Testing the Spatial Mismatch Hypothesis Using Inter-City Variations in Industrial Composition

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Following Kain (1968) economists have argued that a lack of jobs in the inner-city may be responsible for low and declining labor force participation among young blacks. Existing tests of the mismatch hypothesis have yielded contradictory results and have lead to questions of causality. Researchers have implicated industrial shifts in the decline in black employment opportunities. We exploit inter-city variations in industrial composition to develop instruments for job location and variations in the age of the housing stock to instrument for black residential locations. An increase in the fraction of jobs located in the central city raises black employment rates relative to whites as does an increase in the fraction of blacks living outside the central city. The effects are greatest in large MA's and for young workers, women, and those with less than a college education. IV estimates confirm the OLS results. When estimated together, job access and social interactions both have large effects on black employment.

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I. Introduction

Researchers have long been aware of large differences in employment between blacks and whites. While many explanations have been provided, Kain's (1968) suggestion that a spatial mismatch - a lack of jobs in inner-cities where most blacks live - is an important factor has proven to be among the most persistent. More recently, Wilson (1987) and Kasarda (1989) have argued that industrial shifts and the shift of employment out of manufacturing in particular have reduced job opportunities for blacks living in the inner city. This work has renewed interest in the mismatch hypothesis.

Despite this interest, tests of the mismatch hypothesis have yielded contradictory results and raised concerns about endogeneity. Two strategies have been used to test the mismatch hypothesis. One approach has been to exploit inter-city variations in job locations. Cross-city regressions of the labor market outcomes of blacks living in the central city on measures of the availability of jobs in the central city typically indicate that the availability of jobs in the central city has a strong effect on outcomes[1]. A second strand of research exploits intra-city variations in job proximity. Results from these studies often indicate weaker effects of job location on black employment[2].

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[1] In Mooney (1969) the overall employment rate was the most important factor in determining black employment (relative to whites) but the fraction of jobs in the central city was also an important determinant. Farley (1987) also finds that an increase in jobs in the central city raises black employment relative to whites. Ihlanfeldt and Sjoquist (1989) find that an increase in the fraction of low skilled jobs located in central cities decreases black earnings (net of commuting costs).

[2] Kain (1968) and Leonard (1987) find evidence that black employment declines with distance from black neighborhoods. However, Ellwood (1986) finds that cross-neighborhood variations in job proximity have only small effects on black employment rates. Ihlanfeldt and Sjoquist (1989) find strong effects of job locations on black employment. Raphael (1998) finds that changes in job proximity have strong effects. Work

In trying to reconcile these results Jencks and Mayer (1990) suggest that endogeneity may bias inter-city comparisons in favor of the mismatch hypothesis. An exogenous decrease in the labor force attachment of central city residents will lead employers to locate outside of the central city both because it will be harder to find workers and because decreases in labor force attachment may be associated with higher crime rates. On the other hand, if the demand for labor in the central city is measured using the fraction of jobs in the central city estimates may be biased downward if labor supply to the central city varies across MA's or if there are spurious variations in the boundaries of the central cities across MA's. Endogeneity is also an issue in studies that exploit intra-MA variations in job location. Sorting of low labor attachment individuals into neighborhoods with worse job access biases these estimates up. If the neighborhoods with the least desirable housing stock are located closest to the central business districts where jobs are most plentiful these estimates will be biased down.

Rather than addressing the issues of neighborhood choice, the present paper focuses on inter-MA variations developing instruments for job locations. Our instruments exploit inter-MA variations in industrial composition. Both Wilson (1987) and Kasarda (1989) have argued that shifts in the industrial structure have eliminated jobs in central cities. Industry-level differences in the importance of being centrally located and in space requirements generate cross-industry variation in job locations. Cross-city variation in industry employment patterns interacted with industrial differences in job locations provide

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by Zax and Kain (1991), Rogers (1997), and Ross (1998) exploit the dynamics of individual employment and residential mobility to find evidence for the mismatch a source of cross-MA variation in job location which is unlikely to be affected by black labor market status.

The mismatch hypothesis also implies that black concentration in the central city will reduce access to suburban jobs and increase competition for the jobs that exist in the central city. Thus, an increase in the fraction of blacks that live in the central city should decrease black employment. Again, the direction of causality is likely to be a problem with an exogenous decline in black employment making it harder for blacks to afford suburban residences and increasing crime causing whites to leave the central city. We instrument for black residential locations using lagged data on the age of the housing stock and black residential locations.

Our estimates support the mismatch hypothesis. An increase in jobs or a decline in black concentration in the central city increases black employment relative to whites. The effects are greatest in large MA's where the costs of working in a distant portion of the city are likely to be greatest. We also find larger effects on young workers, people with less than a college education, and women. Using instruments for job and black residential locations tends to increase the effects of job location on black employment. Thus, controlling for endogeneity is less important than eliminating variations in job location due to labor supply and variations in city boundaries. A 10 percentage point increase in the share of jobs located in central cities would increase the employment of young non-college educated black men by 6 percentage points. Recent work on the effects of geography on black employment has emphasized the importance of social interactions or neighborhood effects

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hypothesis. Jencks and Mayer (1990); Hozer (1991); and Kain (1992) provide

(Case and Katz 1991; O'Regan and Quigley 1996; Topa 1996; and Cutler and Glaeser 1997) . When we estimate effects of job location and social interactions simultaneously, we find large effects for both variables.

The assumption underlying the mismatch hypothesis - that labor is not freely mobile within MA's - also has implications for wages at the geographic level. We find that an increase in demand for labor in central cities is associated with higher wages for people, black and white, working in central cities.

Section II presents a simple model to illustrate the factors that are necessary for the mismatch hypothesis to operate. Section III describes the construction of the instruments for job and black residential locations. We study the effects of job locations on wages for central city and suburban workers in Section IV. Section V presents estimates of the effects of job locations on employment among blacks and whites. Section VI concludes.

II. A Simple Model

This section develops a simple model of the labor market in a metropolitan area. Our goal is to illustrate the features that are necessary for the mismatch hypothesis. Fundamentally, the mismatch hypothesis relies on geographic immobility of firms and workers although our interest in it derives from racial concerns[3]. We also consider three policy experiments.

Consider an MA with two sections, and two industries. Industry *cc* locates exclusively in the central city while industry *s* locates in the suburbs[4]. These differences, stem from

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comprehensive reviews of the literature.

[3] Arnott (1997) provides a recent model of the mismatch hypothesis.

[4] The fact that each industry locates exclusively, in one part of the city is not crucial for the analysis, what is important is that labor employed in each part of the city is imperfectly substitutable.

differences in the importance of inter-personal contacts, space requirements, and accessibility for shipments of inputs and outputs. Let

$$q^i = \Theta^i F(L^i) \; i \in \{cc, s\}$$

denote the output of industry *i* as a function of the effective labor it employs. Where Θ^i denotes the productivity of industry *i* in the MA. Natural advantages and historical accidents combined with increasing returns to scale in the production of intermediate inputs or informational externalities generate variations in Θ^i across cities (see Krugman (1991) and Ellison and Glaeser (1997)). Under perfect competition, the log wage (per unit of effective labor) in each part of the city is given by the marginal product of the industry that locates in that part of the city,

$$w^i = q^i + \ln F'(L^i), \quad q^i \equiv \ln \Theta^i .$$

We start with a reduced form labor supply function. The supply of labor to each part of the city is assumed to be increasing in the wage in that part of the city and decreasing in the wage in the other part of the city.

$$L^i = L^i(w^{cc}, w^s) \; where \; L^i_i > 0, L^i_{\sim i} < 0.$$

For this assumption to hold two things must be true. First, residential locations must be imperfectly elastic because of heterogeneity in preferences toward living in each part of the city (arising naturally or from discrimination) or because of an upward sloping supply of housing in each part of the city. It must also be costly for people in one part of the city to commute to or obtain information about jobs in the other part of the city.

Under these assumptions, the different portions of cities constitute distinct labor markets in the sense that relative wages in each portion of the city vary with the location of labor demand[5]. This constitutes

PROPOSITION 1. Given a demand for and supply of labor in each part of the city which is less than infinitely elastic, an increase in demand for labor in the central city raises wages in the central city relative to the suburbs.

The proof is in the theory appendix.

To model the effects of the location of labor demand on employment and to study the effects on blacks and whites we model individual employment and commuting decisions. Individuals maximize utility given by $\ln(y)$ if they work in the portion of the city where they live or R if they are not employed. Workers differ in terms of their skill level, a. Let w^i denote the wage per efficiency unit of labor in part of the city i. A person with skill level a who works in area i earns $y = w^i a$. A person residing in area i works if

$\ln(w^i a) \geq R$.

Workers also choose where to work. A worker living in area i who works in area $\sim i$ incurs a utility cost of $C^{i,\sim i}$ which captures the psychic cost of commuting to work as well as the cost in terms of forgone leisure from commuting and additional job search (we assume that everyone works for 1 unit of time). His utility is $\ln(w^{\sim i} a) - C^{i,\sim i}$. A person

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[5] We require two more technical assumptions. First, we assume that an increase in the wage in either portion of the city increases total employment (because some people who had been unemployed choose to work) formally, $L_i^i + L_i^{\sim i} > 0$. Related to this, we assume that $L_i^i + L_{\sim i}^i > 0$ or that an equal increase in wages in both portions of the city, raises employment in both portions of the city. Increasing the wage in one section of the city increases total employment and attracts workers from the other section of the city; an

commutes to work if $w^{\sim i}/w^{i} > c^{i,\sim i} = \exp\{C^{i,\sim i}\}$. To capture individual heterogeneity (in a reduced form manner) $c^{i,\sim i}$ is assumed to be an increasing function of people (measured in terms of effective labor) commuting from *i* to ~*i* to work. For people to be indifferent between working in each part of the city, $c^{i,\sim i} = w^{\sim i}/w^{i}$. In this model, commuting costs arbitrage wage differences between different parts of the city so that employment decisions depend only on the wage in the area of residence.

Let $h_g^i(\cdot)$ and $H_g^i(\cdot)$ denote the probability density and cumulative distribution functions of *a* for group *g* (either black or white) people living in part of the city *i*; let r_g^i denote the fraction of group *g* individuals living in area *i*. For simplicity residential locations are taken as exogenous although the distribution of skills is allowed to differ among central city and suburban residents to account for selection. We assume that $H_b^i(a) \le H_w^i(a)\ \forall a$ and that $r_b^{cc} > r_w^{cc}$. Given our interest in less skilled workers for whom jobs are more plentiful in the suburbs, we assume that in equilibrium, $w^{cc} < w^{s}$. The next two propositions pertain to the employment of blacks relative to whites.

PROPOSITION 2. The employment rate among blacks is lower than whites. Shifting blacks from the suburbs to the central city, holding constant wages, reduces black employment.

The employment rate for group *g* workers is a weighted average of the employment rates in each section of the city,

$$E_g = r_g^{cc} H_g^{cc}\left(w^{cc}\right) + r_g^{s} H_g^{s}\left(w^{s}\right).$$

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increase in the other wage pulls labor away. We assume that the first two effects dominate the third.

Even if the black and white skill distributions are the same, blacks have a lower employment rate than whites because a greater fraction of blacks live in the central city where wages are lower. Shifting any given person from the suburbs to the central city either causes them to stop working (if $w^s > r/a > w^{cc}$) or has no effect on their employment status.

PROPOSITION 3. An increase in the wage in the central city raises the employment of blacks relative to whites. An increase in the suburban wage has an ambiguous effect on the black-white employment difference.

The effect of a wage change is given by,

$$E_b - E_w = \left[r_b^{cc} h_b^{cc}\left(w^{cc}\right) - r_w^{cc} h_w^{cc}\left(w^{cc}\right)\right] dw^{cc} + \left[r_b^s h_b^s\left(w^s\right) - r_w^s h_w^s\left(w^s\right)\right] dw^s .$$

The employment of blacks is more responsive to the central city wage because a larger share of blacks live in the central city ($r_b^{cc} > r_w^{cc}$). A greater labor supply elasticity among blacks ($h_b^i(a^{*i}) > h_w^i(a^{*i})$) accentuates this effect. A decrease in suburban wages may either increase or decrease the employment of blacks relative to whites. While, a higher fraction of whites live in the suburbs ($r_b^s < r_w^s$) making the employment of whites more sensitive to suburban wages, the labor elasticity of suburban blacks may exceed that of suburban whites offsetting this difference. Overall, we expect the black-white employment differential to be increasing in the central city-suburban wage difference.

We are also interested in the effects of job and residential locations (among all workers) on wages in the central city and suburbs.

PROPOSITION 1'. An increase in the productivity of the central city industry (q^{cc}) raises the central city wage relative to the suburban wage.

PROPOSITION 4. Shifting workers from the central city to the suburbs raises the relative wage in the central city.

The labor supply model satisfies the conditions on $L^i(\cdot)$ in proposition 1 making proposition 1' an application of proposition 1. Proposition 4 stems from the location of labor supply. One implication is that less skilled inner city blacks benefit from a movement of high skilled blacks (or whites) out of the central city. This implication of the mismatch hypothesis differs from a social interactions model in which the departure of more skilled blacks hurts the less skilled people who are left behind (see Wilson 1987).

Lastly, we consider the effect of a change in wages on the mean wages of blacks and whites.

PROPOSITION 5. An increase in the central city wage may either increase or decrease the mean log wage of blacks relative to whites.

The mean log wage of group *g* is given by,

$$\overline{w_g} = \overline{\ln\left(a_g\right)} + \Pi_g^{cc} w^{cc} + \left(1 - \Pi_g^{cc}\right) w^s$$

Where the first term represents the mean of the log skill levels of the working members of group *g*; the remaining terms give the mean wage per unit of skill received by group *g* workers (Π_g^{cc} denotes the fraction of group *g* workers measured in efficiency units employed in the central city). An increase in wages reduces the quality of the group *g* workforce lowering their mean wage. This effect will be large when the supply elasticity of group *g* workers is high and when the gap between the skill of the average and marginal workers in group *g* is large. Blacks working in the suburbs also earn higher wages than those working in the central city. This difference may partially reflect selection but central city blacks must earn compensating differentials for commuting to the suburbs. An increase in wages in the central city causes fewer blacks to commute to the suburbs reducing gross earnings even though net earnings among black increase. Overall, an increase in the central city wage has an ambiguous effect on the mean wages of working blacks as employment among less skilled blacks increases and fewer blacks receive compensation for working in distant jobs.

Three policy experiments are worth considering: moving blacks from the central city to the suburbs; shifting jobs from the suburbs to the central city; and investments to reduce the costs of living and working in different areas. Proposition 4 indicates that moving workers from the central city raises wages in the central city. Moving blacks to the suburbs is particularly advantageous because those that move will earn higher wages. The welfare consequences of this policy depend on the causes of black concentration in the central city which are not modeled here. Subsidies for employment in the central city improve black conditions but generate a deadweight loss (even if there is no deadweight loss from taxation). Expenditures to improve commuting and information about job opportunities generate first order gains in terms of lower costs for those who commute and enable more workers to commute to work.

This section provides a simple model of the mismatch hypothesis. The basis for the mismatch hypothesis is imperfect mobility between the central city and suburbs on the part of firms and workers. The question, from an empirical perspective, is not whether there are any barriers to mobility within MA's. Even empirical researchers who have found weak evidence for the mismatch hypothesis find that job locations have effects consistent with the costs of commuting (Ellwood 1986). The question is whether the barriers to mobility are sufficient to explain meaningful differences in employment.

III. Instrumental Variables

To test the mismatch hypothesis we require information on the locations of jobs and black residences. Unfortunately, these locations are likely to be endogenous. A lower labor force attachment among blacks will make it harder for firms in the central city to find workers and may be associated with higher crime rates. Both factors would cause more firms to locate outside the central city biasing estimates up. On the other hand, exogenous variations in the attractiveness of living and working in the central city will cause the supply of labor to the central city to vary across MA's biasing estimates of the mismatch hypothesis down. Spurious variations in the boundaries of the central city lead to attenuation bias. The location of black residences will also be endogenous. A low labor attachment among black will make it harder for blacks to afford suburban housing and may raise crime rates in the central city causing whites to move to the suburbs.

Instruments for Job Locations

Our instruments for job locations exploit inter-city variations in industrial composition interacted with industrial differences in job locations. Classifying industries into 17 broad categories, the fraction of metropolitan employment located in central cities ranges from .181 and .443 for agriculture and durable manufacturing to .629 and .639 for public administration and professional services excluding health and education. These variations appear to be due to variations in space requirements, the importance of being centrally located and the importance of access to transportation. It is notable that manufacturing, which has been the focus of work Wilson (1987) and Kasarda (1989), locates heavily in the suburbs. Thus, declining manufacturing employment would reduce suburban job opportunities.

We estimate the demand for workers in central cities using a fixed coefficients demand index similar to that developed by Freeman (1975) and Katz and Murphy (1992). Let $f_{i|c}$ denote the fraction of the workforce in MA *c* that is employed in industry *i*. We estimate the extent to which each industry locates in central cities using national data. Let $f_{a|i}$ denote the fraction of workers in industry *i* in central cities of MA's, $a = CC$, (or suburbs, $a = S$). Our instrument for the fraction of the workforce in MA *c* employed in central cities is

$$\hat{f}_{CC|c} = \sum_i f_{CC|i} f_{i|c}$$

Intuitively, the instruments are a weighted average of the industrial employment locations where the industry weights for each MA are the fraction of that MA's workforce employed in the industry. We classified industries according to the 3-digit system used in the census (this classification has 232 industries). We also develop separate instruments for the demand for labor in the central city by gender and education[6]. The construction of these instruments is given in the appendix.

These instruments will be valid so long as industrial differences in employment locations represent common differences in industrial locations across cities. To test this assumption, we regressed $f_{CC|ic}$, the fraction of the industry *i* workforce in MA *c* employed in its central city, on MA and industry fixed effects. The F-value for the hypothesis that there were no industry-differences was 43.0 which substantially exceeds the critical value of 1.33 for an F-distribution with 30,331 and 231 degrees of freedom. Controlling for MA effects, the industry fixed effects account for one quarter of the variation in $f_{CC|ic}$. Our first stage regression yields,

$$f_{CC|c} = -.059 + 3.45\,\hat{f}_{CC|c} - .079\,\ln(Population_c)$$
$$(.245)\ (.563)\qquad\qquad (.007)$$

Here $f_{cc|c}$ denotes the actual fraction of jobs in the central city of MA *c*. The regression is weighted by MA population. Conditional on the log of MA population the instruments are strongly related to the actual fraction of jobs in the central city. The partial correlation is .40. Below we estimate separate effects for MA's with more than 500,000 residents. There is little difference in the behavior of the instruments between large and small MA's.

Instruments for Black Residential Locations

Our instrument for black residential locations is the center city-suburban is the fraction of pre-1960 central city housing units that were built before 1940. To control for variations in the age of the housing stock across MA's we also include the fraction of all pre-1960 housing units in the MA built before 1940. We concentrate on units built prior to 1960 as the racial conflicts and escalation in crime experienced during the 1960's are likely to cause the location of more recent housing developments to be endogenous. Twenty-seven percent of working age blacks live in housing units built before 1940 compared to 21% of working age whites. The location of older housing units may affect blacks living in more recent housing by shifting black neighborhoods to the central city. The results from our first stage regression are

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[6] Another method we have used is to construct black specific instruments for job location by weighting our job location instruments by the percent of employment in the industry that is black. These yield similar results to those reported here.

$$\frac{Black_{CC}^{15-64}}{Black^{15-64}} - \frac{White_{CC}^{15-64}}{White^{15-64}} = \underset{(.135)}{.139} + \underset{(.190)}{.473} \frac{\Pr e-1940 Units_{CC}}{\Pr e-1960 Units_{CC}}$$

$$+ \underset{(.225)}{.011} \frac{\Pr e-1940 Units_{CC+S}}{\Pr e-1960 Units_{CC+S}} \underset{(.009)}{-.0006} \log(population) .$$

The correlation between the black residences and the housing stock instruments is .445.

IV. The Mismatch Hypothesis and Wages by Place of Work

Because the mismatch hypothesis is fundamentally a theory of imperfect mobility within MA's, we start our analysis by studying the effects of job locations on the relative wages of central city and suburban workers. We find that an increase in labor demand in the central city is associated with higher relative wages for people employed in central cities indicating imperfect mobility for both firms and workers.

In estimating wages for central city and suburban workers we employ a two stage procedure to control for individual characteristics. Let w_{cai} denote the log weekly wage of individual *i* working in area *a* of city *c* and let x_{cai} denote his characteristics. In the first stage, log weekly wages are regressed upon individual worker characteristics,[7]

$$w_{cai} = bx_{cai} + e_{cai} .$$

[7] Our controls include years of completed schooling, a quartic in potential experience, and dummy variables for hispanic, black, and marital status. The models are estimated separately by gender and education (those without any college and those with some college). This specification permits the effects of each explanatory variable to vary across the four gender-education groups.

The wage in part a of city c is the mean log wage residual of the individuals working in that part of city c, $W_{ca} = \frac{1}{n_{ca}} \sum_i e_{cai}$ [8]. Second stage regressions are run to estimate the effect of job location on the wage of individuals working in the central city relative to those working in the remainder of the MA. Let Z_c denote a vector of MA characteristics; $W_{cCC} - W_{cS}$ denotes the central city-suburban difference in log wage residuals. The second stage specification is

$$W_{cCC} - W_{cS} = Z_c\Gamma + qf_{CC|c} + u_c$$

The parameter of interest is q. The second stage regressions are weighted by the MA population size. Use of the central city-suburban wage difference controls for differences in the cost of living across MA's. We note that the analysis focuses on wages by place of work (as opposed to place of residence). Place of work is determined using the state and county group of work. Summary statistics are presented in table 1.

Table 2 shows that a increase in the relative demand for labor in the central city is associated with higher wages for people working in the central city relative to those working in the suburbs. For all workers, a 1 percentage point increase in the fraction of jobs in the central city increases wages of central city workers by .063 (WLS) or .112 (IV) percentage points relative to suburban workers (column 1). Thus a one standard deviation increase in the fraction of jobs in the central city (.155) would increase central city wages by 1 (WLS) to 1.7 (IV) percentage points relative to suburban wages. We expect the

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[8] We have chosen this procedure to due to computational constraints. Use of dummy variables would require defining over 500 MA-place of work dummy variables for 3.7 million observations. Use of mean residuals should have little effect on the estimates.

effects of job locations to be greatest in large MA's. Indeed, the effects of job location are quite large in MA's with over 500,000 residents, .092 (WLS) to .248 (IV) but non-existent in small MA's (column 2). The remaining columns present estimates by gender and education. Surprisingly, job location has little effect on the wages of non-college men but relatively strong effects for college men. On the other hand, both WLS and IV estimates show that job location has a stronger effect on the wages of non-college women than college women.

These estimates indicate that while highly elastic, the labor supply to each part of an MA is upward sloping. The effects - between $5 and $20 per week for a person earning $25,000 per year from a standard deviation change in job locations - are well within the plausible range.

V. The Mismatch Hypothesis and Racial Outcomes

Weighted Least Squares Estimates

The previous section documents the imperfect mobility of jobs and workers between central cities and suburbs. This section studies the effects of job and black residential locations on the employment of blacks relative to whites. To control for differences in employment rates across MA's, we take the difference between the black and white employment rates as our dependent variable. To avoid selection, we calculate employment rates for all blacks and whites in an MA not just central city residents. Thus our estimates are the difference between a predominantly central city black population and a white population which is more evenly spread across both areas.

As above, we control for differences in observable individual characteristics using a two step procedure regressing individual employment status on the same controls in the first stage and using the mean residual of blacks and non-blacks as our measure of employment status. Individuals who worked or who were not at work but held jobs in the week prior to the survey were classified as employed. The sample includes individuals 18-65 years old not enrolled in school.

Tables 3a and 3b present the results. The WLS estimates in table 3a show that an increase in the fraction of jobs in the central city of an MA raises the employment of blacks relative to whites. The first column shows that a 1 percentage point increase in the fraction of jobs located in the central city of an MA raises the employment rate of the black residents in the MA by .11 percentage points relative to whites. Column 2 allows separate effects of central city jobs for MA's with more than 500,000 residents[9]. The effects for large MA's greatly exceed those for small MA's; in fact, there is little evidence that job locations affect employment status in MA's with less than 500,000 residents[10]. As discussed, variations in the supply of labor to the central city and in the boundaries of the central city will bias these estimates downward (attenuation bias). We control for these factors by including the fraction of people residing in the central city. An increase in central city residents will directly affect the supply to the central city. The fraction of

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[9] Our data set contains 195 MA's with populations over 100,000. Most intra-MA studies focus on the largest MA's (*e.g.* Los Angeles, Chicago, Philadelphia, Detroit). Inter-MA studies by necessity include more MA's. Mooney (1969) uses 25 MA's and Ihlanfeldt and Sjoquist (1989) use 98 SMSA's. Only Farley (1987) includes MA's with as few as 50,000 residents.

[10] We were concerned that the weak results for small MA's may be due to insufficient data for small MA's or to the breakpoint used. The standard errors for small MA's are similar to those for large MA's suggesting that excessive noise is not responsible for the weak results among small MA's. We have shifted the break point from 500,000 residents to 250,000 or 1,000,000 residents. This adjustment has the expected effect on the standard errors of the two estimates but has little effect on the point estimates.

people residing in the central city will also reflect variations in the boundaries of central cities generating a positive correlation with the measurement error in the fraction of jobs in the central city[11]. Columns 3 and 4 control for these by including the fraction of people who live in the central city. As expected, the fraction of people living in the central city has a negative effect on black employment in large MA's and increases the effect of job locations on black-white employment differences.

Columns (4) and (5) estimate the effects of black concentration in central cities on the black-white difference in employment rates. Our measure of black concentration is the black-white difference in the fraction of working age people (ages 15-64) living in the central city. An increase in the fraction of blacks living in the central city is associated with a reduction in the employment of blacks relative to whites. A one percentage point increase in the fraction of blacks living in the central city relative to whites decreases black-white employment differentials by .11 percentage points. A one standard deviation increase in the black-white central city residence difference (18.5%) is associated with almost a 2 percentage point decrease in black employment relative to whites. When separate effects for large and small MA's are included (column 6) the effect for large

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[11] Following Ihlanfeldt and Sjoquist (1989) we have tried to control for the effect of variations in the boundaries of central cities using the fraction of the land area in the central city and suburbs. Variations in land area account for roughly 10 percent of the variation in the fraction of jobs in the central city. Unfortunately the fraction of land located in the central city exhibits substantial variation most of which is due to how wide an area is covered by the MA and most of the variation is in the size of the suburban communities. The MA's in our sample range in size from 226 to 88,082 square kilometers (5 times the variation in population). The coefficient of variation in the fraction of land located in the central city is 1.22 compared to .327 for the fraction of jobs and .436 for the fraction of residents.

MA's is over double that for small MA's but even in small MA's black concentration in the central city is associated with lower black employment rates.

Columns (7)-(10) include both job and black residential location variables. In general including both sets of variables reduces the estimated coefficient on each variable but the variables remain large and statistically significant. Including the place of residence for all workers (columns 9 and 10) increases the effects of job location with small effects on black residential locations.

Instrumental Variable Estimates

Table 3b uses IV estimation to control for endogeneity. These estimates indicate that an exogenous increase in the fraction of jobs located in the central city does increase the employment of blacks relative to whites (columns (1)-(3)). As with WLS, when separate effects are estimated for large and small MA's, job location is an important determinant of employment in large MA's but has little effect in small MA's. The IV estimates are stronger than the WLS estimates which exclude the fraction of people living in the central city but are similar to those which include this control. Thus this difference appears to be due to variations in the supply of labor to the central city or to variations in the boundaries of the central city although it is impossible to determine the relative importance without additional information.

There are a number of concerns with our industrial composition instruments. First, the industrial composition of MA's may be affected by the human capital distribution among black residents of the MA. This problem should be minimal because blacks constitute a small portion of the total population of our MA's (13.4% of the population in the average MA and 13.7% in MA's with populations over 500,000). Second, the industrial composition may affect black human capital investments. To address these concerns, we have computed industrial composition for the MA's with more than 500,000 residents in 1980 for which 1940 data is available from the 1940 census[12]. We have chosen to use 1940 in order to obtain data which predates the human capital composition of the 1980 workforce of the MA's. We find first, that inter-MA differences in industrial structure exhibit a remarkable degree of stability. Controlling for industry fixed effects, the partial correlation between industry employment shares in an MA in 1940 and 1980 is .69. We also construct our instruments for job locations using the 1940 industry employment shares. These estimates, shown in column (3), are quite similar to the estimates using contemporaneous industrial composition. Given the similarity of the estimates and the unavailability of data for many smaller MA's in the 1940 data the remaining analysis utilizes the 1980 industrial composition variables.

Another concern is that our instruments for the demand for labor in the central city may be correlated with the demand for black workers. While, industries which locate in central cities employ more black workers this difference is largely due to the industrial location patterns. Put differently, there is little tendency for industries with high shares in central cities to have higher employment shares for blacks among their central city and suburban. We have constructed instruments for the demand for black workers by using our industrial

[12]For these estimates we have aggregated industries in order to maintain consistency which eliminates some inter-industry variations (we employ a 61 industry classification). Also, the definitions of the metropolitan areas has also changed since 1940 and many of the smaller MA's are not identified on the 1940 census.

composition variables assuming a fixed factors demand structure[13]. A regression of our instruments for job location on the demand index for black workers yields,

$$\underset{}{\hat{f}_{CC|c}} = \underset{(.022)}{.363} + \underset{(.191)}{.385}\, D_c^b + \underset{(.0008)}{.006} \log(\mathit{population}) .$$

The relationship between the job location instruments and the demand for black labor is quite weak (the partial correlation is .144). Including the demand index for black workers in our employment regressions has little effect on our job locations variables.

The IV estimates in confirm that an exogenous increase in the fraction of blacks living in the central city reduces the employment of blacks relative to whites (columns 4-6). When separate effects are estimated for large and small MA's the effects for both are large in magnitude. However, the effects are greater in large MA's. Use of lagged characteristics of the housing stock minimizes the effects of recent events on the housing variable. However, the age distribution of the pre-1960 housing stock in place in 1980 will be affected by the location of construction in the intervening years. To eliminate this bias, we have obtained the age distribution of the housing stock in the large MA's from the 1960 census. Estimates using the housing characteristics in 1960, shown in column (6), are remarkably similar to those using the contemporary measures of the age of the pre-1960 housing stock[14].

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[13] Letting D_c^b denote the demand index for black workers in city *c* and $f_{b|i}$ denote the fraction of industry *i* workforce that is black, $D_c^b = \sum_i f_{b|i} f_{i|c}$. Bound and Holzer (1993) employ a similar procedure.

[14] We have also computed the fraction of central city and suburban residences that are in single unit structures in 1960 and the fraction of blacks that lived in the central city in 1940. Estimates using these variables as instruments are similar to those reported.

The WLS estimates indicate that both job and black residential locations are important determinants of black employment when estimated simultaneously. IV estimation of both effects simultaneously is limited by the availability of instruments. To determine whether job and black residential locations have independent effects on black employment status we have run regressions in which job locations are treated as endogenous while controlling for black residential locations (as an exogenous variable) and *vice versa*. Each set of variables remains large and significant controlling for the other. Thus, both job and black residential locations are important determinants of black employment status.

We have considered a number of alternative explanations for the relationship between the location of labor demand and black residences and black-white employment differentials. We have controlled for the employment rate in the MA and the fraction of the population that is black with little effect on the results. Including region effects tends to reduce the estimated effects, however, both variables remain important determinants of racial employment differences.

Estimates by Gender, Education, and Age

These estimates indicate that the availability of jobs in the central city is an important determinant of employment status for blacks overall but provide little indication as to which groups are most affected by job location. We expect job location to be most important for groups with more individuals on the margin to work - the young and elderly, less educated workers, and women[15]. Indeed much of the work on the mismatch hypothesis focuses exclusively on youth.

Table 4 provides separate estimates of the effects of job location on employment by gender, education, and age. We divide the sample into two education groups: individuals without any college (those with 12 or fewer years of school) and those with at least some college (those with more than 12 years of school including attendance but not completion of a 13th year). We divide the sample into three age groups, 18-30; 31-50; and 51-65[16]. Table 4 presents WLS estimates with and without controls for the fraction of MA residents living in the central city and IV estimates (without controls for residential location though these variables have little impact on the IV estimates). We construct a separate measure of job locations for each gender-education group (as well as separate instruments described in the appendix). This procedure ensures that we measure the location of jobs that are relevant for each group.

As with the earlier results, the WLS estimates without controls for the fraction of residents in the central city (WLS 1) are lower than both the WLS estimates with controls for residence (WLS 2) and the IV estimates. The latter estimates are generally quite similar. We focus initially on the estimates for MA's with populations over 500,000. Using both WLS and IV, the relationship between the fraction of jobs in the central city and racial employment differences is consistently weaker among college-educated workers

[15] While employment among black women is higher than that among white women, it is lower than that among black men. A portion of the estimated effects among women may be due to an effect of job locations on white women.

[16] A separate first stage regression is run for each gender-education-age group to control for observable characteristics.

than among workers with less than a college education. Job location has a greater effect on women. The fraction of jobs in the central city also has the greatest effect on young workers. The WLS estimates for young workers are close to double the estimates for middle-aged workers. In the IV estimates the drop off from young to middle-aged workers is greatest for college-educated workers. The WLS estimates provide some evidence that job location affects older workers more than middle-aged workers, however, the estimates for older workers are generally less precise than those for the other groups. In contrast to studies which focus on the effects of job location on employment for young workers only, our estimates indicate that the fraction of jobs in the central city affects all groups. Job locations have less effect on employment rates in MA's with less than 500,000 residents. Many of the estimates for young non-college men and women and for middle aged women both with and without college are economically important but are statistically insignificant.

Quantifying the Effects of Job Locations

Table 5 presents estimates of the effect of a reallocation of jobs from the suburbs to the central city on black-white employment differences. Given the importance of job location in MA's with over 500,000 residents, we restrict our attention to those MA's. The first row presents the black-white differences in employment rates in large MA's. Blacks have lower employment rates than whites for every group except college educated women (the difference among non-college women is quite small). The second row presents the differences adjusted for observable characteristics. Among men, differences in observable characteristics account for a couple percentage points of the black-white difference in employment rates.

We estimate the effects of a one standard deviation (14 percentage points) increase in the fraction of jobs located in the central city of MA's on the employment difference. As emphasized above, because of variations in labor supply to the central city and in the boundaries of the central city, the actual variation in job locations will overstate the variation due to demand factors. The effects of a one standard deviation increase in the fraction of jobs located in the central city conditional on the fraction of persons residing in the central city (9.5 percentage points) are also presented. The effects of a one (conditional) standard deviation increase in the fraction of jobs in the central city range from a low of 2.5 (1.7) percentage points for college educated men of all ages to a high of 8.5 (5.7) percentage points for young non-college men. The black white difference in employment is greatest for young non-college men. Another experiment would be to raise the fraction of jobs for non-college men located in the central city (.423) to the level for college men (.491) a shift of this magnitude would increase the employment of young black men without any college by 4.1 percentage points relative to equivalent whites. In general a shift of jobs to the central city on these magnitude would reduce the black-white difference in employment rates by roughly 30% for men and would come close to eliminating it for women.

Endogenous MA Choice

If the availability of jobs in the central city increases blacks' chances of obtaining employment, blacks with greater labor force attachment would have an incentive to move to MA's with more jobs in the central city which would bias our estimates up. We note that if the availability of jobs in the central city has no effect on black employment rates then there is no incentive for blacks with high labor force attachments to choose MA's with more jobs in the central city. Thus, choice of MA's is unlikely to generate a positive effect if the true effect is zero. The weak relationship between black-white employment differentials and the location of jobs in small MA's indicates that aside from the effects of job location on employment opportunities for blacks, there is little tendency for blacks with high labor force attachment to move to MA's with more jobs in their central cities. Endogenous MA choice would also lead to greater effects among middle-aged and older workers who have had a greater opportunity to choose their MA. Our results indicate that job locations have smaller effects for these workers.

The 1980 census contains information on employment status and the MA of residence in 1975. Using employment status in 1975 as an indication of labor force attachment we estimate whether people who were employed were more likely to move to MA's with more jobs in their central cities than those who were unemployed[17]. A typical regression is,

$$\begin{aligned} &Jobs\,in\,CC_{1980} \\ &- Jobs\,in\,CC_{1975} \end{aligned} \begin{aligned} &= -.001 \\ &\quad (.0002) \end{aligned} \begin{aligned} &+.0009\; Black \\ &(.0008) \end{aligned} \begin{aligned} &-.0003\, White * Emp \\ &(.0003) \end{aligned} \begin{aligned} &-.002\;\; Black * Emp \\ &(.0009) \end{aligned}$$

The R^2 for the equation is .0001. The positive coefficient on *Black* indicates that blacks as a whole move to cities with more jobs in their central cities than whites. However, the significant negative effect on *Black*Employed* indicates that employed blacks are more likely to move to MA's with fewer jobs in their central cities. This effect would bias our estimates downward. We have estimated similar regressions controlling for the fraction of jobs in the central city of the 1975 MA; categorizing individuals on the basis of full-time

[17] Our sample for this analysis contains individuals between 23 and 65 in 1980 who were not in college in 1975 and who switched MA's. Given the effects of job location in large MA's, we restrict the sample to people who lived in large MA's in 1975 and 1980. The sample contains 77,099 observations.

and part-time employment in 1975; controlling for individual characteristics as well as stratifying the sample by gender and education. None of the estimates differ meaningfully from the results presented here. In general, even the significant effects are quite small compared to the overall variation in the fraction of jobs in the central city (among large MA's, one standard deviation is .140). Thus, movement of blacks with high labor force attachment toward MA's with more jobs in their central cities is unlikely to be responsible for our results.

Spatial Mismatch and Social Interactions

Recent work on the geography of racial outcomes has emphasized the importance of social interactions. Cutler and Glaeser (1997) and O'Regan and Quigley (1997) estimate the effects of social interactions along with job proximity. Both studies conclude that social interactions have a greater effect on black youth employment than job proximity. Cutler and Glaeser use black residential segregation to measure social interactions. While segregation affects job access, it may also be associated with fewer role models and greater acceptance of non-employment. Thus, conditional on job access, segregation should be associated with lower employment for blacks. To estimate the relative importance of job proximity and social interactions, we include measures of segregation from Cutler, Glaeser, and Vigdor (1997) along with our measures of job and residential locations[18]. The coefficient on segregation will reflect the effects of social interactions,

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[18] We measure segregation using their dissimilarity index. Results using their isolation index are similar. The Cutler, Glaeser, and Vigdor data are available at the SMSA level whereas the preceding analysis was conducted at the SMSA/SCSA level (SMSA's that are part of SCSA's were aggregated into a single SCSA). For this portion of the analysis, we

conditional on job access. The black residential locations and job location variables will reflect job accessibility. That said, the segregation variable may well pick up unmeasured aspects of black job access just as the black residential location variable may pick up some unmeasured aspects of segregation.

Before estimating a model with all three sets of variables we estimate the effect of segregation alone. The first two columns of table 6 indicate that segregation is associated with lower employment rates among blacks relative to whites. The effects are similar in large and small MA's, although the effects for small MA's are imprecisely estimated. Columns 3 and 4 report the effect of the black-white difference in central city residence using the SMSA-based sample. Use of the SMSA-based sample increases the effects of black residential location especially among residents of large MA's. Columns 5 and 6 include both the central city residence and racial segregation variables. Estimating both variables together has little effect on the coefficient of black concentration in the central city; segregation remains an important determinant of black employment rates but the effect is reduced considerably. Thus, segregation affects black employment in part because it is associated with more blacks living in central cities away from job opportunities. When the fraction of jobs in the central city is included (columns 7 and 8) it has a large and statistically significant effect on black employment rates. Inclusion of the fraction of jobs in the central city reduces the effects of black-white differences in central city residence but increases the effects of segregation. All variables are important determinants of black employment rates. In large MA's, a one standard deviation change in each variable would

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estimate adjusted employment rates at the SMSA level. Individuals living in SCSA's are increase black employment by 1.1 percentage points (job location), 2.4 (black residence in central cities), and .8 (segregation). Thus, in contrast to Cutler and Glaeser and O'Regan and Quigley, we find that black access to jobs, as determined both by job locations and black residential locations, are more important than social interactions in large MA's.

VI. Conclusions

Following Kain (1968) economists have argued that a lack of jobs in the inner-city may be responsible for low and declining labor force participation among young blacks. Existing tests of the mismatch hypothesis have yielded contradictory results and have lead to questions of causality. We study the effects of job locations and black residential locations on black employment rates across metropolitan areas. We exploit inter-city variations in industrial composition to develop instruments for job location and variations in the age of the housing stock to instrument for black residential locations.

A variety of implications of the mismatch hypothesis are examined. The assumption underlying the mismatch hypothesis - that labor is imperfectly mobile within metropolitan areas - implies that an increase in the demand for labor in central cities should raise wages in central cities relative to suburban communities. Our estimates confirm this implication. Our main interest is in the effects of job locations on black employment rates relative to whites. An increase in the fraction of jobs located in the central city raises black employment rates relative to whites. The effects are greatest in large MA's and for the young, for women, and for less educated workers. IV estimates confirm the WLS results. We also study the effects of black concentration in central cities on their employment

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assigned job and residential location variables for their SCSA.

rates. An increase in the fraction of blacks living in central cities is associated with lower employment rates for blacks relative to whites. Given interest in social interactions, we estimate the effects of job location, black residential locations, and racial segregation on black employment simultaneously. All three variables are found to be important determinants of black employment. However, job locations play a larger role in black employment than social interactions. Thus in a variety of tests, we find that black access to jobs measured by job location and black residential locations is an important determinant of black employment.

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Appendix - Theory

The first proposition states that a shift of labor demand from the suburban industry to the central city industry increases wages in the central city. Total differentiation of the wage conditions and rearrangement yields,

$$d\left(w^{cc}-w^{s}\right)=\frac{\left(1-\frac{F''\left(L^{cc}\right)}{F'\left(L^{cc}\right)}\left(L_{s}^{s}+L_{cc}^{s}\right)\right)dq^{cc}-\left(1-\frac{F''\left(L^{s}\right)}{F'\left(L^{s}\right)}\left(L_{cc}^{cc}+L_{s}^{cc}\right)\right)dq^{s}}{\left(1-\frac{F''\left(L^{cc}\right)}{F'\left(L^{cc}\right)}L_{cc}^{cc}\right)\left(1-\frac{F''\left(L^{s}\right)}{F'\left(L^{s}\right)}L_{s}^{s}\right)-\frac{F''\left(L^{cc}\right)}{F'\left(L^{cc}\right)}\frac{F''\left(L^{s}\right)}{F'\left(L^{s}\right)}L_{s}^{cc}L_{cc}^{s}}.$$

A shift in demand toward the central city industry raises the wage (per efficiency unit of labor) in the central city relative to the suburbs. The importance of a less than infinitely elastic labor supply and demand are evident from this expression. As the (partial) labor demand elasticities ($\left(F''/F'\right)^{-1}$) approach ∞, the denominator diverges to ∞ more quickly than the numerator and the industry shares have no effect on relative wages. The same holds true as the labor supply elasticities (L_{j}^{i}) approach infinity.

Propositions 4 and 5 are from the structural model. The equilibrium conditions for that model are that,

$$c^{cc,s}\left(p^{cc,s}\right)=\frac{w^{s}}{w^{cc}}$$

$$c^{s,cc}\left(p^{s,cc}\right)=\frac{w^{cc}}{w^{s}}$$

$$w^{i}=q^{i}+\ln\left(F'\left(L^{i}\left(w^{cc},w^{s}\right)\right)\right),\quad i\in\{cc,s\}$$

$$L^{cc}=\sum_{g\in\{b,w\}}\left(r_{g}^{cc}p_{g}^{cc,cc}\int_{a^{*cc}}^{\infty}ah_{g}^{cc}(a)da+r_{g}^{s}p_{g}^{s,cc}\int_{a^{*s}}^{\infty}ah_{g}^{s}(a)da\right)$$

$$L^{s}=\sum_{g\in\{b,w\}}\left(r_{g}^{cc}p_{g}^{cc,s}\int_{a^{*cc}}^{\infty}ah_{g}^{cc}(a)da+r_{g}^{s}p_{g}^{s,s}\int_{a^{*s}}^{\infty}ah_{g}^{s}(a)da\right)$$

Where $p^{i,j}$ denotes the fraction of working residents of area *i* (measured in units of effective labor) who work in area *j* and $a^{*i} \equiv r/w^i \equiv \exp(R)/w^i$ denotes the skill level of the marginal worker in area *i*.

Proposition 4 considers the effect of shifting working people from the central city to the suburbs on wages in the central city and suburbs. Consider moving working group *g* members with *dl* units of effective labor from the central city to the suburbs. This shift decreases (increases) labor supply in the central city (suburbs) by the difference in commuting shares,

$$dL^{cc} = \left[-p_g^{cc,cc} + p_g^{s,cc}\right]dl = -dL^s$$

provided that wages are unchanged. Total differentiation of the wage conditions with respect to L^s and L^c yields, after rearrangement,

$$dw^c = -\frac{\frac{F''(L_{cc})}{F'(L_{cc})}\left(1-\frac{F''(L_s)}{F'(L_s)}\left(L_s^s + L_s^c\right)\right)\left(p_g^{cc,cc} - p_g^{s,cc}\right)}{\left(1-\frac{F''(L_{cc})}{F'(L_{cc})}L_{cc}^{cc}\right)\left(1-\frac{F''(L_s)}{F'(L_s)}L_s^s\right)-\frac{F''(L_{cc})}{F'(L_{cc})}\frac{F''(L_s)}{F'(L_s)}L_c^s L_s^c}\,dl\,.$$

A shift in workers out of the central city raises wages in the central city. An analogous expression can be generated for dw^s indicating that an increase in working people living in the suburbs reduces wages in the suburbs.

Proposition 5 pertains to the mean log wage of blacks and whites. The mean log wage of the working members of group *g* is, from the text,

$$\overline{w_g} = \overline{\ln\left(a_g\right)} + \Pi_g^{cc} w^{cc} + \left(1-\Pi_g^{cc}\right)w^s\,.$$

The mean log skill level of working members of group *g* is given by,

$$\overline{\ln(a_g)} \equiv \frac{r_g^{cc} \int_{a^{*cc}}^{\infty} \ln(a) h_g^{cc}(a) da + r_g^{s} \int_{a^{*s}}^{\infty} \ln(a) h_g^{s}(a) da}{r_g^{cc} H_g^{cc}(a^{*cc}) + r_g^{s} H_g^{s}(a^{*s})}.$$

The effect of a change in w^{cc} on $\overline{w_g}$ is

$$\frac{¶\overline{w_g}}{¶w^{cc}} = \frac{d\,\overline{\ln(a_g)}}{dw_{cc}} + \Pi_g^{cc} + \frac{d\Pi_g^{cc}}{dw^{cc}}(w^{cc} - w^{s}).$$

The first term gives the change in the skill composition of the group *g* workforce. The second term gives the fraction of working group *g* individuals (in units of effective labor) who are employed in the central city (Π_g^{cc}); these workers experience wage increases[19].

The last term gives the effect of changing the fraction of group *g* workers employed in the central city given the central city-suburban wage difference.

The effect of an increase in w^{cc} on $\overline{\ln(a_g)}$ is given by,

$$\frac{d\,\overline{\ln(a_g)}}{dw^{cc}} = \frac{r_g^{c} \int_{\frac{r}{w^{cc}}}^{\infty} [\ln(a^{*cc}) - \ln(a)] h_g^{cc}(a) da + r_g^{s} \int_{\frac{r}{w^{s}}}^{\infty} [\ln(a^{*cc}) - \ln(a)] h_g^{s}(a) da}{r_g^{cc} H_g^{cc}(a^{*cc}) + r_g^{s} H_g^{s}(a^{*s})} \cdot \frac{r_g^{cc} h_g^{cc}(a^{*cc}) \frac{da^{*cc}}{dw^{cc}}}{r_g^{cc} H_g^{cc}(a^{*cc}) + r_g^{s} H_g^{s}(a^{*s})}.$$

The first term reflects the log difference in the ability of the average and marginal group *g* workers which will be negative. The second term gives the partial labor supply elasticity.

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[19] Π_g^{cc} satisfies,

$$\Pi_g^{cc} \equiv \frac{r_g^{c} H_g^{cc}\left(\frac{r}{w^{cc}}\right) p_g^{cc,cc}\left(\frac{w^{cc}}{w^{s}}\right) + r_g^{s} H_g^{s}\left(\frac{r}{w^{s}}\right) p_g^{s,cc}\left(\frac{w^{cc}}{w^{s}}\right)}{r_g^{c} H_g^{cc}\left(\frac{r}{w^{cc}}\right) + r_g^{c} H_g^{s}\left(\frac{r}{w^{s}}\right)}.$$

Given that the increase in wages lowers the average skill level of the workforce, a higher labor supply elasticity accentuates of composition changes.

We can study the effects of a subsidy on central city employment. Let s^{cc} denote the percentage subsidy for central city employment. Log wages per efficiency unit of labor solve,

$$w^{cc} = q^{cc} + \ln F'(L^{cc}) + s^{cc}.$$

The employment condition for central city residents is $\ln(w^{i}a) \geq R$. With the subsidy, product of the marginal worker will be beneath his opportunity cost. Commuting decisions will also be distorted. To model a reduction in commuting costs, let $d^{i,\sim i}$ denote the percentage reduction in costs from area *i* to area ~*i*. Utility for someone who commutes is now, $\ln(w^{\sim i}a) - C^{i,\sim i}\exp\left\{-\, d^{i,\sim i}\right\}$. The conditions for commuting from *i* to ~*i* are now, $c^{i,\sim i}\left(p^{\,i,\sim i}\right) - \, d^{i,\sim i} = \frac{w^{\sim i}}{w^{i}}$. For a given wage differential, a greater fraction of area *i* residents will work in ~*i*.

Appendix - Data

PUMS Data

We employ data from the 5% A-sample and 1% B-sample of the 1980 Census Public Use Microdata Samples. The advantage of the B-sample is that it identifies a greater number of MA's that the A sample. The A-sample contains 5 times as many observations as the B-sample, however, it identifies fewer MA's and in some cases suppresses portions of MA's. We have found that estimates using the 5% A-sample are more precise when we estimate outcomes for specific demographic groups (for example, when employment is estimated by gender, education, and age at the MA-level). Therefore, we use the A-sample to estimate all dependent variables. Because sample size is less of a concern when estimating the independent variables (the fraction of jobs located in the central city of each MA, and the instruments for job location) the B-sample is used to estimate these variables. Use of the B-sample ensures that our independent variables are based on full representative samples of the population in each MA. Experimentation indicates that the precision of the estimates is the only difference between results using the A- and B-samples. We use the PUMS data to estimate employment status, commuting times, and wages in addition to the job location variables and instruments.

At the time of the 1980 census, metropolitan areas were classified as Standard Metropolitan Statistical Agglomerations (SMSA) or Standard Consolidated Statistical Agglomerations (SCSA). SCSA's are defined in terms of economic integration and commuting patterns. We aggregate SMSA's that are within SCSA's to the SCSA level so that the unit of analysis approximates the local labor market. In some metropolitan areas the census designates multiple central cities. If blacks encountered costs from living outside the central cities of an MA but could easily live in any of the central cities, it would be appropriate to use all the central cities as the basis of the analysis. This is a particular problem in SCSA's where each SMSA has one (or more central cities). To obtain data for SCSA's with a single (or a minimum number of) central city we classify the central city of the main SMSA as the central city of the SCSA and treat the balance of that SMSA and the remaining SMSA's as outside the central city. We have also performed the analysis treating the central cities of each SMSA as central cities with little effect on the results.

Employment Sample

We estimate employment rates for blacks and non-blacks. The sample included all workers residing in a metropolitan area between the ages of 18 and 65 not currently enrolled in school. The regressions control for the gender, years of completed school, potential experience (age-years of school-6), Hispanic background, race, and marital status. Individuals with imputed values for any of these variables or employment status were dropped from the sample. Individuals who worked in the week prior to the survey and those who were not at work but who held jobs were classified as working. This sample contains 3,685,608 observations total. Breakdowns of the sample by gender and education, by age, and by race are given in appendix table 1. A breakdown of the number of observations for each MA is provided in appendix table 2.

As described in the text, we employ a two stage estimation procedure adjusting for individual characteristics in the first stage, then using the residuals from the first stage regression to estimate employment rates by race for each MA. The sample for the first stage regressions is the one described above containing residents of all MA's. Thus, the effects of individual characteristics on employment status are estimated for the residents of all MA's. Not all MA's were included in the second stage regression. When analyzing the determinants of black employment, MA's with fewer than 50 observations for blacks were excluded from the second stage regressions to reduce noise.

Wage Sample

We estimate the wages of individuals who worked in the central city and suburbs of each MA. The sample selection criteria are similar to those for the employment sample except that this sample included all individuals who worked in MA's (whether or not they lived in an MA). The procedures for determining the place of work are described below. In addition to the criteria above, we further restricted the sample to people who were in the labor force for 40 or more weeks in 1979 and who usually worked 35 or more hours per week. Individuals with positive self-employment or farm income were eliminated from the wage sample. Individuals with imputed earnings or imputed values for the 1979 labor force variables were dropped from the sample as were people whose wage and salary income was less than $40 per week. Individuals with topcoded earnings were assumed to have earnings 1.45 times the topcode value. One concern with our wage measure is that it pertains to the year prior to the survey while our job location variable is for the job in the week prior to the survey. This problem should be minimal because most people do not switch jobs and among people who switched jobs many will continue to work in the same portion of the MA.

We also require information on the MA and section of the MA in which each individual worked. These are determined from the place of work recode and from the state and county group of work which are available for one half of the sample. The 1980 census indicates whether the place of work was in the central city or balance of the MA for all individuals working in MA's[20]. Individuals with allocated place of work information were excluded from the sample.

Job Location Sample

We estimate the fraction of people employed in the central city of each MA using people between 18 and 65 who were employed in the week prior to the survey. As with the wage sample, we used the state and county group of work to determine the MA of work so our estimates include people who did not reside in their MA of work. Our instrument for job location required data on each person's industry. Thus when constructing the instruments we restrict the sample to people who had non-imputed industry codes.

Census Summary Tape File 3C

In addition to the PUMS data, we employ data from the Census STF3C. To maintain confidentiality, the census suppresses whether people resided in the central city or suburbs for residents of smaller MA's and for some of the residents in larger MA's. We use the STF3C to determine the fraction of the working age population (by race) living in each portion of the MA. We use the age classification in the STF3c, people 15 to 64 rather than 18-65. Suppression also prevented us from using the PUMS to estimate the age of the housing stock in the central city and suburbs of each MA. These data are taken from the STF3C. We obtain figures on MA population from the STF3C. The land area for each MA is available on the STF3C. In contrast to the 1990 STF's, the 1980 STF does not present separate estimates for central cities. We have identified the specific cities that constitute the central city of each MA to estimate figures for central cities.

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[20] For people working in the SMSA of residence the census also indicates if the place of work was in the central business district. This information is not available for people

Segregation Data

Data on segregation at the SMSA level computed by Cutler, Glaeser, and Vigdor (1997) were taken from the NBER website. Because these data are available at the SMSA level, we estimate the employment rates of blacks and non-blacks at the SMSA level. For SMSA's that are components of SCSA's the SMSA-level estimates are merged with the SCSA estimate of job location and the fraction of blacks residing in the central city of the SCSA.

Appendix - Instruments for Job Location for Specific Demographic Groups

We develop separate instruments for the demand for labor in the central city by gender and education. Our instruments for the fraction of workers in each demographic group employed in the central city of each MA are, similar to those for all workers, a weighted average of the fraction of people in each industry who work in the central city. Whereas the weights in the instruments for all workers, were the fraction of the MA workforce in an industry, we estimate the fraction of the workers in each gender-education group in each MA employed in each industry to avoid endogeneity. Let $f_{g|i}$ denote demographic group *g*'s share of the national employment in industry *i*. Our estimates of the fraction of workers in group *g* in MA *c* employed in industry *i* are,

$$\hat{f}_{i|gc} = \frac{f_{g|i}\, f_{i|c}}{\sum_i f_{g|i}\, f_{i|c}}\,.$$

As above, $f_{i|c}$ denotes the fraction of all workers in MA *c* that are employed in industry *i*. Let $f_{CC|gi}$ denote the fraction of workers in demographic group *g* in industry *i* employed

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working in an SMSA in which they do not reside.

in central cities estimated from national data. Our instruments for the fraction of workers in group g employed in the central city of MA c, $\hat{f}_{CC|gc}$, are

$$\hat{f}_{CC|gc} = \sum_i f_{CC|gi} \hat{f}_{i|gc} .$$

Table 1. Summary Statistics.

	All MA's		MA's Population>500,000		MA's Population<500,000	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Job Location Variables						
Fraction of Jobs in Central City	.480	.157	.453	.140	.589	.172
Industry Instrument for Fraction of Jobs in Central City	.487	.018	.490	.015	.474	.023
Place of Residence Variables						
Fraction of Population Residing in Central City	.362	.158	.344	.130	.435	.226
Fraction of Blacks 15-64 Residing in Central City	.677	.161	.673	.149	.692	.203
Fraction of Non-Blacks 15-64 Residing in Central City	.308	.173	.282	.138	.411	.248
Black-Non-Black Difference in Fraction Residing in Central City	.369	.184	.391	.154	.281	.256
Central City-Suburban Difference in Fraction of Pre-1960 Housing Stock Built Prior to 1940	.134	.129	.159	.117	.110	.120
Employment Rates, Persons 18-65						
Blacks (Unadjusted)	.642	.065	.641	.063	.644	.076
Non-Blacks (Unadjusted)	.716	.036	.719	.034	.705	.045
Black-Non-Black Difference in Employment Rates (Adjusted for Characteristics)	-	.051	-	.046	-	.063

Table 1. Summary Statistics (Continued).						
	All MA's		MA's Population>500,000		MA's Population<500,000	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Mean Travel Time to Work (in Minutes)						
Working Blacks	25.9	6.02	27.4	5.55	19.6	3.04
Working Non-Blacks	22.6	3.95	23.7	3.62	18.5	1.99
Black-Non-Black Difference	3.22	2.60	3.74	2.35	1.13	2.50
Wages (High Attachment Full Time Workers, 18-65)						
Mean Log Wage Persons Working in Central City (Unadjusted)	5.66	.109	5.69	.092	5.55	.104
Mean Log Wage Persons Working in Suburbs (Unadjusted)	5.63	.120	5.65	.102	5.54	.142
Central City-Suburban Difference in Mean Log Weekly Wages (Adjusted for Characteristics)	-	.045	-	.035	-	.019
Miscellaneous Variables						
MA Population	4,276,750	5,062,848	4,268,995	5,203,910	294,749	113,821
Fraction of MA Population Black	.134	.081	.137	.073	.121	.015
Segregation (Dissimilarity Index) at SMSA Level	.659	.121	.663	.121	.613	.110
Central City Land Area (Square Kilometers)	952	1266	1154	1340	142	115
Suburban Land Area (Square Kilometers)	14,091	20,777	16,514	22,475	4365	4328
Number of MA's (See Note)	195/222		66/93		129/129	

Note: Estimates weighted by MA population. Segregation estimated at SMSA level with 222, 93, and 129 SMSA's.

Table 2. Labor Demand in Central City and Central City-Suburban Wage Differentials.

	All Workers		Non-College Men		College Men		Non-College Women		College Women	
	OLS Estimates									
Fraction of Jobs in Central City	.063 (.022)		.028 (.027)		.116 (.028)		.072 (.032)		.038 (.031)	
MA Population>500,000		.092 (.027)		.070 (.032)		.138 (.034)		.092 (.039)		.004 (.038)
MA Population<500,000		.006 (.038)		-.062 (.045)		.072 (.048)		.032 (.055)		.110 (.053)
R^2	.039	.065	.033	.072	.074	.085	.049	.058	.102	.117
	IV Estimates									
Fraction of Jobs in Central City	.112 (.055)		-.015 (.065)		.162 (.069)		.236 (.082)		.165 (.078)	
MA Population>500,000		.248 (.084)		.068 (.094)		.312 (.104)		.326 (.124)		.148 (.113)
MA Population<500,000		-.016 (.079)		-.114 (.088)		-.001 (.099)		.135 (.116)		.184 (.107)
R^2	.025	.052	.029	.054	.025	.045	.059	.063	.107	.112

Note: Standard errors in parentheses. Regressions weighted by MA population. All estimates by OLS. Sample includes 226 SMSA/SCSA's. Dependent variable is central city-suburban difference in adjusted wages. Wages are MA averages of residuals from regressions of individual log weekly wages on a quartic in potential experience, and dummy variables for marital status, black, and Hispanic ethnicity. Separate regression run for each gender-education group. Regressions without separate effects for large and small MA's include log of MA population. Regressions with separate effects for large and small MA's include a dummy variable for population over 500,000, the log of MA population, and the log of MA population interacted with population over 500,000.

Table 3a. Effect of Jobs in Central City on the Black-White Employment Differential. Weighted Least Squares Estimates.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Fraction of Employment in Central City	.108 (.025)		.184 (.043)				.068 (.026)		.190 (.040)	
Population >500,000		.143 (.030)		.552 (.072)				.083 (.032)		.466 (.074)
Population <500,000		.032 (.044)		-.003 (.055)				.005 (.044)		.019 (.054)
Percent of Working Age Blacks Living in Central City - Percent of Working Age Whites Living in Central City					-.098 (.009)		-.079 (.019)		-.103 (.019)	
Population >500,000						-.139 (.024)		-.109 (.026)		-.084 (.025)
Population <500,000						-.062 (.028)		-.061 (.029)		-.068 (.033)
Fraction of People Residing in Central City			-.081 (.037)						-.142 (.037)	
Population >500,000				-.423 (.069)						-.381 (.068)
Population <500,000				.039 (.042)						-.019 (.049)
R^2	.163	.183	.183	.322	.205	.242	.233	.269	.289	.376

Note: Standard Errors in Parentheses. All regressions weighted by MA population. Sample contains 195 SMSA/SCSA's. Regressions without separate effects for large and small MA's include log of MA population. Regressions with separate effects for large and small MA's include a dummy variable for population greater than 500,000 and an interaction between log of MA population and population greater/less than 500,000. Dependent variable is black-white difference in adjusted employment rate of persons 18-65 not enrolled in school. Employment rates are MA averages of residuals from regressions of individual employment status on a quartic in potential experience, and dummy variables for marital status, black, and Hispanic ethnicity. The effects of the covariates are allowed to vary with gender and education.

Table 3b. Effect of Jobs in Central City on the Black-White Employment Differential. Instrumental Variable Estimates.

	(1)	(2)	(3)	(4)	(5)	(6)
Fraction of Employment in Central City	.239 (.066)					
Population >500,000		.431 (.106)	.393 (.150)			
Population <500,000		.014 (.104)				
Percent of Working Age Blacks Living in Central City - Percent of Working Age Whites Living in Central City				-.280 (.050)		
Population >500,000					-.287 (.057)	-.330 (.096)
Population <500,000					-.239 (.072)	
R^2	.133	.135	.158	.187	.213	.221

Note: Standard Errors in Parentheses. All regressions weighted by MA population. Except columns (3) and (6), sample contains 195 SMSA/SCSA's. Instrument for job location is weighted average of industrial employment locations. Instruments for black residential location are fraction of pre-1960 central city and MA housing stock built prior to 1939. Columns (3) and (6) use industrial composition in 1939 and 1960 data on housing stock as instruments. These samples include 58 SMSA/SCSA's. Regressions without separate effects for large and small MA's include log of MA population. Regressions with separate effects for large and small MA's include a dummy variable for population greater than 500,000 and an interaction between log of MA population and population greater/less than 500,000. Dependent variable is black-white difference in adjusted employment rate of persons 18-65 not enrolled in school. Employment rates are MA averages of residuals from regressions of individual employment status on a quartic in potential experience, and dummy variables for marital status, black, and Hispanic ethnicity. The effects of the covariates are allowed to vary with gender and education.

Table 4. Effect of Jobs in Central City on the Black-White Employment Differential. Effects by Gender, Education, and Age.

	All Persons			Non-College Men			College Men			Non-College Women			College Women		
	WLS1	WLS2	IV	WLS1	WLS2	IV	WLS1	WLS2	IV	WLS1	OLS2	IV	WLS1	WLS2	IV
Young (18-30) - 170 SMSA/SCSA's															
Fraction of Employment in Central City - Large MA's	.181	.663	.458	.158	.488	.605	.096	.247	.254	.193	.669	.472	.172	.478	.334
	(.036)	(.086)	(.122)	(.047)	(.115)	(.224)	(.042)	(.088)	(.111)	(.039)	(.098)	(.110)	(.049)	(.108)	(.148)
Fraction of Employment in Central City - Small MA's	.105	.012	-.0003	.119	-.004	-.113	.015	-.117	-.100	.096	.053	.190	-.085	-.094	.207
	(.057)	(.068)	(.136)	(.072)	(.090)	(.194)	(.066)	(.080)	(.148)	(.060)	(.073)	(.151)	(.079)	(.095)	(.220)
R^2	.257	.407	.176	.181	.247	.115	.063	.123	.062	.279	.386	.223	.092	.141	.051
Middle Age (30-50) - 169 SMSA/SCSA's															
Fraction of Employment in Central City - Large MA's	.097	.429	.473	.109	.361	.672	.054	.237	.146	.075	.353	.407	.117	.249	.242
	(.026)	(.065)	(.113)	(.033)	(.083)	(.206)	(.030)	(.063)	(.077)	(.037)	(.100)	(.114)	(.046)	(.105)	(.133)
Fraction of Employment in Central City - Small MA's	.013	.001	.047	-.013	-.023	-.004	-.032	-.084	-.066	.055	.076	.226	.112	.141	-.085
	(.041)	(.050)	(.124)	(.050)	(.063)	(.176)	(.046)	(.056)	(.104)	(.057)	(.074)	(.154)	(.200)	(.089)	(.195)
R^2	.135	.273	.123	.123	.183	.085	.041	.114	.041	.060	.111	.102	.075	.088	.043
Older (50-65) - 138 SMSA/SCSA's															
Fraction of Employment in Central City - Large MA's	.111	.356	.389	.124	.378	.442	.068	-.063	.065	.099	.314	.377	.055	.079	-.160
	(.035)	(.092)	(.123)	(.041)	(.104)	(.190)	(.060)	(.131)	(.151)	(.042)	(.116)	(.119)	(.080)	(.185)	(.233)
Fraction of Employment in Central City - Small MA's	-.049	-.051	.043	-.056	-.026	.192	.007	.086	.140	.013	.006	.061	-.315	-.361	-.398
	(.071)	(.081)	(.180)	(.080)	(.091)	(.207)	(.118)	(.173)	(.245)	(.082)	(.095)	(.225)	(.167)	(.185)	(.465)
R^2	.284	.327	.226	.239	.280	.171	.065	.076	.059	.209	.232	.195	.070	.073	.049

Note: Standard errors in parentheses. All regressions weighted by MA population. Dependent variable is black-white difference in adjusted employment rate for persons not enrolled in school. Employment rates are MA averages of residuals from regressions of individual employment status on a quartic in potential experience, and dummy variables for marital status, black, and Hispanic ethnicity. Separate regressions run for each gender-education group. Fraction of jobs in central city measured independently for each gender-education group. Large MA's defined as population over 500,000. All regressions include a dummy variable for population over 500,000, the log of MA population, and the log of MA population interacted with population over 500,000. In addition to these, WLS 2 includes fraction of people residing in central city and the fraction of people residing in the central city interacted with population over 500,000.

Table 5. Black-White Difference in Employment Rates and The Effect of An Increase in Jobs in the Central City on Difference. MA's with Populations over 500,000.

	All		Non-College Men		College Men		Non-College Women		College Women	
	18-65	18-30	18-65	18-30	18-65	18-30	18-65	18-30	18-65	18-30
Black-White Difference, Unadjusted	-.078	-.153	-.151	-.215	-.075	-.101	-.017	-.116	.089	-.023
Black-White Difference, Adjusted	-.059	-.137	-.114	-.186	-.069	-.088	-.057	-.171	.054	-.037
Effect of a 1 Standard Deviation Increase in Jobs in the Central City (14%), IV Estimates	0.06	0.064	0.068	0.085	0.025	0.036	0.058	0.066	0.035	0.047
Share of Adjusted Black-White Difference Explained by a 1 Standard Deviation Increase in Jobs in Central City	1.017	0.467	0.596	0.457	0.362	0.409	1.018	0.386	-	1.270
Effect of a 1 Conditional Standard Deviation Conditional Increase in Jobs in the Central City (9.5%), IV Estimates	0.041	0.044	0.046	0.057	0.017	0.024	0.039	0.045	0.023	0.032
Share of Adjusted Black-White Difference Explained by a 1 Conditional Standard Deviation Increase in Jobs in Central City	0.695	0.321	0.404	0.306	0.246	0.273	0.684	0.263	-	0.865

Note: Estimates weighted by MA population. Conditional standard deviation control for the fraction of MA population residing in central city.

Table 6. The Effect of Jobs Location, Residential Location, and Segregation on the Black-White Employment Differential. OLS Estimates.

Fraction of Jobs in Central City							.068	
							(.029)	
MA Population>500,000								.079
								(.032)
MA Population<500,000								.011
								(.062)
Fraction of Working Age Blacks Residing in Central City - Fraction of Working Age Whites Residing in Central City			-.154		-.141		-.116	
			(.021)		(.023)		(.025)	
MA Population>500,000				-.199		-.186		-.155
				(.027)		(.028)		(.030)
MA Population<500,000				-.064		-.060		-.058
				(.040)		(.046)		(.048)
Segregation (Dissimilarity Index)	-.098				-.046		-.059	
	(.026)				(.026)		(.026)	
MA Population>500,000		-.093				-.047		-.063
		(.028)				(.026)		(.027)
MA Population<500,000		-.089				-.019		-.019
		(.102)				(.108)		(.107)
R^2	.066	.071	.196	.224	.207	.235	.227	.256

Note: Standard errors in parentheses. Regressions weighted by MA population. Sample includes 225 SMSA's. Dependent variable black-white difference in adjusted employment rate of persons 18-65 not enrolled in school. Employment rates are MA averages of residuals from regressions of individual employment status on a quartic in potential experience, and dummy variables for marital status, black, and Hispanic ethnicity. The effects of the covariates are allowed to vary with gender and education. Residential locations for individuals 15-64 years of age. Regressions without separate effects for large and small MA's include log of MA population. Regressions with separate effects for large and small MA's include a dummy variable for population over 500,000, the log of MA population, and the log of MA population interacted with population over 500,000.

Appendix Table 1. Sample Size for Employment Sample.

	Total	Black	Non-Black
Total	3,685,608	413,598	3,272,010
Stratified by Gender and Education			
Non-College Men	1,091,934	143,526	948,408
College Men	704,378	43,922	660,456
Non-College Women	1,297,787	171,967	1,125,820
College Women	591,509	54,182	537,327
Stratified by Age			
18-30	1,219,774	158,753	1,061,021
31-50	1,540,104	169,088	1,371,016
51-65	925,730	85,757	839,973

Appendix Table 2. Sample Size for Employment Sample. MA's by Number of Observations

	Black	Non-Black
0-49 Observations	41	
50-99 Observations	21	
100-249 Observations	27	
250-499 Observations	43	
500-999 Observations	38	
1000-2499 Observations	36	34
2500-4999 Observations	14	83
5000-9999 Observations	8	52
10,000-24,999 Observations	6	39
25,000-49,999 Observations	1	15
50,000-99,999 Observations	1	8
100,000+ Observations		5
Total	236	236

Note: MA's with fewer than 50 observations for blacks were not included in the second stage sample leaving a sample of 195 MA's.