# The Urban Rat Race:
# Thick Markets, Signaling, and Hours Worked in Cities

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## Abstract

This paper establishes the existence of the previously overlooked relationship between agglomeration and hours worked. Using 1990 IPUMS data on full-time workers, the paper shows that professionals work longer hours when there is a high density of other workers in the same occupation. This effect is twice as a large for the young as for the middle-aged. Young professional work hours are also shown to be especially sensitive to the presence of labor market rivals. No such relationship is found for the middle-aged. This pattern has a number of potential explanations, including the selection of hard workers into cities and the high productivity of agglomerated labor. The pattern can also be explained by the keen rivalry associated with large markets, a kind of urban rat race. Using differencing methods, the paper finds evidence of all three forces among professional workers. In contrast for non-professionals, work-spreading effects appear to dominate for all age groups.

## 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 or 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, especially with respect to young versus middle-aged workers, and professionals

[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. We will discuss the limitations of these approaches below.

[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.

versus 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. 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 nearly 2 hours longer in the bigger cities on average, 50.05 versus 48.61. In contrast, among middle-aged male lawyers there is little difference in average hours worked. Taken as a whole, the pattern in Table 1 suggests that there is a positive relationship between agglomeration and hours worked for professionals, but not for non-professionals.[6]

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[4]The data are from the 1990 IPUMs. 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. In all cases estimates are based on individual level data from the 1990 Census as obtained from the Integrated Public Use Microdata Series (IPUMS). Person sampling weights available in the IPUMs (perwt) were used to ensure that the estimates in Table 1 are representative.

[6] Evidence that work behavior differs between professionals and non-professionals echoes Colemen and Pencavel (1993a and b), who report 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 are 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, one to which we pay special attention, is that there is more rivalry in large markets, and this may lead workers to choose long hours as a way to signal ability. We characterize this as an "urban rat race". Finally, we also consider the possibility that adding workers to a local labor market could reduce individual hours worked as the total workload is spread out over a larger number of individuals. These models yield different predictions about the agglomeration-hours worked relationship.

We test for the presence of these forces using full-time workers from the 1990 IPUMS of the Decennial Census. Among non-professionals, increased spatial concentration of workers in the individual's occupation results in fewer hours worked, consistent with the presence of work-spreading effects. The opposite is true for professional workers of all ages. Among these workers, hours worked 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. Why?

To investigate these patterns further, we augment the professional models with controls for labor market rivals in the local area and the financial rewards to advancement. When the rewards to getting ahead are zero, the presence of rivals has a negative – work-spreading – 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 very large effect. These findings are consistent with the rivalry explanation of the urban rat race.

The paper's results are also 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 is what 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 in labor markets. Akerlof (1976) is fundamental in the vast literature on adverse selection in labor markets, but there has been little empirical work on the rat race. The best test of the rat race model 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 presents three different theoretical arguments that all imply a positive relationship between agglomeration and hours worked. Section II also identifies additional predictions of the models that allow us to test the various explanations. Section III discuses our data and variable construction. Section IV presents the empirical results, and Section V concludes.

## II. Theories of the agglomeration-hours worked relationship

As noted in the introduction, there are several potential explanations of the result that agglomeration leads to harder work. This section will present simple models that capture these explanations.

We begin with the model of labor market rivalry. There are two key elements to this model. The first is signaling. In our model, productive workers are willing to work long hours to ensure that employers recognize their abilities and pay them accordingly. The second key element is thick market effects. In a large market, workers are closer to each other in type, and so having many rivals leads to more signaling. This leads to a situation where workers in large markets are forced to work very hard to distinguish themselves from their neighbors.

## A. Signaling

We will begin with the model of signaling. For now, suppose that there are two workers, with ability given by $\theta \subset \Theta = [\theta^{-}, \theta^{+}] \subset \Re^{+}$. A higher value of $\theta$ corresponds to greater ability. Workers are employed by firms, who behave as competitors in the labor market. As usual, we suppose that employers do not know workers' abilities. Worker utility is given by $u = w - c\cdot(h-\theta)^2$ for positive constant c, wages w, and hours worked h. This utility function incorporates the standard Spence-Mirrlees condition that more able workers signal at lower cost, in this case by working long hours. In the absence of rivalry, there would be no need to signal, and the worker would choose $h = \theta$. For simplicity only, we also suppose that a firm's profits from hiring a worker of type-$\theta$ equals $\theta$.

We suppose that firms and workers play the following game. In stage 1, workers demand wage-hours bundles, (w, h). In stage 2, firms accept or reject these offers. The second stage captures competition in the labor market, which will require firms to pay each worker according to his or her expected output. In its inclusion of worker effort as a signal, this game is in the spirit of Akerlof (1976). It is also, of course, a signaling game in the spirit of Spence (1973).

The features of a separating equilibrium of this kind of game are well known (see, for instance, Tirole (1989)). The high-type worker must choose hours so that the low-type worker is just indifferent between working hard and being thought to be high-type and not working hard and being correctly recognized as low-type. Denoting the two types as $\theta_H > \theta_L$, an employer will pay a known high-type worker $w = \theta_H$ and a known low-type worker $w = \theta_L$. Using the utility function, this means that the high type's minimum level of effort needed for separation $h_S$ satisfies

$$\theta_L = \theta_H - c(h_S - \theta_L)^2. \qquad \text{(II.1)}$$

Applying the quadratic rule and solving for $h_S$ gives

$$h_S = \theta_L + c^{-1/2}(\theta_H - \theta_L)^{1/2}. \qquad \text{(II.2)}$$

This means that one form that a separating equilibrium might take would be: the low-type chooses $h = \theta_L$, the high-type chooses $h = h_S$, employers believe that a worker choosing $h_S$ is a high-type, employers believe that a worker choosing any other level is a low-type, and employers pay wages equal to productivity levels for the two types. It has already been demonstrated that the low-type worker does not strictly prefer the high-type worker's bundle of wage and hours. To see that the high-type worker does strictly prefer the high hours bundle, one need only solve for the level of hours at which the high type worker is indifferent between being perceived as a low-type and working harder to be perceived as a high type ($h_R$):

$$\theta_L = \theta_H - c(h_R - \theta_H)^2. \qquad \text{(II.3)}$$

Applying the quadratic rule as above, this gives

$$h_R = \theta_H + c^{-1/2}(\theta_H - \theta_L)^{1/2}. \qquad \text{(II.4)}$$

Clearly, $h_R > h_S$ since $\theta_H > \theta_L$. This is a consequence of the marginal cost of additional work hours being lower for the high-type worker for $h > \theta_L$, an instance of the Spence-Mirrlees condition. Finally, in equilibrium the employers cannot do better than to accept the wage-hours demands, and employer beliefs about worker types are correct. It is well-known that other employer beliefs can lead to other separating equilibria. This one described above is the least-cost signaling equilibrium. We will concentrate on it throughout.[7]

The key feature of the separating equilibrium is that rivalry forces the high-type worker to work harder than when a rival was not present. This hard work may not be necessary. If the difference in type is large enough there will be a natural separation of the two types. The utility

[7] See Tirole (1988) for a discussion of why the least-cost equilibrium satisfies reasonable criteria regarding beliefs.

maximizing choice of work effort will be $h_L = \theta_L$ and $h_H = \theta_H$. This situation will arise when $h_S < \theta_H$. Manipulating (II.2) this requires

$$\theta_H - \theta_L \geq 1/c. \tag{III.5}$$

Thus, signaling by working long hours occurs only when the two types of worker are close to each other in ability. The degree of signaling (overwork) is a non-monotonic function of $\theta_H - \theta_L$. For $\theta_H - \theta_L$ near 1/c, the high-type worker does not need to work very hard to separate from the low-type worker. For $\theta_H - \theta_L$ near 0, the low-type worker is not willing to do very much to masquerade as a high-type since the expected rewards are small. Again, the high-type worker does not need to work hard to be distinguished. It is when the two workers are close but not too close that the greatest amount of signaling occurs. Differentiating $h_S$ with respect to $\theta_L$ shows that $h_S$ is maximized when $\theta_H - \theta_L = c$.

The key characteristic of the equilibrium is that when the separating equilibrium is relevant, the high-type worker must work long hours in order to signal his or her type. The heart of the proof is that both types of agents receive additional wages equal to $\theta_H - \theta_L$ from working hard enough to be recognized, correctly or not, as high-type workers. Because effort is more costly to the low-type worker, it is possible to find a level of effort that the high-type worker is willing to put forth but from which the low-type worker would shirk. This result recapitulates Akerlof's (1976) analysis of a rat race in a framework that is amenable to considering the thick market effects associated with agglomeration. The lowest-type worker chooses an effort level that corresponds to type, while higher-type workers choose levels that may be higher than they would have chosen in order to identify their high productivity.

## B. Thick markets

We now turn to the issue of thick market effects. Suppose that instead of there being two workers, there are I. For now, we assume that the workers have types that are random draws from a uniform distribution on Θ. Later, we will allow for nonrandom selection into cities. It is straightforward to extend the signaling analysis presented above. Workers will be forced to work long hours when they are close to each other in type. In the least-cost signaling equilibrium, a worker will choose h such that it discourages the keenest competing worker from pooling.

We have two results that characterize the urban rat race. Proofs are in the Appendix:

> Proposition 1: The probability that a worker will signal through working long hours increases with the number of rival workers.

Adding more workers increases the likelihood that at least one is close enough to a given worker to lead to signaling.

> Proposition 2: The expected level of a worker's hours increases with the number of rival workers.

Adding more workers also increases the expected amount of overwork as well. The heart of the proof is that the rat race arises as a consequence of a kind of negative matching. Like the matching analyzed by Helsley and Strange (1990), the match is closer as the population grows, a thick market effect. In the Helsley-Strange model, this better match increased productivity. In contrast, in this case a better match increases the amount of signaling that occurs. This means that the amount of signaling that occurs in a large market will be greater.

It is also important to keep in mind that this result can be interpreted as bearing on the spatial concentration of an occupation, rather than on the agglomeration of all kinds of workers. The key issue is whether workers compete with those in their own occupation or instead with all workers in their labor market. If rivalry takes place within an occupation, then it is the localization of a given occupation that leads workers to exert themselves in order to separate themselves from their less able neighbors.

This increase in work ethic is inefficient in this model. We would not want to read too much into this. The inefficient overwork is a consequence of the model's simplifying assumptions. In a richer model the long hours associated with large cities might actually enhance efficiency by balancing some other distortion, for instance taxation or agency problems.

## C. Productivity and selection.

There are other potential explanations for correlations between labor market size and worker effort. To consider them, we need to modify the model slightly. The first modification is that productivity equals $\theta h g(I)$, for $g(I)$ an increasing and concave function of market size I. Multiplying type by h means that longer hours add to productivity. Multiplying by $g(I)$ reflects agglomeration economies. The second modification is that a worker incurs congestion costs in a large market, captured by the increasing and convex congestion cost function, $k(I)$. It is likely that k varies idiosyncratically across workers, an issue that we will take up later. Substituting in the zero-profit condition for employers, worker utility becomes:

$$\theta h g(I) - c(h - \theta)^2 - k(I). \qquad \text{(II.6)}$$

A worker would choose the level of hours that maximizes the utility defined in (II.6), satisfying

$$h = \theta(g(I)+2c)/2c. \qquad \text{(II.7)}$$

This increases in I since $g(\cdot)$ increases in I. Workers will choose longer hours in a large market because their labor is more productive, and therefore better rewarded.

Maximizing the utility function in (II.6) over I, the market size that maximizes a worker's utility satisfies

$$\theta h g'(I) - k'(I) = 0. \qquad \text{(II.8)}$$

Substituting in h from (II.7) and applying the implicit function theorem gives

$$dI/d\theta = -2\theta\, g(I)\, (g(I)+2c)/2c/(\theta h g''(I)-k''(I)) > 0.$$

This means that higher-type workers would choose large cities, a selection effect. It is worth noting that the selection effect as modeled here is derived from the productivity effect. There may be other channels through which this kind of selection operates, for instance a taste by productive workers for urban amenities.

## D. Empirical tests

We have considered three models that predict a positive relationship between labor market size and hours worked, rivalry, productivity, and selection. It seems likely that all three forces are at work, at least to some degree. In order to test for the presence of these different forces, we will examine other predictions of the models.

### *Labor supply effects*

One way that the models differ is in their predictions regarding which occupations will exhibit a positive relationship between market size and work hours. In the productivity model, workers put in long hours because they are compensated for doing so. In the selection model, hard workers select long hours anticipating this compensation. These effects should apply to all occupations. On the other hand, in the rivalry model, 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. This condition is more likely to characterize professional occupations, since output is somewhat intangible, rather than nonprofessional occupations where output is more readily identified. Also, professionals typically work for a salary, while most non-professionals work for an hourly wage. That difference weakens the link between output and compensation for professionals relative to non-professionals. Taken together, these differences suggest that the agglomeration-market size relationship should be stronger in professional occupations if rivalry effects are important.

Another way that the models differ is in their predictions regarding work hours over an individual's lifetime. Returning to the rivalry model, 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)).[8] 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 model are not shared by the productivity or selection models. 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 select cities in order to take advantage of urban opportunities. It seems likely that this effect would not erode over a worker's life. Consequently, in both the productivity and selection models, the effect of agglomeration on work hours will persist.

[8] Holmstrom (1982) is a theoretical paper that considers the issue of how incentives differ during a worker's life.

*Labor demand effects*

Thus far, our discussion of the models linking hours worked and agglomeration has emphasized labor supply. Labor demand also plays a role. For example, in the case of professional occupations, workers are likely to be salaried, and the marginal cost to an employer when an employee works longer hours is approximately zero. Under these conditions, employers have incentives to encourage long hours. However, if there is a limited amount of work to be done, then having more professional workers of a particular type will tend to result in each working shorter hours, *ceteris paribus*. This work-spreading effect influences the hours worked of both young and old professionals and implies a negative relationship between the presence of similar type workers and hours worked.

The situation is analogous for nonprofessional workers, with the difference that rivalry effects are likely to be absent for the reasons discussed above. In addition, workers in these occupations are likely to be paid an hourly wage. This means that employers are not necessarily willing for such workers to put in long hours. Compounding this situation, 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 (see Pencavel (1986)). That Act was modified in 1940 to set a standard week at 40 hours for a wide range of non-professional occupations.[9] These features increase the likelihood that for nonprofessional occupations, an increase in the number of similar type workers in the local area will have work-spreading effects that serve to reduce hours worked among individual workers.

Summarizing, from a supply side perspective, rivalry, productivity, and selection all imply a positive relationship between hours worked and agglomeration, at least in some

[9] Professional occupations were specifically exempted.

circumstances. These models never imply a negative relationship. The supply side models 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. In the empirical work that follows, we use differencing strategies along with several specialized agglomeration variables to explore the relationship between agglomeration and hours worked.

## III. Data and variables

The core data for the project were taken from the 1990 5% PUMS of the Census and were obtained from the IPUMS website.[10] From these data, we included 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 experimented with a sample based on individuals working 40 hours per week or more. Results for this latter group were nearly identical as for the 35 hours-plus sample and are not reported.[11]

In the analysis that follows, we divide workers into two occupational groups. Professional workers are defined to be individuals in Census defined occupations categorized as "Professional" or "Technical" who also have a Masters or more for educational attainment.[12] Non-Professional workers are defined to be those belonging to all other occupational categories except farmers and managers who also have less than a Bachelors degree.[13] Individuals not

[10]See www.ipums.org.

[11]We also ran the models setting the minimum hours worked to 1 hour or more per week. Once again, results were similar, in part because the great majority of males in their 30s and 40s work full time.

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

[13]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.

belonging to one of these two groups were excluded from the sample. This ensures that our division of workers into Professional and Non-Professional categories is as meaningful as possible.[14] 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.

Identifying the various dimensions of the agglomeration-hours worked relationship is our primary goal. Nevertheless, we also control for the influence of individual-specific attributes. In part this is because wages affect an individual's willingness to supply labor, but wages 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.[15]

## IV. Results

### A. Hours Worked

In the models to follow, the log of hours worked is used as the dependent variable. Male and female labor market participation are well-known to differ, so we estimated separately for

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[14]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 increasingly similar to that of the Non-Professionals defined above as the level of education falls.

[15]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 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.

the two genders. Only the male results are presented here. The female results, which are similar if slightly weaker. Also, in all of the regressions, the 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.

We begin by regressing log hours on occupation fixed effects, worker attributes, and a measure of population density, 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.[16] This variable is intended to capture the influence of urbanization. As noted earlier, popular folklore and our preliminary summary measures in Table 1 suggest that individuals work longer hours in larger cities – urban life is busy – in which case one would expect a positive coefficient on *PopDen*. However, work-spreading effects might imply the opposite sign.

Results are presented in Tables 2. For young professionals, 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.

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[16]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*).

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.

Three patterns are worth remarking on. First, the coefficients fit 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, estimates for young professionals also are similar to those for middle-aged professionals. As will become apparent, these patterns provide useful reference points when examining the role of agglomeration.

Consider now 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 the presence of work-spreading effects. 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.

Do these estimates imply that market size *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 controls for the occupation-specific employment density for each 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 the each of occupations in the Professional-Technical group and each of the occupations in the Non-Professional group, a total of just over two hundred occupations.

Table 3 reports results with *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 non-professionals (the last four columns of Table 3), adding the localization variable (*Occden*) causes the sign of population density to change from negative to positive, but *Popden* is small in magnitude and insignificant among both young and middle-aged workers. In contrast, the elasticity of hours worked with respect to employment density in the worker's occupation (*Occden*) is several times larger in magnitude, negative, and significant for both age groups. Once more this is consistent with the presence of work-spreading effects, but in this case the evidence suggests that such effects arise from proximity to similar type workers and not from city size *per se*.

Among professional workers, adding *Occden* also completely changes the patterns previously observed. Here, the big story is for young workers, for whom the elasticity of hours worked with respect to *Occden* is .43 percent and highly significant. Among middle-aged workers the elasticity on *Occden* is smaller, just .23 percent with a t-ratio of 2.35. Also, after controlling for localization effects, population density (*PopDen*) has a negative impact on hours worked for both age groups.

These patterns suggest that urbanization is associated with some combination of rivalry, selection, and productivity effects among professional workers. To be precise, the larger localization effect for young professionals relative to middle-aged professionals is consistent with the presence of rivalry effects that diminish in importance as individuals enter middle age. The positive and significant localization (*Occden*) effect on young *and* middle-aged male professionals is consistent with the presence of selection and/or productivity effects: selection to the extent that industrious workers of all ages are drawn to locations with active professional environments, and productivity effects to the extent that active locations enhance worker productivity and wages, encouraging workers to log longer hours.[17]

Table 4 explores these patterns further by including variables designed to more clearly separate the influence of rivalry from selection and productivity effects. With that in mind, we construct an additional variable whose function is to help isolate the potential for labor market rivalry (*Rival*). We begin by calculating the national hourly wage distribution for all full-time workers in the individual's age cohort and occupation grouping men and women together. Next, we add up the number of full-time workers present in the individual's work PUMA and occupation that are in the individual's 5-percentile range in the age-specific (e.g young versus middle-aged) national wage distribution for that occupation.[18] As before, person sampling weights are used to ensure that the number of rivals present is representative. 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.

[17]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.

[18]For example, for a 30-year old doctor at the $32^{nd}$ 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 $30^{th}$ through $34^{th}$ percentiles of the national wage distribution. Had the doctor's wage been at the $36^{th}$ percentile, we would have added up individuals in the $35^{th}$ through $39^{th}$ percentiles of the distribution.

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.*[19] 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.[20]

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 out work loads across individuals, reducing individual hours worked. The positive effect of *Rival* on young professional work hours lends further 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. To be precise, the theory outlined earlier in the paper 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

[19]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.

[20] When running the models with 40 hours per week as the cut-off for full-time workers the coefficients and t-ratios for *Occden* were somewhat lower relative to those in Table 4. That may indicate that a higher hours worked cut-off reduces variation in the sample making it harder to identify the localization-hours worked relationship. In addition, it is worth noting that all of the other results from the 40 hour per week cut-off models were very similar to the remaining estimates in Table 4.

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 to which the professional worker is exposed. 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 (*WageIQR*).[21]

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 arguments from Bell and Freeman (2000) that wage inequality increases hours worked. Also, the remaining agglomeration coefficients are little changed from the previous model. That pattern begins to change in Model 5 where *WageIQR* is replaced with its interaction with *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

[21]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.

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 population. These results are consistent with priors and 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 out 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, or 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 which makes identification 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 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.

**B. 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 also shedding further light on the nature of the forces that contribute to the agglomeration-hours worked relationships. 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 *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 localization effects increase with worker skill levels.

In Table 6, we add controls for local rivals. Adding these controls does not affect the qualitative impact of population density (*PopDen*) and occupation employment density (*OccDen*), although the elasticity with respect to *OccDen* is diminished somewhat. As before, the elasticity with respect to occupation employment density is 50 to 100 percent larger for middle-aged professionals than for younger professionals. This is in stark contrast 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? Results related to the influence of *PopDen* and *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)). Our findings are also consistent with recent work on agglomeration and wages. Glaeser and Mare (1999) report evidence that wages are higher in large cities, consistent with our findings in Model 1 (Table 5), while Wheaton and Lewis (2001) find evidence that localization effects contribute to higher wages, consistent with our results in Model 2 (Table 5).[22]

In addition, our results suggest that some combination of selection and productivity effects enhance the average hourly output of urban professionals. That is exactly what one

[22] 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).

would expect to the extent that agglomerated labor markets make workers more valuable while also attracting talented individuals.[23]

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.[24] 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. This result is in the spirit of Saxenian (1994), and adds to the literature in which the nature of urban interactions is crucial to agglomeration economies (see also Rosenthal and Strange (2003a)).[25]

## C. 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 the middle-aged. This section will characterize the economic importance of these differences.

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[23] 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.

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

[25] 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 Model 2 of Table 3, the estimated elasticities with respect to employment concentration within the worker's own occupation (*OccDen*) are .43 percent for young professionals, half that size for middle-aged professionals, and -.16 percent for non-professionals of all ages.[26] These estimates imply that a doubling of occupation employment density would serve to widen the difference in hours worked between young professional versus non-professional workers by .59 percent, and between young versus middle-aged professionals by .21 percent. These effects are important as they help to understand differences in labor supply between different segments of the labor market. But doubling of city size does not do justice to the wide range of city sizes in the United States.[27] In addition, the influence of rivals on hours worked, especially for young professionals, is likely of much larger magnitude.

In Table 7 we examine the degree to which the presence of rivals contributes to hours worked and hourly wage rates for young and middle-aged professionals in the same two groups of cities examined at the beginning of the paper, New York, Los Angeles, and Chicago for the large cities, and Hartford, Milwaukee, and Sacramento for the middle-sized 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.[28]

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.

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[26] 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)). However, such comparisons must be made with care since the 4% estimate just noted is based primarily on studies that have estimated industry production functions, typically with controls for the number of workers but not for hours worked.

[27] As an analogy, rush hour traffic jams occur when small congestion externalities generated individual cars are scaled by the large number of vehicles present.

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

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.

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).[29] 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

[29] 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.

1.9 percent in the three moderate sized sizes 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.

## V. 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.

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.

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## Appendix

> Proposition 1: The probability that a worker will signal through working long hours increases with the number of rival workers.

Proof: Denote the worker's type by $\theta'$. The claim is that the probability that a worker will set $h > \theta'$ increases in I. There are two cases. First, suppose $\theta' > \theta^{-} + 1/c$. $h > \theta'$ when there is at least one other worker of type at most 1/c lower. The probability that $h > \theta'$ equals $1-[1-(1/c) / (\theta^{+}-\theta^{-})]^{I-1}$, which is increasing in I. Second, suppose $\theta' < \theta^{-} + 1/c$. In this case, the probability is $1-[1-\theta'/ (\theta^{+}-\theta^{-})]^{I-1}$, which is again increasing in I. QED.

> Proposition 2: The expected level of a workers hours increases with the number of rival workers.

Proof: Again, denote a worker's type by $\theta'$. This worker's hours depend on the realization of all other I-1 workers' types, $\{\theta_1, \theta_2,..., \theta_{I-1}\}$. The worker will choose hours so that the keenest rival -- the one that elicits the most signaling -- is unwilling to match the effort level. Formally, let $H(\theta', \theta'') = h_S(\theta',\theta'')$ for $\theta' \in [\theta-1/c, \theta]$ and 0 otherwise. Then, the type $\theta'$ worker will choose hours equal to max $\{H(\theta', \theta''): \theta'' = \{\theta_1, \theta_2,..., \theta_{I-1}\}\}$. Since all worker types are random variables, the hours choice of any worker is also random, with the type of the keenest worker being central.

The type of the keenest rival depends on the properties of order statistics (see Hoel, Port, and Stone(1971)). The probability density of the type $\theta'$ worker's hours, the probability that the worker sets hours equal to h, is the product of three terms. The first is the probability that a rival worker's type causes the type $\theta'$ to choose hours equal to h. By the uniform distribution assumption, this equals $1/(\theta^{+}-\theta^{-})$. The second term equals the number of rivals who could be the keenest, equal to I-1. The third term is that all of the other rivals are further away in the sense that they provoke less signaling.

To find this probability, it is necessary to invert (II.2), the equation defining $h_S$. In addition to defining a level of hours that discourages a low-type worker, (II.2) also defines the exact type of worker who would induce a high-type worker to put forth hours equal to $h_S$. (II.2) has the following two roots:

$$\theta_L^1 = -1/2c + h - [1-4ch-4\theta']^{1/2}/2c \tag{A.1}$$

$$\theta_L^2 = -1/2c + h + [1-4ch-4\theta']^{1/2}/2c,$$

defined for $h \in (0, 1/4c)$. $\theta_L^1$ represents the worker type below which the type $\theta'$ worker would choose hours less than h. $\theta_L^2$ represents the type above which the worker would also choose hours less than h. $\theta_L^1$ increases in h, while $\theta_L^2$ is decreasing in h. The probability that any one worker is less keen than the hypothetical keenest is the sum of the probabilities that the worker has type less than $\theta_L^1$ and greater than $\theta_L^2$. Under the assumption of a uniform distribution, this equals $\phi \equiv [(\theta_L^1-\theta^-)/(\theta^+-\theta^-) + 1- (\theta^+-\theta_L^2)/ (\theta^+-\theta^-)]$. The first term in brackets is the probability of a worker having type below $\theta_L^1$. The second two terms are the probability of the worker having type above $\theta_L^2$. The probability that all I-2 of the other rivals are less keen than the keenest then equals $\phi^{I-2}$.

Putting all these pieces together, the probability density of hours worked for a type $\theta'$ worker when there are I workers in total -- I-1 potential rivals -- equals:

$$g^I \equiv (I-1)/(\theta^+-\theta^-)\, \phi^{I-2}. \tag{A.2}$$

This can be compared to the probability density when there are I+1 workers in total, I of whom are potential rivals for the type $\theta'$ worker:

$$g^{I+1} \equiv I/(\theta^+-\theta^-)\, \phi^{I-1}. \tag{A.3}$$

Subtracting (A.2) from (A.3) gives the change in probability density from adding one more worker:

$$g^{I+1} - g^{I} = [(I-1)/(\theta^{+}-\theta^{-})\ \phi^{I-2} * [\phi I/(I-1) -1]. \quad (A.4)$$

The sign of this expression depends on the last term in brackets, $[\phi I/(I-1) -1]$. It equals zero for

$$\phi = (I-1)/I. \quad (A.5)$$

$\phi$ increases in h (through $\theta_L^{\,1}$ increasing in h and $\theta_L^{\,2}$ decreasing). Thus, (A.5) defines a level of h, call it h*, at which the probability density is the same when there are I workers and when there are I+1. For $h > h^*$, $g^{I+1} > g^{I}$, while for $h < h^*$, $g^{I+1} < g^{I}$. This means that the probability distribution of hours is stochastically larger (see Ross(1983, p.251)) for a larger I. An immediate consequence is that expected hours is also larger for a larger I (Ross(1983, p.252)). QED.

**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 | 43.57 | 43.56 |
| | Hartford, Milwaukee, Sacramento | 43.71 | 44.04 |
| Professional Workers (including Lawyers & Judges)[b] | New York, Chicago, Los Angeles | 48.09 | 46.75 |
| | Hartford, Milwaukee, Sacramento | 47.22 | 46.72 |
| Lawyers and Judges | New York, Chicago, Los Angeles | 50.05 | 48.61 |
| | Hartford, Milwaukee, Sacramento | 47.69 | 48.66 |

[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* | .0011 | .00005 | -.0033 | -.0022 | -.0012 | -.0011 | .0004 | .0005 |
| *(Popden)* | (1.79) | (0.96) | (-3.38) | (-2.14) | (-3.68) | (-3.30) | (0.46) | (0.54) |
| *Log employment density of worker's* | | | .0043 | .0023 | | | -.0016 | -.0016 |
| *occupation in Work PUMA (Occden)* | | | (4.74) | (2.35) | | | (-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 $\theta_1$ and $\theta_2$ for the "All Professionals" results were obtained from Model 7 in Tables 4 and 6. For the "Lawyers and Judges" results, Model 7 was re-estimated including 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.