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Hotchkiss, Julie L. and Sjoquist, David L. and Zobay, Stephanie M.

Andrew Young School of Policy Studies, Georgia State University

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EMPLOYMENT IMPACT OF INNER-CITY DEVELOPMENT PROJECTS: THE CASE OF UNDERGROUND ATLANTA

Julie L. Hotchkiss, David L. Sjoquist, and Stephanie M. Zobay*

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*Department of Economics, School of Policy Studies, Georgia State University, University Plaza, Atlanta, GA 30303. We have benefited from the comments of Keith Ihlanfeldt, Robert E. Moore, Connie Bryant Moore and from the research assistance of Nikki Finlay and Salouha Sehili. This project received partial support from the Georgia State University Research Grant Program #92-013 and from the Economic Development Administration of the U.S. Department of Commerce under award #04-06-04072. All opinions are those of the authors.

Abstract

This paper makes use of a unique data set to explore the issue of whether inner-city residents are more likely to be hired by a new inner-city development than non-residents. A selection model with partial observability is specified and estimated. This partial observability model allows us to control for self-selection at the application stage and to obtain unconditional estimates at the hiring stage. We determine, holding individual and neighborhood characteristics constant, that while inner-city residents are less likely to be considered "hirable," their greater propensity to apply for jobs at this development means that they were at least as likely as non-residents to both apply *and* be hired. We also tentatively conclude that distance between an applicant's residence and the location of the development does not appear to have been an issue in the application decision.

I. Background and Introduction

John Kasarda (1985) details two recent fundamental transformations older cities have experienced that lie at the heart of the inner-city employment dilemma. The first change is *functional*; inner-cities have changed from centers of production and transportation to centers of administration and information exchange. One result of this change is the decentralization of blue-collar jobs. Wilson (1987) has argued that this decentralization of jobs is one of the factors explaining the rise in the urban underclass.[1] The second change is one of *demographics*; inner-cities have lost predominantly middle-income whites while increasing lower-income minority groups. Decline in aggregate personal income and expansion of the economically disadvantaged within the inner-city results.[2]

Both of these transformations are apparent in the relatively new city of Atlanta (new compared with New York, Chicago, or Philadelphia, for example). Between 1970 and 1990 the number of blacks residing in the city of Atlanta increased 4 percent and the number of whites declined 49 percent (Bureau of the Census). In addition, the total unemployment rate in 1995 in the city of Atlanta was 7.3 percent whereas the unemployment rate for the Atlanta MSA was 4.3 percent (Bureau of Labor Statistics).

One of the proposed policies for addressing the persistent non-employment of lower skilled minorities within the inner-city is to encourage development within the city. In this paper we consider the effect of a specific inner-city development on the employment of city residents.

One of the premises on which such a policy is advanced is Kain's (1968) spatial mismatch hypothesis.[3] Kain argued that job decentralization and residential segregation combine to reduce employment of inner-city minorities. Central to Kain's argument is that the likelihood of being employed at a given employment site is a decreasing function of distance between one's residence and the job site. While much of the early literature relating the employment of low-skilled, inner-city residents to commuting distance yields mixed conclusions, more recent evidence indicates that access is important.[4]

The spatial mismatch research suggests two general types of policies: make it easier for inner-city residents to get to or learn about suburban job sites (easier and cheaper public transportation, subsidized transportation, increased job information, or residential relocation), or bring jobs to inner-city residents (promote development projects within the inner-city).[5] With regards to the first type of policies, research has found that relocating low-income households to the suburbs has resulted in improved labor market performance (Rosenbaum and Popkin, 1991). Research as to the benefits of improved reverse commuting abilities of public transit, however, is inconclusive.[6] Research on the second type of policies has largely focused on whether employers can be induced to locate in the central city, especially in low-income areas such as enterprise zones. Research concerned with the residential location of those employed by firms in enterprise zones has largely amounted to simple comparisons of the residence of the workers hired.[7]

In this paper we provide a more rigorous analysis of the employment of inner-city residents by a major inner-city development. In addition to controlling for selected human capital characteristics, we also control for access and for neighborhood effects of concentrated poverty.[8]

This paper explores these issues with a unique data set, namely the application and hiring data associated with the recent development of Underground Atlanta. With these data we address three related issues. The first issue is whether a large inner-city development that creates low- and semi-skilled jobs can materially improve the employment of inner-city residents.[9] The second issue concerns the role of job access. We can determine whether distance (i.e., access) between residence and Underground Atlanta is a factor in determining who is employed. The third issue is the effect that neighborhood characteristics might have on the decision to apply. The ability to distinguish between applying and being hired offers an advantage over much of the previous research.

While this research focuses on the impact of Underground Atlanta, the results of the analysis are of general interest and applicability. We are able to say more about the employability issue than previous research, allowing us to address whether creating jobs in the inner-city is a viable strategy for improving the employment situation of inner-city residents. The results of the research also give additional insights into the question of the effect of job access and of the concentration of poverty on the employment of low-skilled, inner-city residents.

II. Underground Atlanta - A Natural Experiment

When Atlanta built viaducts over the railroad tracks on the South side of downtown, shops closed their street level stores and moved upstairs, on top of the viaducts. Underground Atlanta is a retail and entertainment complex that contains 165 establishments built under and above this historic maze of viaducts. The development of Underground Atlanta combined the efforts and resources of the City of Atlanta with those of private business. The development was completed in 1989.[10] Underground Atlanta is located across from the intersection of the two MARTA rail lines. About 51 percent of the businesses are minority owned.

As part of the planning for development of Underground Atlanta the Atlanta Private Industry Council created a free-of-charge job placement service, First Source, whose goal was primarily to find competent employees for the establishments and secondarily to fill as many of the new jobs as possible with city of Atlanta residents, particularly those from known pockets of the unemployed. In order to accomplish the first goal, First Source provided initial screening and referral of potential job candidates taking into account the stated needs and requests of each of the establishments. The referral service was used by 94 percent of the establishments in Underground Atlanta (use of the service was not mandatory). First Source took steps toward the secondary goal by visiting and distributing application forms to various known pockets of unemployed poor throughout Atlanta. In addition, First Source engaged in informal training of the unemployed in matters of interviewing technique and presentability. The efforts of job training and placement continue today through the First Source Job Program, which is part of the City of Atlanta Citizens Employment and Training office.

Through the Private Industry Council we obtained all of the job application forms processed by First Source; a total of 2,603. We also know the identity of the 326 individuals who were eventually hired through the efforts of the placement service. The completed job application forms provide a rich source of information with which to examine various issues regarding employment of inner-city residents: the impact of inner-city development projects, the success of targeting inner-city unemployed for jobs created by the development, and the role of distance and neighborhood characteristics in the application process.

Information from the job applications include residence location (from which we calculated the census tract centroid distance from Underground Atlanta), education, age, race, gender, number of children, marital status, and previous employment information (types of previous jobs and reasons for termination). The data from the job application forms are supplemented with data from the census tract in which each applicant resides, allowing us to identify potential neighborhood influences. Table 1 provides the means and standard deviations of the individual characteristics of the job applicants (Appendix A defines the variables used in the analysis). On average, the 2,603 applicants are young, black, live in the city of Atlanta, and are fairly attached to the labor market, given that only a small percent have no labor market experience. The large number who quit their previous job, however, suggests that this group of applicants may be fairly unstable workers, an observation consistent with the behavior of lower skilled workers. Table 1 also shows that there are no significant differences in the means of the individual characteristics between city of Atlanta residents and nonresidents.

The address on the application form was used to assign census tract characteristics to that applicant. Applicants that live in the city of Atlanta come from census tracts with higher rates of poverty, lower labor force participation, less education, and, of course, shorter distance to Underground Atlanta.

Table 2 contains weighted means of the census tract characteristics for the entire applicant pool, those who where hired, and population means for the entire Atlanta metro area for these variables. There is not much difference in census tract characteristics for those who were hired and the whole applicant pool. Applicants, however, came from census tracts closest to Underground Atlanta and neighborhoods more heavily black, poverty stricken, and less educated than the average for the entire metro area.

III. Empirical Methodology

The data suffer from a problem of partial observability, that is, we are able to observe only those individuals who have applied for jobs at Underground Atlanta. If there are unobservables that influence both the probability of applying for a job and the probability of being hired, then ignoring an individual's decision to apply will result in biased parameter estimates on the determinants of being hired. Borrowing the illustration in Bloom, *et al*. (1983), say there are two groups of potential applicants, and that those in group 1 (non inner-city residents, say) have more of some unobserved characteristics (e.g., motivation) that make them more likely to apply for jobs at Underground Atlanta. Consequently, individuals in group 2 (inner-city residents) will be less likely to apply than those in group 1 with identical observed characteristics. Therefore, those in group 2 who actually apply will have above average amounts of those unobserved characteristics. Now, if those unobserved characteristics also enter (e.g. positively) into the potential employer's hiring decision, the probability that an applicant is considered hirable will be positively associated with membership in group 2, even though such group membership does not explicitly enter the employer's decision function. Thus, the coefficients in the hiring equation are biased unless the application decision is accounted for. The *empirical* importance of controlling for the application decision will be seen in the presentation of the results. Note also, that if the employer does have a discriminatory ranking function such that group 2 membership increases the likelihood of rejection (not being hired), this will lead researchers to underestimate the degree of discrimination if the application decision is ignored since the group 2 applicant pool is "above average" relative to the entire group 2, merely by the nature of having decided to apply.

To overcome this problem of partial observability we use an econometric model suggested by Bloom, *et al*. (1983).[11] In the absence of such a model, an analysis of the application process would not allow the use of the individual level data; we would have to use census tract level data. The implication of partial observability for employment analysis is that merely estimating the probability of an applicant being hired would yield results conditional on that person having applied for a job in the first place. The inability to generalize the results from estimating this conditional probability is particularly acute here since certain applicants were actually sought out by the job placement service. While the conditional probability results would be of interest to some extent (and are also reported), we are particularly interested in obtaining unconditional results; in order to determine whether Underground Atlanta affected employment of inner-city residents, we would like to know whether inner-city residents end up being favored by the combined application and hiring process.

Following Bloom, *et al*. (1983: 100) consider the population for which

$$A_i^* = Z_i\gamma + \eta_i \tag{1}$$

$$H_i^* = Y_i\delta + \nu_i \tag{2}$$

where a person applies for a job at Underground Atlanta if $A_i^* > 0$, and not otherwise; a person is considered "hirable" (i.e., capable of eliciting a positive hiring decision) if $H_i^* > 0$, and not otherwise; and Z and Y are vectors of covariates with associated parameters γ and δ. Assume, as is standard, that $(\eta,\nu) \sim F(0,\Sigma)$ where F(.) is the bivariate normal distribution function with a variance/covariance matrix given by:

$$\Sigma = \begin{bmatrix} 1 & \sigma_{\eta\nu} \\ \sigma_{\nu\eta} & 1 \end{bmatrix}.$$

These parameters would be estimated via standard maximum likelihood bivariate probit techniques if individuals for whom $A_i^* \leq 0$ were observed. Since we do not have data on these individuals, we have a truncated sample. By merely specifying the distribution of (the unobserved) H_i^* over the subset for whom $A_i^* > 0$ we can estimate a conditional univariate probit. But this does not allow for self-selection at the application stage. Consequently, H_i^* is defined over the whole population and the model is analyzed from the truncated sample. Defining Hi* over the population allows us to make inferences about whether someone drawn from the population at random would be hired (i.e., would be considered hirable), regardless of any decision they may have made about applying.

Obviously, since we do not observe non-applicants, equation (1) can not be estimated by itself. However, in the words of Manski (1995: 83), "Sampling from one response stratum obviously reveals nothing about the magnitude of response probabilities[,]...but inference becomes possible if auxiliary distributional information is available." In other words, if we add sufficient structure to the model, we can identify it. For our problem, knowing (assuming) the distribution of η and using the information provided through the covariance $\sigma_{\nu\eta}$, we are able to identify equation (1), i.e., the individual's application decision.[12]

We specify a likelihood function that best describes the hiring pattern observed given that we only observe those who applied. The likelihood function (equation 3) consists of two pieces. The first piece describes the contribution of those who were hired, which is the joint probability of applying and being hired conditional on having applied. The second piece is the contribution of those not hired, which is the joint probability of applying and not being hired conditional on having applied. So, the likelihood function describes all possible outcomes and yields parameter estimates that are most likely to have generated the data, accounting for the fact that we are observing a truncated sample; these are the unconditional parameter estimates for the hiring equation (see Bloom, *et al*. 1983: 100-101).

$$L(H_i^* \mid A_i^* > 0, Z_i, Y_i, \rho) = \prod_{H_i^*>0} \frac{\Pr(H_i^*>0 \ \&\ A_i^*>0)}{\Pr(A_i^*>0)} \cdot \prod_{H_i^*\leq 0} \frac{\Pr(H_i^*\leq 0 \ \&\ A_i^*>0)}{\Pr(A_i^*>0)} \qquad (3)$$

In equation (3), Pr(.) refers to the probability of the event occurring and ρ is the correlation between η and ν.[13] Note that if ρ=0, equation (1) cannot be identified and the estimation of equation (2) reduces to univariate probit, whose results are interpretable only in the context of having applied for a job at Underground Atlanta.

Defining $H_i=1$ if $H_i^* > 0$ ($H_i=0$ otherwise) and $A_i=1$ if $A_i^* > 0$ ($A_i=0$ otherwise), the following log-likelihood function is maximized to obtain estimates of γ, δ, and ρ:

$$\ln L_i = H_i*\ln\left[\frac{F(Z_i\gamma, Y_i\delta, \rho)}{\Phi(Z_i\gamma)}\right] + (1-H_i)*\ln\left[\frac{\Phi(Z_i\gamma) - F(Z_i\gamma, Y_i\delta, \rho)}{\Phi(Z_i\gamma)}\right] \quad (4)$$

where, again, F(.) is the joint normal distribution function, and Φ(.) is the standard normal univariate distribution function.[14]

IV. Results

Table 3 contains maximum likelihood parameter estimates for the model detailed in equations (1) and (2) as well as the conditional univariate probit results.[15] It is notoriously difficult to obtain estimates for the partial observability model.[16] While we experienced similar difficulty, the presence of census tract variables seems to have allowed us to better identify the first stage selection of applying for a job at Underground Atlanta.

A. Probability of Applying

Three different categories of variables are included in our equation: individual-level variables including whether the individual lives in the city of Atlanta; census tract-level variables to reflect Wilson's concentration of poverty hypothesis; and, distance from residence to Underground Atlanta to incorporate the potential effect of access on the probability of applying. (See Appendix A for the definition of all the variables.) Consider first the probability of applying equation (column 3). The coefficient on DIST, distance to Underground Atlanta, is negative but insignificant. We tried several different specifications; DIST was frequently negative, but never significant. The coefficient on RESID (being a resident of the city of Atlanta) is positive and marginally significant. We assume this slightly higher probability of inner-city residents applying has something to do with the efforts of First Source, however we have no way of testing this explicitly. We also tried in place of RESID whether the individual lived in the area targeted by First Source; the results were the same.[17]

There are several possible explanations for the insignificance of DIST. First, RESID or PCTPOOR may be picking up the effect of DIST. Eliminating RESID and/or PCTPOOR from the equation, however, had no effect on the DIST coefficient. Regardless of the specification, DIST was never statistically significant.[18] Second, it is possible that the result is driven by the decision of applicants to relocate their residence if they are successful in being hired. However, this is unlikely in the case of Underground Atlanta since it is downtown where there is an absence of housing. Furthermore, many of these jobs are part-time and have high turnover. Third, it may be that distance is not a factor in this situation. There are at least three reasons why access is found to be significant in spatial mismatch studies: increased cost and difficulty in commuting to the job site; increased difficulty in acquiring information about and searching for job openings; greater social distance.[19] As noted above, Underground Atlanta is well served by MARTA's rail system. This may mean that commuting distance or time is not a significant factor. Similarly, First Source actively solicited applications from city residents, thereby increasing information regarding job openings and reducing the cost of search. In addition, it seems unlikely that social distance would be a factor given the location of Underground Atlanta and the number of minority businesses in Underground Atlanta. Given these factors, one conclusions that can be drawn is that if access is a factor in general, it is possible to overcome it with appropriate actions or circumstances. Fourth, we cannot rule out that access simply does not matter and that the other studies that find that it does are wrong.

The signs on the coefficients in the application equation for other individual characteristics are as expected and generally significant. Turning to the census tract variables, we do not find great support for Wilson's (1987) concentrated poverty hypothesis. The coefficient on PCTPOOR (percent in poverty) is negative and significant, which is consistent with Wilson's hypothesis. But the coefficients on the other census tract variables either have signs that are counter-expected from the concentrated poverty hypothesis, or are not significant. For example, individuals from census tracts with high labor force participation (LFPR) are *less* likely to apply, meaning that applicants from low labor force participation areas are more likely to apply. Likewise, PCTHS (percent of census tract with a high school degree) is negative, meaning that individuals from areas with lower education levels were more likely to apply. The results for LFPR and PCTHS may be a consequence of the types of jobs available at Underground Atlanta and/or because First Source sought out applicants from poor areas which are likely to have higher rates of non-participation and lower education levels.

B. Probability of Being Judged Hirable

We now turn to the results for "hirability" (column 4). These results give the determinants of the unobserved variable H_i^* in equation (2), which itself determines whether an application submitted by such a person would be successful. Note that this equation is not conditional on the person actually submitting an application, but rather determines whether the person meets the standards being used by employers in making their hiring decisions. The coefficients on AGE, FEMALE, BLACK, and MARRIED are negative and significant, suggest a preferential hiring for young, white, single males; in other words, young, white, single males are more likely to be judged as hirable.

For comparison, we estimated the probability of being hired conditional on having applied; the results from estimating this univariate probit are presented in column 2 of Table 3. It is of interest to note that the AGE and BLACK coefficients from the conditional, univariate probit estimation are insignificant and that AGE and FEMALE are positive. From column 3 (the partial observability model) we see that older black females are more likely to apply. When the higher probability of applying is taken into account in the partial observability model, the results in column 2 do not hold. These results illustrate the importance of controlling for selection at the application stage. For example, if one were to form conclusions about how successful females are at being hired at Underground Atlanta, the conditional model says that females are more likely to be hired than males (a significant coefficient of +0.110). However, once one controls for the greater likelihood that females apply for the jobs, the unbiased answer is that women are significantly less likely to be judged hirable at Underground Atlanta, controlling for other factors in our analysis (a significant coefficient of -0.202).

Returning to the results in column 4, the positive coefficients on QUIT and LAYOFF imply that quitting or being laid off results in less of a stigma than being fired from one's last job. Lack of labor market experience (NOEXP) also reduces one's chances of being hired.

Being an Atlanta resident reduces the probability of being judged hirable. This result is consistent with findings from other studies that being from the inner-city stigmatizes the individual (e.g., Kirschenman and Neckerman, 1991), although the source of this stigma is not discernible with these data. This indication of a prejudice against hiring inner-city residents is also supportive of Wolman, *et al*. (1994) who find that inner-city successes may be more elusive than otherwise hoped.[20] It is also possible that there may be other employability characteristics specific to city of Atlanta residents that are missing from the estimation.

To further explore the hirability of Atlanta residents, we ran separate regressions for city of Atlanta residents and nonresidents. These results are reported in Table 4.[21] For the probability of applying equations the results for the two groups are quite similar; while the magnitudes of some of the coefficients differ, the coefficients have the same sign, except for LFPR, and similar levels of significance. The noticeable difference occurs in the probability of being hiring equations. While the coefficients have the same signs for the two samples, all except the intercept are significant for the nonresidents, but none is significant for residents. This suggests that there are other factors that determine hirability for city residents. This conclusion is consistent with the observation from Table 3 that city of Atlanta residents are less likely to be judged hirable than nonresidents.

C. Joint Probability of Applying <u>and</u> Being Hired

We calculate the partial derivatives of the probability of applying, the probability of being judged hirable, and the joint probability of applying *and* being hired with respect to changes in each of the independent variables. To do this we differentiated the univariate and joint distribution functions respectively, and calculated the values at the full sample means (see Table 5).[22] In general, these partial derivatives are small. The effect of distance on the univariate probability of applying, besides not being significant, implies that even a one standard deviation reduction in distance (4.31 miles) would increase the probability of applying by only 0.4 percentage points.[23] While being black increases the probability of applying, the negative effect of being black on the perception of hirability results in a negative impact of being black on the joint probability of applying *and* being hired. The larger partial derivatives for the neighborhood variables reflect the units in which those variables are measured; a standard deviation change in any of the those variables also results in a small change in the probabilities.

While being a city of Atlanta resident increases the probability of jointly applying and being hired by only two percentage points (17 percent of the mean joint probability), the higher probability of residents applying appears to overcome their lower chance of being judged hirable. This result is consistent with the descriptive statistics reported in Table 2; the sample of people hired at Underground Atlanta contains much higher proportions of people from poor, nonwhite census tracts than does the Atlanta metro area.

V. Conclusions

Our results suggest that distance, once we control for individual characteristics and sample selection, did not matter in deciding whether to apply for a job at Underground Atlanta. This result is inconsistent with much of the literature that suggests that, in general, access does matter. However, given the accessibility to Underground Atlanta through MARTA, that First Source made a significant effort to recruit inner-city applicants, and that Underground Atlanta is not likely to be viewed as hostile to minority employees, the result suggests that it may be possible to overcome the effect access has on employment of lower-skilled, inner-city minorities.

What about the policy of trying to employ inner-city workers? The results are somewhat encouraging. While being a resident of the city of Atlanta reduced the probability of being judged hirable, city of Atlanta residents were much more likely to apply for the jobs. The net outcome was that city of Atlanta residents were at least as likely as non-residents to both apply *and* be hired. This provides some encouragement that job location and/or placement efforts on behalf of those deemed less employable may be effective in actually placing them in jobs.

Endnotes

[1]Ihlanfeldt and Sjoquist (1989) also find that decentralization results in lower net earnings. For a review of the underclass literature see Sjoquist (1990) and chapters in Lynn and McGeary (1990).
[2]Wheeler (1990) also describes the impact of these transitions on the living standards of inner-city residents.
[3]Wilson (1987) relies heavily on Kain's argument and Kasarda's analysis of job suburbanization in his theory of the underclass.
[4]The literature on spatial mismatch has been recently reviewed by Holzer (1991), Ihlanfeldt (1992), and Kain (1992).
[5]These two solutions have long been debated in the literature. See, for example, Kain and Persky (1969), Harrison (1974), and Downs (1968).
[6]While HUD (through its "Bridges to Work" program) is experimenting with alternative transportation between central cities and suburban job sites, a recent study by Turner (1997) suggests that these efforts will not be successful in landing inner-city residents in suburban jobs.
[7]For a discussion of the literature evaluating enterprise zones, see Ladd (1994).
[8]Wilson (1987) has argued that factors associated with concentrated poverty lead residents of such areas to engage in nonproductive behavior. For a review see Jencks and Mayer (1990).
[9]Note that improvement in employment opportunities is only one dimension of overall economic well-being as defined by Wolman, *et al*. (1994: 838).
[10]The original Underground Atlanta, started in the 1960s, was closed in the late 1970s.
[11]Bloom and Killingsworth (1982, 1985) developed this approach for the case in which the dependent variables are continuous. They show it is a generalization of Heckman (1979).
[12]It should be noted that models that result from sampling from "one response stratum," as described by Manski (1995), can yield parameter estimates that are not considered very reliable (also see Maddala, 1984: 267). Consequently, while we will discuss the parameter estimates obtained from the decision-to-apply equation, they should be received with caution. However, although the reliability of the decision-to-apply parameter estimates can be called into question, the presence of the decision-to-apply equation has served its primary purpose of producing unbiased parameter estimates for the hiring equation.
[13]See Abowd and Farber (1982) for a version of this likelihood function when the error terms are assumed to be independently distributed.
[14]See Appendix B for estimation details.
[15]The conditional results are presented to demonstrate the importance of controlling for selection at the application stage and are discussed in greater detail later.
[16]For example, see Bloom, *et al*. (1983) and Maddala (1983, p. 282). Although we, too, experienced difficulty in achieving convergence, we were able to obtain estimates for a number of specifications, giving us confidence in the stability of the estimates reported.
[17]We report the results for RESID here because we do not have a lot of confidence in the consistency with which First Source identified an applicant as coming from a target area.
[18]This result held even when DIST was the *only* neighborhood characteristic left as a regressor.
[19]By social distance we mean that inner-city minorities may believe that they will not be socially accepted at suburban job sites.
[20]Wolman, *et al*. (1994) find that, "the change in the economic well-being of residents of cities that are typified as 'urban success stories' between 1980 and 1990 did not differ from--and in some cases was inferior to--change in the economic well-being of residents of other cities that were (like the 'urban success stories') distressed in 1980," (p. 844).
[21]The inherent difficulty in getting estimates for a partial observability model forced us to restrict the number of regressors in the estimations for the two subsamples.
[22]See Appendix B for the analytical expressions for these partial derivatives.
[23]This amounts to about 34 percent of the mean joint probability.

Table 1. Means of individual and census tract (neighborhood) characteristics of applicants for jobs at Underground Atlanta, 1989; non-missing observations.

Variables	Full Sample	Hired = 1	Atlanta Resident	Atlanta Non-resident
Individual Characteristics:				
Age	27.75 (8.83)	26.97 (0.08)	28.84 (9.06)	26.89 (7.70)
High School Graduate = 1	0.88 (0.33)	0.87 (0.33)	0.84 (0.36)	0.91 (0.29)
Some College = 1	0.38 (0.49)	0.40 (0.49)	0.32 (0.47)	0.42 (0.49)
College Degree = 1	0.06 (0.23)	0.07 (0.25)	0.05 (0.22)	0.06 (0.23)
In School when Applied = 1	0.17 (0.37)	0.23 (0.42)	0.14 (0.35)	0.19 (0.39)
No Labor Market Experience = 1	0.03 (0.16)	0.01 (0.10)	0.03 (0.17)	0.02 (0.15)
Female = 1	0.51 (0.50)	0.57 (0.50)	0.48 (0.50)	0.53 (0.50)
Married = 1	0.14 (0.34)	0.10 (0.30)	0.13 (0.34)	0.14 (0.35)
# Children Less Than Six Years	0.31 (0.62)	0.29 (0.62)	0.33 (0.65)	0.30 (0.60)
Black = 1	0.91 (0.29)	0.90 (0.31)	0.92 (0.27)	0.90 (0.30)
Quit most recent job = 1 (most common reason: job dissatisfaction)	0.40 (0.49)	0.49 (0.50)	0.41 (0.49)	0.39 (0.49)
Fired from most recent job = 1	0.03 (0.17)	0.03 (0.16)	0.03 (0.16)	0.03 (0.17)

Laid-off most recent job = 1	0.22 (0.42)	0.25 (0.43)	0.22 (0.42)	0.22 (0.42)
Target Applicant = 1 (city of Atlanta resident)	0.44 (0.50)	0.40 (0.49)	1.00	0.00

Table 1, cont.

Variables	Full Sample	Hired = 1	Atlanta Resident	Atlanta Non-resident
Individual Characteristics, cont.:				
Hired = 1	0.13 (0.33)	1.00	0.11 (0.32)	0.14 (0.34)
Census Tract Characteristics:				
Percent below poverty level	0.27 (0.18)	0.24 (0.18)	0.34 (0.18)	0.21 (0.17)
Labor force participation rate	0.78 (0.11)	0.79 (0.10)	0.74 (0.11)	0.80 (0.10)
Percent of residents with HS degree	0.66 (0.17)	0.67 (0.17)	0.58 (0.16)	0.73 (0.14)
Distance to Underground (in miles)	6.21 (4.31)	6.58 (4.38)	3.10 (1.56)	8.65 (4.20)
Number of Observations	2,603	326	1,145	1,458

Notes: Standard deviations are in parentheses.

Table 2. Weighted means of census tract characteristics for whole (non-missing) applicant pool, for applicants that were hired, and for the Atlanta Metropolitan Area.

Census Tract Characteristics	Mean for All Applicants	Mean for Hires Only	Mean for Atlanta Metro Area
Distance in miles from Underground	6.21	6.58	18.21
Percent white	20	20	72
Percent female	54	54	51
Percent below poverty level	27	24	10
Percent receiving welfare	18	16	6
Percent female headed household	17	16	7
Percent with high school degree	66	67	80
Labor force participation rate	78	79	83

Notes: Means for the Atlanta metropolitan area represent weighted means of census tract information for those census tracts represented by the applicant pool.

Table 3. ML estimates for the single-equation probit and two-equation partial observability model: full sample.

	UNIVARIATE PROBIT MODEL	TWO-EQUATION PARTIAL OBSERVABILITY MODEL	
Dep. Variable =	Probability of Being Hired	Probability of Applying	Probability of Being Hired
Intercept	-1.271***	8.208*	-0.359
	(0.203)	(4.931)	(0.335)
Individual Characteristics:			
AGE	0.00005	0.265**	-0.014**
	(0.004)	(0.098)	(0.006)
FEMALE	0.110*	4.219**	-0.202*
	(0.065)	(1.386)	(0.112)
BLACK	-0.097	0.496	-0.204^
	(0.109)	(0.731)	(0.128)
MARRIED	-0.163^	--	-0.149^
	(0.104)		(0.103)
HS	0.002	--	-0.020
	(0.104)		(0.108)
SOMECOLL	-0.069	--	-0.071
	(0.080)		(0.084)
COLL	0.187	--	0.168
	(0.146)		(0.152)
QUIT	0.299***	--	0.300***
	(0.075)		(0.078)
LAYOFF	0.269**	--	0.264**
	(0.087)		(0.090)
NOEXP	-0.463*	--	-0.449*
	(0.271)		(0.272)
SCHOOL	0.207**	2.228**	0.030
	(0.096)	(0.988)	(0.122)
CHILDRN	--	-1.433**	--
		(0.531)	

RESID	-0.093^ (0.066)	1.026^ (0.665)	-0.195** (0.079)

Table 3, cont.

Dep. Variable =	UNIVARIATE PROBIT MODEL	TWO-EQUATION PARTIAL OBSERVABILITY MODEL	
	Probability of Being Hired	Probability of Applying	Probability of Being Hired
Census Tract Variables:			
PCTPOOR	--	-10.435**	--
		(4.076)	
LFPR	--	-8.889**	--
		(3.965)	
PCTHS	--	-8.802**	--
		(3.566)	
DIST	--	-0.010	--
		(0.080)	
ρ =	--	-0.417**	
Log-likelihood =	-961.38	-941.80	
N = 2,603			

Notes: Standard errors are in parentheses. Two-tailed significance levels: * => 90%, ** => 95%, *** => 99%. ^ => significant at least at the 90% level with a one-tailed test. Definitions of variable names are found in Appendix A.

Table 4. ML estimates for the two-equation partial observability model: target and non-target applicants.

Dep. Variable =	Atlanta Residents (target applicants) Probability of Applying	Probability of Being Hired	Atlanta Nonresidents (non-target applicants) Probability of Applying	Probability of Being Hired
Intercept	12.228^	-1.016	-5.353^	0.075
	(9.241)	(0.248)	(3.320)	(0.273)
Individual Characteristics:				
AGE	0.304**	-0.005	0.177**	-0.032***
	(0.141)	(0.006)	(0.054)	(0.008)
FEMALE	4.338*	-0.149	3.051***	-0.431***
	(3.204)	(0.118)	(0.707)	(0.054)
QUIT	--	0.141	--	0.412***
		(0.123)		(0.102)
LAYOFF	--	0.175	--	0.333**
		(0.140)		(0.113)
NOEXP	--	-0.256	--	-0.589^
		(0.364)		(0.403)
SCHOOL	3.307^	--	0.849*	--
	(2.351)		(0.458)	
CHILDRN	-1.252**	--	-0.993***	--
	(0.590)		(0.222)	
Census Tract Variables:				
PCTPOOR	-11.038*	--	-1.162	--
	(5.705)		(2.292)	
PCTHS	-12.970**	--	-7.061**	--
	(4.792))		(2.232)	
LFPR	-9.122^	--	6.416**	--
	(6.971)		(2.552)	
DIST	0.132	--	0.047	--
	(0.460)		(0.044)	

ρ =	-0.614***	-0.511***
	(0.106)	(0.104)
Log-likelihood =	-392.40	-544.52
N =	1,145	1,458

Table 4, cont.

Notes: Standard errors are in parentheses. Two-tailed significance levels: * => 90%, ** => 95%, *** => 99%. ^ => significant at least at the 90% level with a one-tailed test. Definitions of variable names are found in Appendix A. Because of the difficulty in getting this type of model to converge, the likelihood functions were maximized via an iterative procedure. After convergence is achieved for a subset of regressors, that subset is held constant while the likelihood function is maximized for the remaining regressors. This is repeated until regressors do not change much from one iteration to another. For the target applicants (Atlanta residents), the log-likelihood value corresponds to a model where the correlation coefficient (ρ) is held constant. For the non-target applicants (Atlanta nonresidents), the log-likelihood value corresponds to a model where FEMALE is held constant.

Table 5. Partial derivatives of the marginal and joint probabilities of applying and of being hired: full sample.

Independent Variables (X)	$\frac{\partial P(\text{Apply}=1)}{\partial X}$	$\frac{\partial P(\text{Hired}=1)}{\partial X}$	$\partial P(\text{Apply}=1, \text{Hired}=1)/\partial X$
Intercept	0.715	-0.087	0.383
Individual Characteristics:			
AGE	0.023	-0.003	0.012
FEMALE	0.367	-0.049	0.194
BLACK	0.043	-0.049	-0.011
MARRIED	--	-0.036	-0.028
HS	--	-0.005	-0.004
SOMECOLL	--	-0.017	-0.013
COLL	--	0.040	0.032
QUIT	--	0.072	0.056
LAYOFF	--	0.064	0.050
NOEXP	--	-0.108	-0.084
SCHOOL	0.194	0.007	0.128
CHILDRN	-0.125	--	-0.079
RESID	0.089	-0.047	0.020
Census Tract Variables:			
PCTPOOR	-0.909	--	-0.573
LFPR	-0.774	--	-0.488
PCTHS	-0.766	--	-0.483
DIST	-0.001	--	-0.001

Notes: The mean joint probability of applying and being hired, $F(\bar{Z}'\hat{\gamma}, \bar{Y}'\hat{\delta}, \hat{\rho})$ from equation (4), is 0.1181. While standard errors for these partial derivatives could be calculated through standard (but time-consuming) bootstrapping techniques, the significance of the estimated coefficient for each variables usually yields a good idea as to whether the partial derivative is significantly different from zero.

Appendix A: Definitions of Variable Names

Individual Characteristics:

AGE: age of applicant in years (100s)

FEMALE: dummy variable that equals one if applicant is female

BLACK: dummy variable that equals one if applicant is black

MARRIED: dummy variable that equals one if applicant is married

HS: dummy variable that equals one if applicant has a high school degree

SOMECOLL: dummy variable that equals one if applicant has some college education

COLL: dummy variable that equals one if applicant has a college degree

QUIT: dummy variable that equals one if applicant quit his or her most recent job

LAYOFF: dummy variable that equals one if applicant was laid off from his or her most recent job

NOEXP: dummy variable that equals one if applicant has no labor market experience

SCHOOL: dummy variable that equals one if applicant is in school at time of application

CHILDRN: the number of children the applicant has less than six years old

RESID: dummy variable equal to one if applicant is a city of Atlanta resident (city of Atlanta residents were targeted for application for jobs at Underground Atlanta).

Census Tract Variables (all variables refer to the census tract in which the applicant lives):

PCTPOOR: number of persons in census tract with incomes below poverty level / total number with incomes above poverty level plus total number with incomes below poverty level) UNIVERSE : Persons for whom poverty status is determined. percent of census tract population below poverty line

LFPR: number of persons aged 16-64 in census tract in the labor force (both employed and unemployed) / total number in the labor force plus total number of persons aged 16-64 in census tract not in the labor force
UNIVERSE: Civilian non-institutional persons 16 years and over.

PCTHS: total number of persons aged 25 and over in census tract with a high school diploma or equivalent / total number of persons aged 25 and over in census tract

DIST: Linear distance in miles from the centroid of the census tract to the centroid of the census tract in which Underground Atlanta in located.

APPENDIX B: ESTIMATION DETAILS AND PARTIAL DERIVATIVES

The likelihood function in equation (4) was maximized using the Berndt-Hall-Hall-Hausman (1974) optimization method for approximating the Hessian and for calculating the asympototic covariance matrix of the parameter estimates. The empirical analysis was performed using the TSP software (TSP International, Palo Alto, CA), version 4.2B, on a Power Macintosh 7100/80. The following standard approximation for the bivariate normal cumulative distribution function was used in the maximum likelihood estimation procedure:

$$F(Z_i\gamma, Y_i\delta, \rho) = \Phi(Z_i\gamma)\,\Phi(Y_i\delta) + \phi(Z_i\gamma)\,\phi(Y_i\delta)\left\{\rho + \tfrac{1}{2}\rho^2(Z_i\gamma)(Y_i\delta) + \tfrac{1}{6}\rho^3\left[(Z_i\gamma)^2-1\right]\left[(Y_i\delta)^2-1\right]\right\}$$

This is a Taylor expansion around ρ for small ρ.

The following partial derivatives were evaluated at the sample means and the parameter estimates reported in Table 3 to measure the impact on the probability of applying and the probability of being judged hirable, respectively, of a one-unit change in some regressor, X_k:

$$\frac{\partial\Phi(\bar{Z}'\hat{\gamma})}{\partial X_k} = \phi(\bar{Z}'\hat{\gamma})\hat{\gamma}_k$$

$$\frac{\partial\Phi(\bar{Y}'\hat{\delta})}{\partial X_k} = \phi(\bar{Y}'\hat{\delta})\hat{\delta}_k$$

The following partial derivative was evaluate at the sample means and the parameter estimates reported in Table 3 to measure the impact on the joint probability of applying and being hired of a one-unit change in some regressor, X_k:

$$\begin{aligned}\frac{\partial F(\bar{Z}'\hat{\gamma},\bar{Y}'\hat{\delta},\hat{\rho})}{\partial X_k} &= \phi(\bar{Z}'\hat{\gamma})\,\Phi(\bar{Y}'\hat{\delta})\,\hat{\gamma}_k + \Phi(\bar{Z}'\hat{\gamma})\,\phi(\bar{Y}'\hat{\delta})\,\hat{\delta}_k \\
&\quad - \phi(\bar{Y}'\hat{\delta})\,\hat{C}(\bar{Z}'\hat{\gamma})\;\phi(\bar{Z}'\hat{\gamma})\,\hat{\gamma}_k - \phi(\bar{Z}'\hat{\gamma})\,\hat{C}(\bar{Y}'\hat{\delta})\;\phi(\bar{Y}'\hat{\delta})\,\hat{\delta}_k \\
&\quad + \phi(\bar{Z}'\hat{\gamma})\,\phi(\bar{Y}'\hat{\delta})\Big[\tfrac{1}{2}\hat{\rho}^2(\bar{Z}'\hat{\gamma})\,\hat{\delta}_k + \tfrac{1}{2}\hat{\rho}^2(\bar{Y}'\hat{\delta})\,\hat{\gamma}_k + \tfrac{1}{3}\hat{\rho}^3(\bar{Z}'\hat{\gamma})^2\,\hat{\gamma}_k \\
&\qquad + \tfrac{1}{3}\hat{\rho}^3(\bar{Z}'\hat{\gamma})^2(\bar{Y}'\hat{\delta})\,\hat{\delta}_k - \tfrac{1}{3}\hat{\rho}^3(\bar{Z}'\hat{\gamma})\,\hat{\gamma}_k - \tfrac{1}{3}\hat{\rho}^3(\bar{Y}'\hat{\delta})\,\hat{\delta}_k\Big],\end{aligned}$$

where $\hat{C} = \left\{\hat{\rho} + \frac{1}{2}\hat{\rho}^2(\bar{Z}'\hat{\gamma})(\bar{Y}'\hat{\delta}) + \frac{1}{6}\hat{\rho}^3\left[(\bar{Z}'\hat{\gamma})^2-1\right]\left[(\bar{Y}'\hat{\delta})^2-1\right]\right\}$.

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