is twice as strong for the young as for the middle-aged. Moreover, young professional hours worked are shown to be especially sensitive to the presence of rivals. We show that these patterns are consistent with the selection of hard workers into cities and the high productivity of agglomerated labor. The behavior of young professionals is also consistent with the presence of keen rivalry in larger markets, a kind of urban rat race. This evidence of a rat race is nearly unique in the literature.

I. Introduction

" [In New York] [e]very man seems to feel that he has got the duties of two lifetimes to accomplish in one, and so he rushes, rushes, rushes, and never has time to be companionable - never has any time at his disposal to fool away on matters which do not involve dollars and duty and business." Mark Twain, Letter to Alta California, 11 August 1867.

"*The twelve labors of Hercules were trifling in comparison with those which my neighbors have undertaken; for they were only twelve, and had an end; but I could never see that these men slew or captured any monster or finished any labor*" Henry David Thoreau, Walden, Chapter 1: Economy (1854).

It is not a new idea that cities are busy places, as the quotes from Twain and Thoreau show. It is also not an idea without current relevance. If anything, modern life is more hurried than was life in the Nineteenth Century. For instance, a recent ABC News Poll found that 26% of Americans believed they worked too hard.[1] Despite this, the connection between spatial concentration and the intensity of work has for the most part escaped attention in both labor and urban economics. In the literature on labor supply (see Pencavel (1986) for a survey), there has been almost no attention paid to agglomeration.[2] In the literature on agglomeration economies, the focus has been on labor productivity and growth rather than on hours worked.[3]

This paper considers the relationship between agglomeration and hours worked. It makes three contributions. First, it shows that there is a consistent relationship between agglomeration and the intensity of work. Second, it establishes that the impact of agglomeration varies across the labor market, with important differences between young and middle-aged workers and

[1]The same poll finds overwork to be a cause of mistakes at work and of health problems. In a similar vein, Schor (1991) uses CPS data on reported work hours to conclude that leisure has declined since the late 1960s. In contrast, Robinson and Bostrom (1994) use time diaries, concluding that leisure has increased.

[2]The only exceptions have been the inclusion of metropolitan area population or urban dummies.

[3]See Rosenthal and Strange (2003b) for an empirical survey or Fujita and Thisse (2001) for theory. Glaeser et al (1992), Henderson et al (1995), and Ciccone and Hall (1996) are important empirical contributions.

between professionals and non-professionals. The paper's third contribution is to test for various explanations of the agglomeration-hours worked pattern that appears in the data.

We begin with an illustration. Using data from the 5% Integrated Public Use Microdata Series (IPUMS), Table 1 reports average hours worked by full-time male employees for the three largest cities and three much smaller nearby cities located beyond typical commuting distance (respectively, New York, Chicago, Los Angeles and Hartford, Milwaukee, Sacramento).[4] The data are partitioned into young men in their 30's and middle aged men in their 40's, and also into professionals and non-professionals.[5] The table documents a clear relationship between hours worked and agglomeration. For non-professionals, average hours worked are similar for the two groups of cities and for each age class. In contrast, professionals work roughly 1 hour longer in the larger cities. Moreover the difference in hours worked is greater among the young than the middle-aged. This pattern also is apparent among male lawyers and judges, a profession famous for its long hours worked (Landers et al (1996)). Young lawyers, for example, worked roughly 2 hours longer in the bigger cities on average, 50.05 versus 47.71. In contrast, among middle-aged male lawyers there is little difference in average hours worked. Taken as a whole, Table 1 suggests that there is a positive relationship between agglomeration and hours worked for professionals, but not for non-professionals. This evidence of work behavior differing between professionals and non-professionals echoes Colemen and Pencavel (1993a and b), who report

[4]Full-time is defined as those working at least 35 hours per week. Summary measures based on a cut-off of 40 hours per week are similar, with the average hours worked slightly higher for each category as would be expected. We also conducted all of the analysis in this paper separately for female workers. Results were similar although somewhat weaker, and are not reported to conserve space.

[5]Professionals are defined as individuals in Census occupations in the Professional-Technical group who also have a Masters degree or higher. Non-professionals are defined as individuals in all other occupations except managers and agricultural workers who also have less than a college degree. Person sampling weights available in the IPUMs (perwt) were used to ensure that the estimates in Table 1 are representative.

that hours worked has increased over time among educated workers in the U.S., while hours worked have fallen among less educated workers.

What forces might be responsible for this pattern? One is that big city workers may choose longer hours because their work is more productive and therefore better rewarded. Another is that hard workers may be drawn to large cities. A third explanation is that there is more rivalry in large markets, leading workers to choose long hours as a way to signal ability. We characterize this as an "urban rat race". Finally, it is also possible that adding workers to a local labor market could reduce individual hours worked as the total workload is spread over a larger number of individuals. These forces yield different predictions about the agglomeration-hours worked relationship.

We test for the presence of these forces using full-time workers from the 1990 5% IPUMS of the Decennial Census. Among non-professionals, increased spatial concentration of workers in the individual's occupation is associated with fewer hours worked, consistent with work spreading. The opposite is true for professional workers of all ages. Among these workers, hours increase with the density of employment in the worker's occupation and location, consistent with the presence of selection and productivity effects. Moreover, the latter effect is twice as large for young professionals as for middle-aged professionals.

To investigate these patterns further, we augment the professional models with controls for local labor market rivals and the financial rewards to advancement. When the rewards to getting ahead are zero, the presence of rivals has a negative effect on hours worked for both young and middle-aged professionals. This effect is of nearly the same magnitude for both groups. This implies that when the rewards to getting ahead are limited, young professionals behave in a manner similar to middle-aged professionals. However, as the rewards to getting

ahead increase, the presence of rivals has a positive influence on hours worked that is sharply higher for young professionals as compared to middle-aged professionals. Our estimates imply that in large cities such as New York, Los Angeles, and Chicago, the presence of rivals increases young professional work hours by the equivalent of a standard work week over the course of a year – a large effect. These findings are consistent with the rivalry explanation of the urban rat race.

The paper's results are quite robust, holding for an extensive set of occupation-MSA fixed effects. In addition, results of a wage model reinforce our interpretation of the hours model. The key finding is that wage rates increase with the density of employment in the worker's occupation, regardless of age and professional status. However, this effect is substantially larger for middle-aged professionals and smallest for non-professionals, suggesting that agglomeration enhances productivity most for the skilled. In addition, the extra hours worked generated by rivalrous behavior among young professionals is shown to reduce wage rates among this group. That pattern is consistent with diminishing productivity and worker fatigue, which would be anticipated when workers divert their efforts from production to signaling activities.

Although the paper's primary purpose is to advance the understanding of urban labor markets by documenting the relationship between labor supply and agglomeration, the paper also advances the understanding of rat race effects. Akerlof's (1976) paper is fundamental in the vast literature on adverse selection in labor markets. Despite this, there has been little empirical work on the rat race. The best test to date is Landers et al (1996), who survey lawyers in two large firms in large Northeastern cities. They identify a rat race in several ways. First, they show that lawyers work long hours, especially young ones, and that these lawyers would like to reduce

hours even if this were to mean lower income. Second, they show that both associates and partners perceive hours worked as being crucial in determining which associates will be accepted as partners. As with Landers et al, we consider the different situations faced by younger and older workers. In contrast to Landers et al, we look across all occupations and cities rather than analyzing a single occupation in a single firm or city. In addition, we examine actual hours worked rather than relying on survey evidence on worker satisfaction and attitudes.

The remainder of the paper is organized as follows. Section II discusses our data and variable construction and documents the relationship between agglomeration and hours worked. Section III looks at several explanations of the observed relationship, including productivity, selection, and rivalry. Section IV concludes.

II. Agglomeration and labor supply: stylized facts

A. Data and variables

This section documents the relationship between agglomeration and labor supply using the IPUMs data described above.[6] As before, we include only full-time workers in the analysis, defined as those who reported that their usual hours worked were 35 or more per week. We also experiment with a sample based on individuals working 40 hours per week or more. Results for this latter group are nearly identical to those from the 35 hours-plus sample and are not reported.[7]

As in Table 1, we divide workers into two occupational groups. Professional workers are defined to be individuals in Census occupations categorized as "Professional" or "Technical"

[6]See www.ipums.org.

[7]We also ran the models setting the minimum hours worked to 1 hour or more per week. For men results were little changed. For women results differed owing to the substantial number of part-time workers.

who also have a Masters or more for educational attainment.[8] Non-Professional workers are defined to be those who have less than a Bachelors degree and belong to all other occupational categories except farmers and managers.[9] Individuals not belonging to one of these two groups are excluded from the sample. This ensures that our division of workers into Professional and Non-Professional categories is as meaningful as possible.[10] In addition, in all of the estimated models, each of these groups is further subdivided into young and middle-aged men and women, where young workers are between age 30 through 39, and middle-aged workers are between age 40 through 49.

Our primary goal is to identify the various dimensions of the agglomeration-hours worked relationship. To do this we must control for the influence of individual-specific attributes. In part this is because unobserved wage rates affect an individual's willingness to supply labor, but wage rates themselves are sensitive to an individual's skills and attributes. Accordingly, in all of the empirical models to follow we control for the worker's level of education, the presence of children, marital status, age, race, years of residency in the United States, and commute times. In addition, we also control for occupation fixed effects in order to capture unobserved productivity differences across occupations. Such differences further affect wage rates and hours worked.[11]

---

[8] This includes individuals with a Masters, Professional of Ph.D. degree.

[9]The occupational categories were defined based on the OCC1950 variable in the IPUMs data file. In addition, occupations excluded from both Professional-Technical workers and Non-Professionals include Farmers and farm managers (occ1950>=100 & occ1950<=123), Managers, Officials, and Proprietors (occ1950>=200 & occ1950<=290), Non-occupational responses (cc1950>=980 & occ1950<=997), NA-blank (occ1950==999) and any observations with missing values for OCC1950.

[10]For example, many individuals indicate that they work in professional or technical occupations but have less than a Masters degree, and in some cases, less than a college degree. Regressions based on these individuals suggested that their behavior becomes similar to that of the Non-Professionals defined above as the level of education falls.

[11]Wage rates are not included directly in the model because of concerns about endogeneity. This issue arises in nearly all hours worked studies, but is especially tricky when using the PUMS data where wage is not directly

For all of the labor supply models, we use the log of hours worked per week as the dependent variable. Specifically, we use the usual hours worked per week in the last year.[12] It is widely understood that male and female labor market participation differs, so we estimate separately for the two genders. Only the male results are presented here. The female results are similar, if slightly weaker. Finally, for all of the models to follow, t-ratios are calculated based on robust standard errors that are further clustered based on the Work PUMAs. This tends to work in the direction of lowering the reported t-ratios but allows for a more general pattern of residuals.

B. Urbanization and hours worked

We begin by regressing log hours on occupation fixed effects, worker attributes, and a measure of urbanization, the log population density of the Work PUMA (*PopDen*). Work PUMAs have an average of roughly 210,000 people in residence and range from just over 100,000 people present to over 3 million.[13] The popular notion that urban life is busy and preliminary summary measures in Table 1 both suggest that individuals work longer hours in larger cities, leading one to expect a positive coefficient on *PopDen*. However, if there is a limited amount of work to be done, then having more workers of a particular type might tend to result in each working shorter hours, *ceteris paribus*. If this kind of work-spreading occurs, this

---

reported. Instead, hourly wage rates are calculated by dividing annual wage earnings by the number of weeks worked in the previous year and the usual number of hours worked per week. See Kahn and Lang (1991) for a discussion of this reduced-form approach.

[12]In the IPUMS this is measured using UHRSWORK.

[13]Work PUMAs correspond to regions identified by the first three digits of the 5-digit residential PUMA code. Large metropolitan areas have numerous work PUMAs, but in rural areas a single work PUMA can cover a large geographic area. Information on the population and geographic area of each residential PUMA was obtained from the Census Mable geographic engine available on the web (See http://www.census.gov/plue/). Residential PUMAs were then matched to their corresponding work PUMAs, enabling us to calculate the work PUMA population and land area. Dividing yields the population density of the work PUMA (*PopDen*).

would imply the opposite sign on *PopDen*. The possibility that workers might concentrate in this way in equilibrium is consistent with various models, including Harris-Todaro (1970) on urban unemployment and MacDonald (1988) on rising stars.[14]

Results are presented in Table 2. We consider young professionals first. For young workers, hours worked are 4.3 percent higher for individuals with a Ph.D. or professional degree in comparison to the omitted category of workers with a Masters degree. Among middle-aged professionals the influence of a higher degree is nearly identical, 4.6 percent. Both estimates are highly significant. For both age groups, the presence of children does not have a significant effect on hours worked. Married individuals work 1.2 percent and 2.0 percent longer among young and middle-aged workers, respectively. Age has no effect for either group. African Americans work 2.7 percent and 2.8 percent less than the omitted white group for young and middle-aged workers, respectively. Similar effects are present for Asian and Hispanic workers and once more, estimates are similar across age groups. Immigrant status has varying effects that differ in some instances across age groups. The influence of log commute times is negative and similar for both age groups. Finally, for non-professionals, the variables above have similar qualitative effects on hours worked. The principal exception is the presence of children, which has a strong positive effect on non-professional hours.

Several patterns are notable in these results. First, the coefficients agree with priors about the influence of household attributes on labor supply. Second, for non-professional workers, estimates are similar for young and middle-aged workers, a pattern that will extend to the agglomeration variables to follow. Third, coefficient estimates for young professionals also are

[14]Harris and Todaro (1970) show that when the urban wage is fixed above the market clearing level, there can be unemployment in equilibrium. In Macdonald (1988), the possibility of a rewarding career as a "star" leads a large number of young workers to participate in the contest determining who gets to be a star.

similar to those for middle-aged professionals. However, this pattern will not extend to the role of agglomeration.

We now consider the influence of log-population density on hours worked. Among non-professionals, the elasticity of hours worked with respect to population density of the individual's Work PUMA is negative and similar in magnitude for both age groups. This is consistent with work-spreading. In contrast, the elasticity among professional workers is positive and significant for younger workers but twenty times smaller, close to zero, and insignificant for older workers. Thus, urbanization has a positive effect on the labor supply of young professionals, but has either an insignificant or a negative effect on other workers.

C. Localization and hours worked

Do the estimates from Table 2 imply that population density *per se* is associated with longer hours worked by young professional workers? Not necessarily. Perhaps instead a worker is motivated more by the presence of workers in the same occupation. After all, lawyers do not compete with doctors in the labor market. To consider this possibility, we add a control for the occupation-specific employment density of a work PUMA (*OccDen*). This was done by adding up the number of full-time workers (35 or more hours per week, as noted above) between the ages of 30 to 65 in each occupation for each work PUMA – weighted by the person weights in the IPUMS to ensure a representative sample – and then dividing by the geographic area of the work PUMA. This variable was calculated separately for each of the occupations in the Professional-Technical group and each of the occupations in the Non-Professional group, a total of just over two hundred occupations. Following Hoover (1948), we refer to this as a measure of localization.

Table 3 reports results with the localization variable *OccDen* included in the model. To simplify presentation, only the coefficients on the agglomeration variables are reported. In addition, the *PopDen* coefficients from the models in Table 2 are also presented to facilitate comparison.

Beginning once more with the non-professionals (the last four columns of Table 3), for both age groups, adding the localization variable causes the population density coefficient to change from negative and highly significant, to positive, close to zero, and clearly insignificant. In contrast, the elasticity of hours worked with respect to *OccDen* is - 0.16 percent and significant for both age groups. Once more this is consistent with the presence of work-spreading, but in this case the effect arises from proximity to workers in the same occupation and not from city size *per se*.

Among professional workers, localization effects also appear to dominate. For young workers the elasticity of hours worked with respect to *OccDen* is .43 percent and highly significant. Among middle-aged workers the elasticity with respect to *OccDen* is smaller, just .23 percent with a t-ratio of 2.35. In contrast, *PopDen* now has a negative impact on hours worked for both age groups, though significant only for the younger workers.

In sum, this section has presented evidence that labor supply varies systematically with agglomeration. The strongest pattern is for young professionals. They work longer hours when there is a high density of other workers in the same occupation. The elasticity is roughly twice as a large for young professionals as for middle-aged professionals. Non-professionals, in contrast, work fewer hours when there are many similar workers nearby.

III. Agglomeration and labor supply: explanations

A. Productivity, selection, and the urban rat race

There are many factors that might lead to some sort of positive relationship between agglomeration and labor supply among professional workers. This section will consider three: productivity, selection, and rivalry among workers that produces a sort of rat race. The productivity channel is easy to understand. There is compelling evidence that agglomeration increases productivity (see the literature review in Rosenthal and Strange (2003b)). If workers are paid for extra hours, either through an explicit wage or some sort of implicit contract, then agglomeration and related productivity gains will encourage workers to choose longer hours.

Several kinds of selection can lead to a positive relationship between agglomeration and labor supply. As above, if workers are more productive when agglomerated, then those with a taste for long hours will be well-rewarded for choosing cities. This leads naturally to a positive relationship. This is related to Leamer (1999), who argues that employers seek to match expensive capital with workers who will take best advantage of it. Agglomeration is like an expensive piece of capital: urbanization enhances productivity but urban land rents are high. Urban entrepreneurs, therefore, will seek out industrious workers, while industrious workers will be lured to urban areas by the promise of higher wages. Selection can also occur if hard working professionals have a taste for theater, fine restaurants, and other consumption amenities that are more readily found in large cities. Both the wage- and consumption-selection mechanisms have the potential to draw industrious workers to cities, contributing to a positive relationship between agglomeration and hours worked.

The effect of rivalry on labor supply in cities is more complicated. Here we appeal to Akerlof's (1976) classic signaling model. He supposes that workers are heterogeneous in type,

with higher-type workers being both more productive and more willing to work long hours. The latter is obviously related to the Spence (1973) condition. Under some circumstances, a rat race equilibrium exists, with all workers except those of the lowest type working harder than they would like in order to avoid being mistaken for lower-type workers and paid accordingly. This result depends crucially on local labor markets being relatively "thick". Unless there is a low-type worker who is fairly close in ability, a high-type worker need not buy into the rat race and work long hours in order to signal. Urban markets are thick, of course. This means that a worker in a large city may choose to work harder in order to be distinguished from rivals, especially if the rewards to advancement are high.

This rat race discussion is quite particular. The idea that rivalry is keener in larger markets is much more general. For instance, in a patent race, a larger number of competitors results in a larger equilibrium level of research and development (Lee and Wilde (1980)). Also, in independent values first-price auctions, a larger number of rivals leads each individual to bid an amount closer to his or her actual valuation (McAfee and McMillan (1988)). Thus, there are many situations where a larger market leads to more vigorous competition.

B. Predictions of the explanations

Productivity, selection, and rivalry can all explain some sort of positive relationship between agglomeration and hours worked. However, the three forces have very different implications for the form that the relationship will take. One difference concerns the sorts of occupations that are likely to exhibit a positive relationship between market size and work hours. In the presence of productivity effects, workers put in long hours because they are compensated

for doing so. Because of selection-wage effects, industrious workers are drawn to agglomerated areas anticipating this compensation. These patterns should apply to workers in all occupations.

On the other hand, in the rivalry explanation, workers put in long hours in order to signal their ability. These effects are likely to be stronger in occupations where productivity cannot be easily monitored, and where reputation building is important. Such conditions are often characteristic of professional occupations, where output is somewhat intangible. This is in contrast to non-professional occupations, where output is more readily identified. In addition, professionals typically work for a salary, while most non-professionals work for an hourly wage. This weakens the link between output and compensation for professionals relative to non-professionals. Taken together, these differences suggest that rivalry effects will lead to a stronger agglomeration-market size relationship for professional occupations than in non-professionals occupations.

Another difference between the productivity, selection, and rivalry explanations concerns work hours over an individual's lifetime. Returning to the rivalry explanation, it is likely that after a worker has been active in the labor market for many years, then firms will no longer be uncertain about the worker's type. This would be consistent with models of job ladders (i.e., MacLeod and Malcomson (1988)). In this situation, later in their careers, workers would no longer need to work longer hours to distinguish themselves from their less-able coworkers. This implies that the effect of agglomeration on work hours should be lower for older workers.

The life-cycle predictions of the rivalry explanation are not shared by the productivity or selection-wage explanations. As long as productivity is higher for all workers – there is no evidence otherwise in the agglomeration literature – then workers would continue to take advantage of high urban productivity and work long hours. Similarly, industrious workers will

be drawn to agglomerated areas in order to take advantage of higher wages. It seems likely that these effects would not erode over a worker's life. Consequently, in both the productivity and selection-wage explanations, the effect of agglomeration on work hours is likely to persist. This implies that localization effects should be relatively similar for young and middle-aged workers.

One final difference depends the nature of agglomeration itself, specifically city size versus the spatial concentration of a given occupation. Urban consumer amenities (e.g. theater) are likely associated more with the size and density of the entire city rather than with the density of a given occupation. For that reason, selection-consumption effects are likely captured by the *PopDen* variable in Model 2 of Table 2 and are unlikely to account for the positive relationship between localization (*OccDen*) and hours worked among professionals.

Thus far, our discussion of the explanations linking hours worked and agglomeration has emphasized labor supply. As suggested earlier, labor demand may also play a role. If there is a limited amount of work to be done, having more workers of a particular type will tend to result in each working shorter hours, *ceteris paribus*. This has the potential to affect the hours worked of both young and middle-aged workers. In addition, the effect will presumably be stronger for non-professional workers, since they must be paid overtime.[15]

Summarizing, from a supply side perspective, the rivalry, productivity, and selection explanations all imply a positive relationship between hours worked and localization, at least in some circumstances. These explanations never imply a negative relationship. The supply side explanations predict different patterns of labor supply for different types of occupations and age groups. From a demand side perspective, a work-spreading effect is predicted.

[15] The Fair Labor Act of 1938 requires that employers pay 1-1/2 times the regular wage for hours worked beyond a "standard" work week (Pencavel (1986)). The law was modified in 1940 to set the standard week at 40 hours for a wide range of non-professional occupations.

C. Urbanization and localization revisited

This suggests that differencing strategies can shed light on the agglomeration-hours worked relationship. We return, therefore, to the patterns in Model 2 of Table 3. In this model the coefficients on urbanization (*PopDen*) for young and middle-aged non-professionals are both nearly equal to zero, while the coefficients on localization (*OccDen*) are negative, significant, and identical in magnitude. This pattern is consistent with work spreading, but offers little evidence of selection, productivity, or rivalry.

Among professional workers, the most important patterns concern the localization variable, *OccDen*. The coefficient on *OccDen*, although positive for both young and middle-aged professionals, is much larger for the younger workers. The positive influence of *OccDen* on hours worked among young and middle-aged professionals is consistent with the presence of selection and/or productivity effects.[16] The much larger influence of *OccDen* on young versus middle-aged professionals is consistent with a rat race. The next section focuses more tightly on the rat race. For that reason, from this point on we restrict our analysis to professional workers.

D. Rivalry and inequality among professional workers

We begin by constructing an additional variable whose function is to help isolate the potential for labor market rivalry (*Rival*). As a first step, we calculate the national hourly wage distribution for all full-time workers in the individual's age cohort and occupation grouping men

[16]Kahn and Lang (1991) find that about half of the workforce would prefer to work more or less, holding the hourly wage constant. A much greater number would prefer to work more. Our results are at least broadly consistent with this finding. There are fewer professionals than nonprofessionals, and we find behavior consistent with a rat race for the former and not the latter. For nonprofessionals, we find "work spreading," which is consistent with wanting to work more and not being able to.

and women together. Next, we add up the number of full-time workers in the individual's work PUMA and occupation that are in the individual's 5-percentile range in the age- and occupation-specific national wage distribution.[17] As before, person sampling weights are used to ensure that the number of rivals present is calculated from a representative sample. If rivalry effects are present for young professionals but not for older professionals, *Rival* should have a positive influence on hours worked among young professionals but not for older professionals.

Table 4 presents results from several different models that provide increasingly stringent tests for whether rivalry contributes to longer hours worked. Beginning with the simplest specification, Model 3 controls for the influence of *PopDen, OccDen*, and *Rival.*[18] In this model, the effect of *PopDen* is negative, marginally significant, and nearly identical for both age groups, while the effect of *OccDen* is positive, significant, and also nearly identical for both age groups. Controlling for rivalry, therefore, young and middle-aged professionals tend to behave in a similar manner, at least with respect to the influence of agglomeration on work hours.

Consider next the coefficient on *Rival*. The estimated elasticity of hours worked with respect to *Rival* equals .40 percent for young workers (with a t-ratio of 2.58) but *minus* .68 percent (with a t-ratio of -3.80) for middle-aged workers. The negative effect of *Rival* on middle-aged professional work hours is indicative of demand-side effects: an increase in the presence of similar workers serves to spread work loads across individuals, reducing individual hours worked. The positive effect of *Rival* on young professional work hours lends further

[17]For example, for a 30-year old doctor at the 32nd percentile of the national wage distribution for all doctors in their 30s (including men and women), we add up the number of doctors in the individual's work PUMA whose wages are in the 30th through 34th percentiles of the national wage distribution. Had the doctor's wage been at the 36th percentile, we would have added up individuals in the 35th through 39th percentiles of the distribution.

[18]As before, only the agglomeration variables are presented, but all of the variables and the occupation fixed effects in Table 2 are included in these models.

support to the idea that signaling and rivalry contribute to an urban rat race among young professionals.

The theory governing rivalrous behavior allows for even more stringent tests. This is because the rat race depends crucially on the rewards to getting ahead. Eliminate such rewards, and the incentive to compete with rivals goes away, or at least is diminished. This idea is consistent with the argument that an unequal wage distribution creates incentives for workers to seek advancement and so encourages hard work (e.g. Bell and Freeman (2000)). Accordingly, we specify a variable that captures the degree of wage inequality in professional occupations (*WageIQR*). This measure equals the inter-quartile range of log-wage rates for full-time workers (35 hours or more per week) in the individual's occupation and age category (young versus middle-aged) in the individual's work PUMA.[19]

When *WageIQR* is large, there are large rewards to getting ahead in the individual's occupation and local labor market. In this case, we expect professionals to work longer hours. Moreover, when *WageIQR* equals zero, rivalry effects should disappear, young professionals should behave more like middle-aged professionals, and *Rival* should have a negative effect on hours worked as the work load allocated to a group of potential rivals is spread over more individuals. These latter ideas are tested by including interactions between the *Rival* and *WageIQR* variables in the model.

Returning to Table 4, Model 4 adds the wage inequality measure (*WageIQR*). The corresponding coefficients are positive and highly significant for both age groups. This is consistent with the Bell and Freeman (2000) conclusion that wage inequality increases hours worked. Also, the remaining agglomeration coefficients are little changed from the previous

[19]The inter-quartile wage variable is calculated using the person weights in the IPUMS to ensure a representative measure as with the *OccDen* and *Rival* variables.

model. The pattern begins to change in Model 5 where *WageIQR* is replaced with the interaction of *Rival* and *WageIQR*. Although the interactive term is positive and highly significant, absent wage inequality (*WageIQR* equal to zero), the influence of *Rival* is substantially reduced and no longer significant among young professionals.

Model 6 provides a complete specification of the *Rival* and *WageIQR* variables, with direct measures of each along with the interactive term. Two striking results emerge. First, the coefficient on *Rival* is now negative and highly significant for young professionals and similar in magnitude to the corresponding coefficient among middle-aged professionals. Second, the interactive term is positive, highly significant for both groups, but twice as large for the younger workers. These results are consistent with priors, and they suggest that when the financial rewards to getting ahead are zero (*WageIQR* equal to zero), the presence of rivals (*Rival*) has nearly the same effect on the hours worked of young professionals as for middle-aged professionals. The negative coefficient on *Rival* is suggestive of demand side effects in which the work load is spread among a greater number of individuals. In contrast, as the financial rewards to getting ahead increase (*WageIQR* becomes large), young professionals work longer hours relative to middle-age professionals.

As a further robustness check, Model 7 interacts the occupation fixed effects with MSA fixed effects. This controls for additional unobserved MSA attributes that might affect hours worked, including MSA differences in productivity levels, the local cost of living, and the activities carried out by a Census defined occupation. This approach also increases the number of fixed effects from 70 in the previous models to roughly 6,100. The inclusion of so many fixed effects controls for a vast array of unobserved effects, but also has the effect of reducing variation in the data, making identification more difficult.

Not surprisingly, in Model 7 the significance of the coefficients on *PopDen* and *OccDen* is substantially reduced. This occurs because *PopDen* and *OccDen* do not vary within Work PUMAs for a given occupation, which limits their variation within MSAs. On the other hand, the rival and wage inequality variables do vary within Work PUMAs for each occupation. Estimates of the coefficients on these variables and their interaction are little changed from those in Model 6. This is an important result because it suggests that the various agglomeration variables already included in the model largely capture the influence of metropolitan area attributes relevant to hours worked among professionals.

D. Wages

Do the forces that contribute to hard work in cities also enhance the hourly output and productivity of urban workers? Examining wages enables us to address this question, while shedding further light the forces that contribute to the agglomeration-hours worked relationship. We are guided by the following principle: with competitive markets, factors that encourage longer work hours without commensurate gains in output result in lower hourly wages. Thus, if the extra work is matched by a greater than proportionate increase in output, then hourly wages will rise.

Tables 5 and 6 replicate the specifications in Tables 3 and 4, with log of hours worked replacing log of hourly wage. In Table 5, Model 1 shows that wages are higher in more densely populated areas (*PopDen*) for both professional and non-professional workers. However, as with the hours worked analysis, in Model 2 it is clear that localization effects – measured by the density of employment in the worker's occupation – are the driving force behind higher wages in urbanized areas. Specifically, the coefficients on *PopDen* are negative in all cases, while the

coefficients on *OccDen* are positive and highly significant for all groups. For professionals, the *OccDen* wage elasticity is 5 percent for younger workers and 6.7 percent for middle-aged workers. For non-professionals the analogous elasticities are 3.1 and 3.8 percent, respectively. Thus, localization effects appear to be stronger for professionals relative to non-professionals, and for middle-aged workers relative to younger workers. Assuming that older workers and professionals are more skilled, this suggests that the productivity gains associated with localization are larger for more highly-skilled segments of the workforce.

In Table 6, we add controls for local rivals, restricting attention to professional workers. Adding these controls does not affect the qualitative impact of *PopDen* and *OccDen*. As reported before, for example, the elasticity with respect to *OccDen* is 50 to 100 percent larger for middle-aged professionals than for younger professionals. A very different pattern is evident with regard to the influence of local rivals. In Model 7, for example, the direct effect of *Rival* is positive, highly significant, and twice as large for young professionals as for middle-aged professionals. In addition, the interactive term has an elasticity of minus 11.36 percent for young professionals and is highly significant, but is small, positive, and insignificant for middle-aged professionals.

How should these results be interpreted? The negative coefficients on *PopDen* could indicate either that congestion is costly to firms or that workers enjoy amenities found in densely populated areas, both of which would serve to reduce wages. In contrast, the positive coefficients on *OccDen* suggest that cities are productive places not so much because of their size *per se*, but because of the concentration of activity within individual occupations. This finding is consistent with some prior studies of employment growth in cities (e.g. Henderson et al (1995), Rosenthal and Strange (2003a)). This finding is also consistent with recent work on

agglomeration and wages. Glaeser and Mare (1999), for example, report evidence that wages are higher in large cities, consistent with our findings in Model 1 (Table 5). Wheaton and Lewis (2001) find evidence that localization effects contribute to higher wages, consistent with our results in Model 2 (Table 5).[20] In addition, the positive coefficients on *OccDen* suggest that some combination of selection and productivity effects enhance the average hourly output of urban professionals. That is exactly what one would expect to the extent that agglomerated labor markets make workers more valuable while also attracting talented individuals.[21]

These findings are in the spirit of the well-known Marshall (1890,1920) vs. Jacobs (1969) debate on whether localization or urbanization economies are more important.[22] The results on the rival variable address an entirely different aspect of agglomeration economies. As noted above, the interactive term *Rival*WageIQR* has a significantly negative and large coefficient for young professionals, but is positive, small, and insignificant for middle-aged professionals. Among young professionals, therefore, the extra hours worked arising from rivalrous behavior (as documented in Table 4) is not matched by a corresponding increase in output, causing hourly wages to fall. This result is consistent with diminishing marginal productivity of work effort, in other words, fatigue. The result is also in the spirit of Saxenian (1994), and adds to the literature

[20] Neither Wheaton and Lewis (2001) nor Glaeser and Mare (1999), however, identify the marginal effects of both the overall level of urbanization and employment concentration within individual industries, in contrast to our specifications here. In addition, Wheaton and Lewis (2001) and Glaeser and Mare (1999) use total counts of workers and residents when measuring agglomeration while we express our agglomeration measures in terms of the density of development. In this regard, our agglomeration measures are closer in spirit to the measures used by Ciccone and Hall (1996) and Rosenthal and Strange (2003a).

[21] Glaeser and Mare (1999) take pains to distinguish between selection and productivity effects that contribute to higher urban wages. After drawing on a variety of datasets and methods, they conclude that productivity effects undoubtedly contribute to higher big city wages, although selection effects may play a role as well.

[22] For instance, Glaeser et al (1992) and Henderson et al (1995).

in which the nature of urban interactions is crucial to agglomeration economies (see also Rosenthal and Strange (2003a)).[23]

F. Magnitudes

This paper has analyzed the effects of agglomeration on hours worked and wages. A clear pattern has emerged, the key features of which are the differences between the effects of agglomeration on professionals versus non-professionals and young versus middle-aged workers. This section will further characterize the economic importance of these differences.

Earlier in the paper, Model 2 of Table 3 showed that *OccDen* had different effects on hours for young and middle-aged professionals. To get a sense of the magnitude of these estimates, we calculate the impact of *OccDen* on hours worked for the two groups of cities in Table 1 (New York, Chicago,Los Angeles and Hartford, Milwaukee, Sacramento). Among young professionals, on average, localization effects (*OccDen*) increase hours worked in the larger cities by 0.7 percent relative to the smaller cities. This is equivalent to roughly 16 additional work hours per year assuming a 45 hour work week for 50 weeks. Among middle-aged professionals *OccDen* increases hours worked in the larger cities by .28 percent relative to the smaller cities, an increase of 6.3 hours per year. As a point of comparison, consensus estimates of the magnitude of agglomeration economies associated with a doubling of city size are roughly 4% (Rosenthal and Strange (2003b)). Of course, the hours-worked numbers discussed here are based on a model that does not separately identify the influence of rivalrous behavior.

[23] Our findings regarding the influence of rivals contrast with Porter (1990), whose analysis stresses the productivity benefits of competition among producers. In our case, competition among rivals appears to contribute to signaling that is not necessarily productivity enhancing.

In Table 7, therefore, we examine the degree to which the presence of rivals contributes to hours worked and hourly wage rates among young and middle-aged professionals for the same two groups of cities. This is done by applying the *Rival* and *Rival*WageIQR* coefficients from Model 7 of Tables 4 and 6 to the individual level data and then averaging across observations.[24]

Several patterns stand out. First, rivals have a substantial impact on hours worked for young professionals, as shown by the first row and first four columns of the table. The presence of rivals increases the hours worked among younger workers by 2.3 percent in the larger cities. This translates into just over 1 additional hour worked per week or the equivalent of about one extra week of work per year – a very large effect. In the smaller cities, this effect is only half as large. In addition, the presence of rivals *reduces* hours worked among middle-aged professionals by 2 percent in both groups of cities. It is clear, therefore, that the presence of rivals substantially elevates hours worked among young professionals relative to middle-aged professionals, and this effect is most pronounced in the largest cities.

The remaining four columns of the table consider the influence of rivals on wages. Here too the patterns are revealing. Among young professionals, the presence of rivals has a similar influence on wage rates in both groups of cities, adding roughly 13 percent to hourly wage. Among middle-aged professionals, the presence of rivals also has a similar influence on wage rates in both groups of cities, but here the impact is much larger, roughly 25 percent. The large positive impact of rivals on middle-aged wage rates is suggestive that for this group the presence of similar workers enhances productivity. However, consistent with our earlier discussions, the much smaller impact of rivals on the wage rates of younger professionals is suggestive of worker fatigue, possibly the result of long hours spent signaling.

[24] Sampling weights were used when averaging to ensure a representative result.

Finally, the second row of Table 7 highlights the impact of the presence of rivals on hours worked and wage rates for young and middle-aged lawyers, a profession famous for its long hours and also the focus of recent work by Landers et al (1996).[25] It is immediately apparent that the influence of rivals on hours worked and wage rates for lawyers is qualitatively the same as for all professionals. However, it is also clear that the presence of rivals has a substantially larger impact on the hours worked of young lawyers relative to all young professionals. Specifically, proximity to rivals elevates hours worked among young lawyers by 1.9 percent in the three moderate sized cities and by 3.8 percent in the larger cities. Lawyers, it would seem, deserve some of their reputation for rivalrous behavior, at least among younger individuals.

IV. Conclusion

This paper is the first to systematically document a relationship between hours worked and agglomeration. In doing so, we find convincing evidence that among non-professional workers, agglomeration tends to spread out workloads over a larger number of individuals, resulting in diminished individual hours worked. Among professional workers, the pattern is different. Here, agglomeration increases hours worked. Using differencing methods, the paper finds evidence of both selection and productivity effects and also of the rat race effect. The paper is, therefore, one of very few to have provided empirical evidence in support of Akerlof's (1976) theory of the rat race.

[25] In constructing these measures we first estimated the hours worked and wage models separately for lawyers and judges including metropolitan fixed effects as in Model 7 in Tables 4 and 6.

The paper can also be seen as contributing to the literature on agglomeration. Over eighty years ago Marshall (1890, 1920) argued that cities are productive places because they allow for pooling of labor, sharing of intermediate inputs, and knowledge spillovers. This paper adds to that list by providing evidence that industrious professionals are drawn to agglomerated areas, and that agglomeration requires professionals to work harder. This provides an entirely new explanation for why cities are productive and in so doing adds to our knowledge of the nature and benefits of agglomeration and related economies of scale.

References

ABC News Poll (2001), http://abcnews.go.com/sections/politics/PollVault/PollVault.html].

Akerlof, G.A. (1976), "The economics of caste and of the rat race and other woeful tales," *Quarterly Journal of Economics* 90(4), 599-617.

Bell, L.A. and R.B. Freeman (2000), "The Incentive for Working Hard: Explaining Hours Worked Differences in The U.S. and Germany," NBER Working Paper 8051.

Ciccone, A. and R.E. Hall (1996), "Productivity and the Density of Economic Activity," *American Economic Review* 86, 54-70.

Fujita, M. and J. Thisse (2001), *The Economics of Agglomeration*, Cambridge: Cambridge University Press.

Glaeser, E.L., and D. C. Mare (2001), "Cities and Skills," *Journal of Labor Economics* 19(2): 316-342.

Glaeser, E.L, H. D. Kallal, J. A. Scheinkman, and A. Shleifer (1992), "Growth in Cities," *Journal of Political Economy* 100, 1126-1152.

Harris, J.R., and M.P. Todaro (1970), "Migration, Unemployment, and Development: A Two Sector Analysis," *American Economic Review* 107, 126-142.

Henderson, J.V. (2003), "Marshall's Scale Economies," *Journal of Urban Economics* 53: 1-28.

Henderson, J.V., A. Kuncoro and M. Turner (1995), "Industrial Development in Cities." *Journal of Political Economy* 103, 1067-1085.

Hoel, P.G., S.C. Port, and C.J. Stone (1971), *Introduction to Probability Theory*, London: Houghton Mifflin.

Hoover, E. (1948), *The Location of Economic Activity* (New York: McGraw-Hill).

Jacobs, J. (1969), *The Economy of Cities*, New York: Vintage.

Jaffe, A. B. M. Trajtenberg, and R. Henderson (1993), "Geographic Localization of Knowledge Spillovers as Evidenced by Patent Citations," *Quarterly Journal of Economics* CVIII, 577-598.

Kahn, S. and K. Lang (1991), "The Effects of Hours Constraints on Labor Supply Estimates," *Review of Economics and Statistics* 73(4), 605-611.

Landers, R.M., J.B. Rebitzer, and L.J. Taylor (1996), "Rat Race Redux: Adverse Selection in the Determination of Work Hours in Law Firms," *American Economic Review* 86(4), 329-348.

Leamer, E. (1999), "Effort, Wages, and the International Division of Labor," *Journal of Political Economy* 107, 1127-1162.

Lee, T. and L. Wilde (1980), "Market Structure and Innovation: A Reformulation," *Quarterly Journal of Economics* 194, 429-436.

Marshall, A. (1920), *Principles of Economics*, London: MacMillan.

MacDonald, G. M. (1988), "The Economics of Rising Stars," *American Economic Review* 78, 155-166.

MacLeod, W.B. and J.M. Malcomson (1988), "Reputation and Hierarchy in Dynamic Models of Employment," *Journal of Politicl Economy* 96(4), 832-854.

McAfee, R. P. and J. McMillan (1988), "Auctions and Bidding," *Journal of Economic Literature*, Vol. 25, No. 2. (Jun., 1987), pp. 699-738.

Pencavel, J. (1986), "Labor Supply of Men: a Survey," in O. Ashenfelter and R. Layard, eds., *Handbook of Labor Economics*, Amsterdam: North Holland.

Porter, M. (1990), *The Competitive Advantage of Nations*. (New York: The Free Press).

Quigley, J. (1998) "Urban Diversity and Economic Growth," *Journal of Economic Perspectives* 12, 127-138.

Robinson, John P. and Bostrom, Ann (1994), "The Overestimated Workweek? What Time Diary Measures Suggest," *Monthly Labor Review* 117.8.

Rosenthal, Stuart S. and William C. Strange (2001), "The Determinants of Agglomeration," *Journal of Urban Economics* 50(2), 191-229.

Rosenthal, Stuart S. and William C. Strange (2003a), "Geography, Industrial Organization, and Agglomeration," *Review of Economics and Statistics*, forthcoming.

Rosenthal, Stuart S. and William C. Strange (2003b), "Evidence on the Nature and Sources of Agglomeration Economies", prepared for the *Handbook of Urban and Regional Economics*, Volume 4.

Ross, S.M. (1983), *Stochastic Processes*, New York: John Wiley and Sons.

Ruggles, Steven, and Matthew Sobek et. al (1997), *Integrated Public Use Microdata Series: Version 2.0*, Minneapolis: Historical Census Projects,University of Minnesota (http://www.ipums.org).

Saxenian, A. (1994), *Regional Advantage: Culture and Competition in Silicon Valley and Route 128,* Cambridge, MA: Harvard University.

Schor, Juliet B (1991). *The Overworked American: The Unexpected Decline of Leisure*. New York: Basic Books.

Spence, M. (1973) "Job Market Signalling"*, Quarterly Journal of Economics* 87, 355-374.

Tirole, J. (1989), *The Theory of Industrial Organization*, Cambridge: MIT Press.

Wheaton, W. C. and M. J. Lewis, (2002), "Urban Wages and Labor Market Agglomeration," *Journal of Urban Economics* 51, 542-562.

Table 1: Average Hours Worked Among Full-Time Workers In Select Metropolitan Areas[a]

Occupation Category	Metropolitan Area	Young Males	Middle Aged Males
Non-Professional Workers[b]	New York, Chicago, Los Angeles	43.58	43.55
	Hartford, Milwaukee, Sacramento	43.72	44.02
Professional Workers (including Lawyers & Judges)[b]	New York, Chicago, Los Angeles	48.12	46.77
	Hartford, Milwaukee, Sacramento	47.21	46.77
Lawyers and Judges	New York, Chicago, Los Angeles	50.06	48.63
	Hartford, Milwaukee, Sacramento	47.71	48.75

[a]All data are weighted to be representative using the perwt variable in the IPUMs. Hours worked are based on the "usual hours worked per week". Only individuals working 35 hours or more per week are included in the sample.

[b]Professional workers are individuals in occupations categorized as Professional-Technical in the OCC1950 variable of the IPUMS *and* who have a Masters degree or more. Non-Professionals include all other workers except managers and agricultural workers *and* who have less than a Bachelors degree.

Table 2: MALE WORKERS – 35 Hours or More Per Week
Usual Hours Worked Per Week in the Last Year
Professional Versus Non-Professional Workers

Dependent Variable: Log of Hours Worked
(t-ratios in parentheses; Robust standard errors with clustering on Work PUMAs)

	Professional Workers[a]		Non-Professional Workers[b]	
	Age 30-40	Age 41-50	Age 30-40	Age 41-50
Professional or Ph.D. Degree[c]	0.043	.0462		
	(17.42)	(19.73)		
Some College or Associate Degree[c]			.0047	.0033
			(5.87)	(3.62)
High School Degree[c]			.0161	.0154
			(17.25)	(15.27)
Have Children	.0034	-.0008	.0096	.0050
	(1.62)	(-0.38)	(13.14)	(6.24)
Married	.0125	.0204	.0131	.0094
	(5.53)	(8.04)	(17.52)	(10.97)
Age	-.0036	-.0038	.0053	.0112
	(-0.60)	(-0.39)	(2.75)	(3.03)
Age Squared	.00002	.00004	-.00008	-.00001
	(0.28)	(0.35)	(-2.91)	(-3.03)
Black	-.0270	-.0285	-.0344	-.0332
	(-5.86)	(-5.94)	(-34.44)	(-28.35)
Asian	-.0270	-.0364	-.0062	-.0007
	(-6.87)	(-8.48)	(-1.37)	(-0.14)
Hispanic	-.0179	-.0163	-.0252	-.0256
	(-3.81)	(-3.07)	(-17.85)	(-14.75)
Other Race	-.0126	-.0160	-.0175	-.0108
	(-0.87)	(-3.07)	(-4.83)	(-2.84)
Immigrated 6-10 years ago[d]	-.0079	.0039	-.0029	-.0109
	(-1.39)	(0.42)	(-0.99)	(-2.69)
Immigrated 11-15 years ago[d]	-.0079	.0172	-.0065	-.0081
	(-1.42)	(1.68)	(-2.07)	(-1.95)
Immigrated 16-20 years ago[d]	.0143	.0253	-.0020	-.0062
	(1.68)	(2.85)	(-0.58)	(-1.62)
Immigrated > 21 yrs or Nat. US Citizen[d]	.0103	.0207	-.0073	-.0155
	(2.29)	(2.85)	(-2.76)	(-4.44)
Log commute time	-.0108	-.0134	-.0067	-.0089
	(-10.16)	(-13.03)	(-12.83)	(-16.68)
Log population density of Work PUMA	.0011	.00005	-.0012	-.0011
	(1.79)	(0.96)	(-3.68)	(-3.30)
Constant	3.892	3.857	3.686	3.529
	(36.83)	(17.39)	(111.95)	(42.29)
No. of Occupation Fixed effects	71	70	135	133
No. Observations	56,940	55,079	465,254	295,441
Adj R^2	0.2045	0.1537	0.0750	0.0760
Root MSE	0.1745	0.1746	0.1617	0.1604

[a]Professional workers belong to "professional and technical" occupations and have a Masters or higher degree.
[b]Non-professional workers belong to non-professional and non-technical occupations and have less than a BA degree.
[c]Omitted categories for salaried and hourly workers are Masters Degree and less than high school degree, respectively.
[d]Omitted category is immigrated in the last five years.

Table 3: MALE WORKERS – 35 Hours or More Per Week[a]
Usual Hours Worked Per Week in the Last Year
Professional Versus Non-Professional Workers

Dependent Variable: Log of Hours Worked
(t-ratios in parentheses; Robust standard errors with clustering on Work PUMAs)

	Professionals[b]				Non-Professionals[c]			
	Model 1		Model 2		Model 1		Model 2	
	Age 30-40	Age 41-50	Age 30-40	Age 41-50	Age 30-40	Age 41-50	Age 30-40	Age 41-50
Log population density of Work PUMA (PopDen)	.0011	.00005	-.0032	-.0018	-.0012	-.0011	.0004	.0005
	(1.79)	(0.96)	(-2.52)	(-1.28)	(-3.68)	(-3.30)	(0.46)	(0.54)
Log employment density of worker's occupation in Work PUMA (OccDen)			.0043	.0024			-.0016	-.0016
			(3.63)	(1.96)			(-2.06)	(-2.08)
No. of Occupation Fixed effects	71	70	71	70	135	133	135	133
No. Observations	56,940	55,079	56,940	55,078	465,254	295,441	465,254	295,440
Adj R^2	0.2045	0.1537	0.2048	0.1538	0.0750	0.0760	0.0750	0.0761
Root MSE	0.1745	0.1746	0.1745	0.1746	0.1617	0.1604	0.1617	0.1604

[a]All other variables listed in Table 2 are also included in the model but their coefficients are suppressed to conserve space.
[b]Professional workers belong to "professional and technical" occupations and have a Masters or higher degree.
[c]Non-professional workers belong to non-professional and non-technical occupations and have less than a Bachelors degree.

Table 4: PROFESSIONAL MALE WORKERS – 35 Hours or More Per Week[a,b]
Usual Hours Worked Per Week in the Last Year
Alternative Specifications of Occupation Density Effects

Dependent Variable: Log of Hours Worked
(t-ratios in parentheses; Robust standard errors with clustering on Work PUMAs)

	Age 30-40					Age 41-50				
	Model 3	Model 4	Model 5	Model 6	Model 7	Model 3	Model 4	Model 5	Model 6	Model 7
Log population density of Work PUMA (PopDen)	-.0024	-.0020	-.0021	-.0024	-.0018	-.0024	-.0021	-.0020	-.0019	-.0017
	(-1.66)	(-1.54)	(-1.43)	(-1.76)	(-1.06)	(-1.60)	(-1.42)	(-1.35)	(-1.30)	(-0.93)
Log employment density of worker's occupation in Work PUMA (OccDen)	.0032	.0027	.0025	.0029	.0014	.0036	.0031	.0029	.0028	.0024
	(2.30)	(1.87)	(1.80)	(2.09)	(0.82)	(2.54)	(2.21)	(2.11)	(2.05)	(1.41)
Log number of workers in the individual's age group, occupation, and Work PUMA within 5 percentage points in the occupation-age national wage distribution (Rival)[c]	.0040	.0040	.0009	-.0081	-.0126	-.0068	-.0068	-.0082	-.0124	-.0101
	(2.58)	(2.56)	(0.57)	(-4.06)	(-5.44)	(-3.80)	(-3.81)	(-4.63)	(-4.66)	(-3.92)
Interquartile range of log wages in worker's occupation in the worker's Work PUMA (WageIQR)	-	.0124	-	-.0507	-.0726	-	.0076	-	-.0270	-.0181
		(5.44)		(-5.80)	(-6.59)		(3.68)		(-2.48)	(-1.51)
Interactive Term: Rival x WageIQR	-	-	.00073	.0205	.0270	-	-	.0030	.0114	.0078
			(7.15)	(7.48)	(7.66)			(4.32)	(3.22)	(2.05)
No. of Occupation Fixed effects	71	71	71	71	-	70	70	70	70	-
No. of Occupation and MSA Fixed Effects	-	-	-	-	6443	-	-	-	-	6,102
No. Observations	51,302	51,302	51,302	51,302	51,302	49,673	49,673	49,673	49,673	49,673
Adj R^2	0.2093	0.2100	0.2105	0.2113	0.2100	0.1555	0.1558	0.1560	0.1561	0.1607
Root MSE	.1724	.1723	.1723	.1722	.1723	.1721	.1721	.1721	.1721	.1716

[a]All other variables listed in Table 2 are also included in the model but their coefficients are suppressed to conserve space.
[b] Professional workers belong to "professional and technical" occupations and have a Masters or higher degree.
[c]*Rival* is calculated by counting the number of workers in the individual's Work PUMA in the same occupation and age category (young versus middle-aged) within 5 percentage points in the national wage distribution pertinent to the individual. For these purposes, national wage distribution is measured using all (male and female) full-time workers (35 hours or more per week) for the same occupation and age category (young versus middle-aged) as the individual.

Table 5: MALE WORKERS – 35 Hours or More Per Week[a]
Professional Versus Non-Professional Workers

Dependent Variable: Log of Wages
(t-ratios in parentheses; Robust standard errors with clustering on Work PUMAs)

	Professionals[b]				Non-Professionals[c]			
	Model 1		Model 2		Model 1		Model 2	
	Age 30-40	Age 41-50	Age 30-40	Age 41-50	Age 30-40	Age 41-50	Age 30-40	Age 41-50
Log population density of Work PUMA (PopDen)	.0113	.0180	-.0374	-.0461	.0220	.0209	-.0081	-.0166
	(4.01)	(5.41)	(-3.99)	(-7.48)	(8.89)	(7.57)	(-1.24)	(-2.25)
Log employment density of worker's occupation in Work PUMA (OccDen)			.0499	.0669			.0307	.0382
			(5.61)	(11.31)			(5.58)	(6.14)
No. of Occupation Fixed effects	71	70	71	70	134	133	134	133
No. Observations	51302	49674	51302	49673	440148	276350	440148	276349
Adj R^2	0.1895	0.2210	0.1930	0.2265	0.1615	0.1654	0.1625	0.1669
Root MSE	.60692	.59709	.60562	.59499	.52264	.53815	.52233	.53766

[a]All other variables listed in Table 2 are also included in the model but their coefficients are suppressed to conserve space.
[b]Professional workers belong to "professional and technical" occupations and have a Masters or higher degree.
[c]Non-professional workers belong to non-professional and non-technical occupations and have less than a Bachelors degree.

Table 6: PROFESSIONAL MALE WORKERS – 35 Hours or More Per Week[a,b]
Alternative Specifications of Occupation Density Effects

Dependent Variable: Log of Wages
(t-ratios in parentheses; Robust standard errors with clustering on Work PUMAs)

	Age 30-40					Age 41-50				
	Model 3	Model 4	Model 5	Model 6	Model 7	Model 3	Model 4	Model 5	Model 6	Model 7
Log population density of Work PUMA (PopDen)	-.0194	-.0239	-.0234	-.0222	-.0296	-.0311	-.0355	-.0355	-.0346	-.0549
	(-3.04)	(-3.55)	(-3.36)	(-3.09)	(-4.52)	(-5.08)	(-5.31)	(-5.24)	(-5.20)	(-6.96)
Log employment density of worker's occupation in Work PUMA (OccDen)	.0252	.0323	.0323	.0313	.0299	.0424	.0490	.0490	.0478	.0543
	(4.44)	(5.28)	(5.19)	(4.92)	(4.57)	(7.07)	(7.48)	(7.37)	(7.23)	(7.00)
Log number of workers in the individual's age group, occupation, and Work PUMA within 5 percentage points in the occupation-age national wage distribution (Rival)[c]	.0607	.0610	.0905	.1172	.1036	.0846	.0844	.0996	.0610	.0491
	(5.07)	(5.02)	(7.34)	(9.66)	(7.26)	(9.73)	(9.71)	(11.78)	(5.33)	(4.09)
Interquartile range of log wages in worker's occupation in the worker's Work PUMA (WageIQR)	-	-.1433	-	.1503	.1795	-	-.1064	-	-.2507	-.2062
		(-10.00)		(2.30)	(2.53)		(-7.28)		(-3.60)	(-2.39)
Interactive Term: Rival x WageIQR	-	-	-.0499	-.0951	-.1136	-	-	-.0308	.0476	.0232
			(-10.59)	(-4.51)	(-4.94)			(-6.15)	(2.06)	(0.83)
No. of Occupation Fixed effects	71	71	71	71	-	70	70	70	70	-
No. of Occupation and MSA Fixed Effects	-	-	-	-	6443	-	-	-	-	6102
No. Observations	51302	51302	51302	51302	51302	49673	49673	49673	49673	49673
Adj R^2	0.1976	0.2050	0.2068	0.2074	0.2255	0.2356	0.2397	0.2389	0.2401	0.2651
Root MSE	.60389	.6011	.60041	.60019	.59329	.59148	.58987	.59017	.58972	.57992

[a] All other variables listed in Table 2 are also included in the model but their coefficients are suppressed to conserve space.
[b] Professional workers belong to "professional and technical" occupations and have a Masters or higher degree.
[c] *Rival* is calculated by counting the number of workers in the individual's Work PUMA in the same occupation and age category (young versus middle-aged) within 5 percentage points in the national wage distribution pertinent to the individual. For these purposes, national wage distribution is measured using all (male and female) full-time workers (35 hours or more per week) for the same occupation and age category (young versus middle-aged) as the individual.

Table 7: The Influence of Rivals on Hours Worked and Wages in Large and Moderate Sized Cities[a]

	Percentage Impact on Hours Worked				Percentage Impact on Wages			
	Young Males		Middle Aged Males		Young Males		Middle Aged Males	
	New York, Chicago, Los Angeles	Hartford, Milwaukee, Sacramento	New York, Chicago, Los Angeles	Hartford, Milwaukee, Sacramento	New York, Chicago, Los Angeles	Hartford, Milwaukee, Sacramento	New York, Chicago, Los Angeles	Hartford, Milwaukee, Sacramento
All Professionals[b]	2.30	1.10	-2.08	-2.09	13.0	13.7	26.9	22.0
Lawyers and Judges	3.79	1.92	-1.34	-1.70	13.4	13.5	34.3	23.5

[a]Estimates were obtained by forming $\theta_1 Rival + \theta_2 Rival*WageIQR$ for each individual observation in the sample and then averaging across individuals while applying the sampling weights ("perwt") in the IPUMs to ensure a representative result. Estimates of θ_1 and θ_2 for the "All Professionals" results were obtained from Model 7 in Tables 4 and 6. For the "Lawyers and Judges" results, Model 7 was estimated using only lawyers in the sample and estimates from those regressions (for hours and wages) used to compute the influence of rivals.

[b]Professional workers are in occupations categorized as Professional-Technical in the OCC1950 variable of the IPUMS *and* who have a Masters degree or more. Non-Professionals include all other workers except managers and agricultural workers *and* who have less than a Bachelors degree. Lawyers and Judges belong occupation category (OCC1950) 55 and have a Masters degree or more.