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ABSTRACT

While urban location theory predicts rent and wage gradients within cities, there has been limited empirical verification of these. By investigating relative wages of "identical" black and white workers employed at differing locations within areas, distinct wage gradients are estimated. These wage gradients work to lessen wage gaps for the more centrally employed blacks, but continued employment dispersal is likely to expand racial differences in wages. Within southern metropolitan areas (but not other regions), blacks are imperfect substitutes for whites, indicating either imperfect measurement of worker skills or labor market discrimination. Segregated housing for blacks, however, does not imply a wage penalty.

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by Eric A. Hanushek

The spatial structure of cities almost certainly influences the patterns of prices and wages that are observed. This notion is central to urban economics which, unlike many other subfields in economics, emphasizes the importance of transportation costs and other locational advantages. The central feature emanating from models of the urban economy is that, within cities as well as across cities, the spatial distribution of economic activities will dictate varying prices for otherwise similar goods.

This research integrates several strands of literature. Housing analyses have concentrated on the spatial character of the price of housing services along with the locational and housing choices of individuals. The spatial economy of cities has, however, other implications for the character of urban labor markets. The interaction of housing and labor markets is a fundamental feature of locational theory, but one that has not been fully exploited. Additionally, as American cities have become centers for poverty, analysts have probed into the implications for employment and earnings of varying housing patterns, particularly with respect to housing segregation.

The paper begins with a short review of the basic predictions of locational theory with respect to housing price and wage gradients in cities. It then describes the empirical implications of spatial structure for the consideration of urban labor markets. The empirical analysis concentrates on disentangling spatial patterns from the inherent

heterogeneity of labor and housing markets.

Variations in wages both within and across metropolitan areas provide a direct test of the fundamental character of spatial economies. The empirical analysis exploits the difference in locational decisions of blacks and whites to identify the influence of systematic variations in residence and workplace locations on observed wages and provides direct confirmation of standard location models. At the same time, it provides insights into racial earnings disparities.

I. Fundamental Location Theory and Empirical Tests

A. Overview. Variations in land prices have received most attention in theoretical models of urban economies. The prototypical models of Muth [1969] and Mills [1972] illustrate the general locational problem. Consider a city in which all employment is centrally located (the "monocentric city" model). Consumers maximize utility which is a function of housing and other goods subject to a budget constraint. The budget constraint is partially a function of transportation costs, such that living farther away from the central employment involves greater expenditures on transportation. In solving the consumer's problem, it is apparent that more distant locations must involve lower prices for housing services to compensate for the increased costs of commuting. In fact, consumer equilibrium dictates that the marginal increase in transportation costs must be just offset by the marginal savings in securing housing services. This insight leads directly to the proposition that housing price gradients should be declining with distance from the central business

district (CBD). Under specific assumptions about the production function for housing and preferences of individuals, these models lead to common empirical specifications of rent gradients (e.g., Muth[1969]).

This is a static, long run equilibrium model. It ignores a variety of factors that might be thought to be important such as supplies of housing of different types, decentralized employment locations, specific locational preferences, and so forth.[1] Nevertheless, it provides direct predictions about spatial variations in prices, and it has spawned a number of empirical investigations designed to test the fundamental character of urban economies.

One particularly salient theoretical development modifies the employment location assumption. Consider the addition of local employment that is more evenly dispersed around the city. A worker then has a choice between central employment and local employment (which might include a variety of population services such as groceries, schools, etc.). If all employment offered the same wage, workers employed in outlying areas would be better off since they could obtain cheaper housing and could have lower transportation costs. Thus, employment equilibrium must imply that wages also fall with distance from the CBD. Indeed, this simple theoretical extension suggests that a wage gradient should exist and that this gradient should mimic the land price gradient but be less steep.[2]

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[1] The basic model has been extended to consider both the theoretical and empirical implications of each of these. Such extensions do not, however, alter the general formulations considered here. See reviews by Arnott [1986] and Fujita[1986].

[2] See Muth[1969] and Moses[1962]. The relative steepness of the profiles reflects the importance of wages and housing costs in the budget constraint. A complete model of employment and residential location would also consider how the production function for goods varies with location,

Thus, an alternative test of the basic spatial model involves the spatial structure of wages within cities. This idea has itself led to another strand of literature, although it too faces a variety of empirical challenges. While it does not require dealing with the heterogeneity of housing, it does require characterization of the heterogeneity of labor. It also requires some consideration of other supply and demand influences on wages (Roback[1982]).

A final body of literature is relevant. Beginning with Kain[1968b], many authors have investigated the relationship between racial segregation in housing and the employment opportunities of blacks. While the findings have been controversial and subject to considerable reanalysis, the basic idea is simply that residential segregation constrains accessibility to employment.[3] Much of the empirical study has related to employment probabilities, but some has investigated the earnings implications.[4] Because these studies are based on nonuniform employment decentralization, there are few theoretical predictions about the exact nature of the location effects on labor markets.

B. Empirical Findings. The corresponding empirical investigations into rent and wage gradients have met with only limited success. A

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but this is seldom considered explicitly. Extensions to the general equilibrium framework are found in White[1974] and Sullivan[1986]. The theoretical properties particularly as pertain to existence of the full general equilibrium structure are, however, subject to severe criticism; see Berliant and ten Raa[1987].

[3] Subsequent discussions can be found in Mooney[1969], Noll[1970], Harrison[1974a, 1974b], Offner and Saks[1971], Kain[1974]. Oi[1976] presents a related discussion of residence and labor supply.

[4] See Price and Mills[1985] and Straszheim[1980].

fundamental complication has been separating land prices--the central feature of the theoretical models--from the prices attached to components of housing and improvements. Specifically, markets for undeveloped land are very thin, and most transactions involve specific housing bundles consumed at varying locations. Housing is, however, a durable and very heterogeneous commodity. Therefore, the empirical task is one of isolating a pure "location" price. While there have been numerous attempts at this, typically involving hedonic models of housing characteristics, they have failed to provide convincing evidence of spatial variations in prices.[5] The bulk of the empirical analyses have centered not upon the direct investigation of variations in rental prices but instead on the implications of the basic models for population densities. This analysis, while consistent with much of the theoretical work, is open to alternative interpretations and therefore does not provide a direct test of spatial price variations.

Empirical analyses of wage gradients, like their counterparts of rent gradients, frequently rely upon less than ideal data. The underlying theory is derived for a single household and then aggregated to the metropolitan area. With housing, the device of aggregating bid rent functions provides the linkage to aggregate demand, and, with assumptions about the spatial configuration of housing and employment, empirical specifications can be derived (e.g., Galster[1977]). While not done in the same amount of detail, an analogous development is clearly possible in

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[5] See, for example, Harrison and Kain[1974], Jackson, Johnson, and Kaserman[1984]. An alternative has been the use of assessment data that attempts to estimate separate land prices; see, for example, Ohkawara[1985] for application of this to Tokyo.

terms of wage opportunities.

Without pursuing this development, however, one can still clearly specify the key issues. First, the theory holds that otherwise identical workers would be willing to work for a lower wage at an employment location that was closer to the residential location. (Wages of different workers would, nonetheless, vary according to their individual skills). Second, at the aggregate level, both the pattern of employment locations and the pattern of residential locations will interact since the key element is the aggregation of commuting times and costs. Third, different metropolitan areas which vary in spatial characteristics and in employment structure will likely differ in terms of wages.

The simplest analysis of wage gradients considers a homogeneous group of workers within a given city and determines the spatial variation in wages by employment location (Rees and Shultz[1970], Eberts[1981]].[6] Examples of this type of analysis are rare because such data are rare. A modified version of this approach can be found in Straszheim[1980] where, however, there are only imprecise measures of differences in characteristics of workers.

Perhaps the most common empirical investigation of the geography of wages employs national data. Individual differences are statistically controlled by estimating variants of standard wage determination equations. These may or may not include factors describing aggregate characteristics

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[6]For their classic study, Rees and Shultz employ a special survey of employers in the Chicago area. Analysis concentrated on wages within occupations, although additional schooling and experience measures were included. They found that both the geographic subarea of employment and the commuting distance of the worker entered into wage determination. Eberts generally finds downward sloping wage gradients for public employees in Chicago.

of local areas and local labor markets. To these standard earnings models, characteristics of residential location and, occasionally, employment location are appended. Examples of this approach which include measures of both employment and residence location are found in Galster[1987] and Madden[1985]. Mills and Price[1985] and Reid[1985] concentrate entirely on how wages vary with residential location, perhaps motivated by the concerns raised by Kain[1968b].

Past research has indicated clearly that wages vary significantly and systematically across metropolitan areas (e.g., Fuchs[1967]). Alternative explanations have been offered ranging from amenity differences (and a compensating differential explanation) to productivity differences.[7] Without consensus on the proper measurement of labor market characteristics, difficult empirical issues are introduced in the specification of spatial characteristics of an area. Evidence on earnings determination does suggest that local characteristics may interact with the returns to schooling and training (Hanushek[1981]). One analysis (Madden[1985]) circumvents many of these problems by concentrating upon wage growth and employment decisions.[8] To the extent that area specific and individual specific determinants of earnings have an additive effect

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[7]Compensating differential explanations have concentrated upon a variety of specific factors: employment probabilities (Hall[1972], Harris and Todaro[1970]), price differences, or general amenities (Rosen[1979], Nordhaus and Tobin[1972], Kelley[1977]). An alternative demand or productivity explanation is found in Sveikauskas [1975] and Mera [1973]. Investigations of city size differentials are also relevant (Hoch[1972], Segal[1976], Garofalo and Fogarty[1979]). It is not possible, however, to distinguish among alternative explanations on empirical grounds (Hanushek[1981]).

[8]This analysis concentrates on the explaining changes in the length of work trip as a function of changes in wage rates, opening questions about simultaneity bias in the estimation.

(in growth terms), such an approach will allow for both measured and unmeasured differences. Her analysis, however, suffers from missing information on both employment and residential geographic location.[9]

The final issue in most interarea analyses is the characterization of location within a metropolitan area. The theory describes how wages vary by employment location within a metropolitan area. Implicitly, metropolitan areas with different spatial patterns of employment and housing will differ in the spatial patterns of wages. Thus, characterizing wage differences across areas by just central city or suburb is unlikely to capture the importance of spatial characteristics. Metropolitan areas, as defined by the Census Bureau, differ widely in the geographic location of economic activity. One view is provided by Mills [1972] where he estimates widely different density gradients for population and employment across cities.[10] A simpler characterization is found in the 1970 Census data: For metropolitan areas with more than 200,000 people, the population in central cities made up 45.5 percent of the SMSA population, but this ranged from 16 to 100 percent.

II. Empirical Analysis

A. Conceptual Model. Location theory implies a systematic distribution of

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[9]The only data on residence and employment is commuting distance, which can be converted into the appropriate geographical measures only with very strong assumptions.

[10]His work characterizes employment and population densities in terms of exponential distributions of distance from the CBD. His empirical analyses suggest that metropolitan areas differ dramatically in terms of the shapes of these density surfaces.

people and jobs within a metropolitan area and a resulting equilibrium price surface for rents and wages. The approach here is to begin with the reduced form wage equation defined by employment location and to trace its implications for aggregate wages within the area. This derivation provides a precise specification of area wages for the subsequent empirical investigation.

Assume that the reduced form for wages at any employment location in a metropolitan area (s) can be written as a function of distance of employment location from the center of the area (D):

$$(1) \quad W_s(D) = \Gamma_s \tilde{W}_s \exp(-\alpha_s D)$$

The wage for employment in the CBD is given by a base wage for a given quality of worker, $\tilde{W}_s$, modified by specific characteristics of labor market supply and demand factors (Γ_s).[11] The wage at dispersed employment locations is adjusted according to the locational gradient (α_s) (which differs across areas as a function of the spatial structure of employment and residence location). Using lower case letters to reflect logarithms of variables,

$$(1') \quad w_s(D) = \gamma_s + \tilde{w}_s - \alpha_s D$$

Now consider the average wage (for "identical" workers) given differences in employment location.[12] The geometric mean of area wages ($\bar{w}_s$) is:

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[11] Γ_s also includes amenities and other characteristics of areas that determine local wages (see Rosen[1979], Hanushek[1981]).

[12] Assuming that the metropolitan area is circular and exhibits radial symmetry, employment and residence densities at any distance from the center are the same on any ray out from the center.

$$(2)\quad \bar{w}_s = \int_0^{D_r} 2\pi k\ (ED(k)/N)\ (\gamma_s + \tilde{w}_s - \alpha_s k)\ dk$$

where ED(k) is the employment density (workers per square mile) at distance k from the center, D_r is the distance to the edge of metropolitan area, and N is the total number of workers in the area. We can approximate this function by taking the mean employment density in the central city (ED_{cc}) and the surrounding ring (ED_r) and rewriting (2) as:

$$(3)\quad \bar{w}_s = \gamma_s + \tilde{w}_s + (1/N)\int_0^{D_{cc}} 2\pi k\ ED_{cc}(-\alpha_s k)dk + (1/N)\int_{D_{cc}}^{D_r} 2\pi k\ ED_r(-\alpha_s k)dk$$

where D_{cc} is the distance to the edge of the central city. Performing this integration and substituting P_s for the proportion of employment located in the central city, we have that average wages are:[13]

$$(4)\quad \bar{w}_s = \gamma_s + \tilde{w}_s - \alpha_s/3\ \left[\frac{(D_r^2 + D_r D_{cc} + D_{cc}^2) - P_s D_r^2}{(D_r + D_{cc})}\right]$$

Average wages are thus related to base wages ($\tilde{w}_s$), an area-specific wage differential (γ_s), the spatial structure of wages (α_s), employment distribution (P_s), and size of the central city and area (D_{cc} and D_r).

While average wages in the area, the distribution of employment (P_s), and the size of the area are directly observable, the area specific parameters (γ_s, α_s, and $\tilde{w}_s$) cannot be separately identified and estimated.

Now consider a comparison of mean black and white wages within a local labor market. If area specific factors have the same effect on black and white wages and if the wage gradients are equal for both, we can write mean

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[13]The key substitutions are that $P_s=N_{cc}/N$ and $(1-P_s)=N_r/N$ where N_{cc} and N_r are the number of employees in the central city and ring, respectively, and employment densities (ED) are number of employees divided by area.

black wages as:

$$(1'') \quad \bar{w}_s^b = \gamma_s + \tilde{w}_s^b - \alpha_s D$$

where $\tilde{w}_s^b$ is the base wage of a black worker in the CBD. A similar expression holds for mean white wages, $\bar{w}_s^n$. Then, the difference in mean wages is simply:

$$(5) \quad \bar{w}_s^b - \bar{w}_s^n = (\tilde{w}_s^b - \tilde{w}_s^n) + \alpha_s/3 \; (P_s^b - P_s^n) \; [D_r^2/(D_r+D_{cc})]$$

where P_s^b and P_s^n equal the proportion of central city employment for blacks and whites, respectively. The first term reflects differences in base wages between blacks and whites, while the second reflects the interaction between area wage gradients and relative employment locations of the two groups.

The relative base wages, which are independent of actual employment location, indicates the substitutability of blacks for whites. If "identical" black and white workers were truly comparable in terms of labor market skills and if there were no discrimination in the labor market, one would expect no difference in base wages. However, if either condition does not hold, base wages would differ.

We can characterize the base wage differences as arising from the substitutability of blacks for whites in production. If the production function is CES, i.e.,

$$(6) \quad Q = A\left[\eta (N_s^b)^{-\rho} + (1-\eta)(N_s^n)^{-\rho} \right]^{-1/\rho}$$

wages are related to numbers of employees in equilibrium such that:

$$(7)\quad \tilde{w}_s^b - \tilde{w}_s^n = a + (1/\sigma)[\log N_s^n - \log N_s^b] \qquad \text{where } \sigma = 1/(1+\rho).$$

The substitution elasticity (σ) differs from ∞ either because of unmeasured quality differences in workers or racial discrimination.

The wage gradient (α_s) differs across areas with its magnitude depending upon the relative dispersion of population and employment in an area and the size of the area (reflecting transportation costs). The wage gradient reflects the additional compensation required at more central locations[14] to attract the right number of workers. This in turn will be related to supply and demand functions for workers at each point in the area. If the housing price gradient declines with distance from the center, workers should never commute outward from their residences (because, for any distance travelled, a worker can always increase net utility by living outside employment location). Therefore, with transportation costs proportional to distance, the steepness of the wage profile should be related to the rate at which the gap between population and employment demands close as one moves out. In particular, holding constant location of residence, areas with more concentrated employment should have steeper wage gradients; and, holding constant employment location, areas with more dispersed residences should have steeper wage gradients.

A simple characterization of this is:

$$(8)\quad \alpha_s = \lambda(\mu_s^e - \mu_s^p)$$

where μ^e is the gradient of the linearized employment density with respect

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[14] This assumes that employment is more centralized than population.

to distance, μ^p is the gradient of linearized population density, and λ is a constant of proportionality. When the employment and population distributions are normalized to the totals for the area, Equation 8 can be thought of as an approximation of commuting costs when such costs are directly related to distances within areas.

Substituting (7) and (8) into (5) yields:

$$(9)\quad \bar{w}_s^b - \bar{w}_s^n = \beta_o + (1/\sigma)[\log N_s^n - \log N_s^b] + \lambda(\mu_s^e - \mu_s^p)(P_s^b - P_s^n)[D_r^2/(D_r+D_{cc})]$$

Equation 9 characterizes the relative mean wages in an area for black and white workers. While there are a number of obvious simplifications in arriving at this, it does capture the key elements of spatial economies in a form that can be directly estimated with existing census data.

B. Data Sources and Definitions. The empirical analysis begins with the calculation of earnings for a homogeneous group of white and black workers in different Standard Metropolitan Statistical Areas (SMSAs). The 1970 Public Use Sample from the Census of Population is used to obtain estimates of the mean earnings for a 30 year old male high school graduate in each SMSA. Attention is restricted to fulltime (35+ hours), full year (48-52 weeks) workers in an attempt to uncover long run wage differences.[15] The mean of log earnings is calculated from separately estimated "Mincer"

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[15]Annual hours are more sensitive to cyclic factors than are wages. Moreover, since metropolitan areas differ significantly in terms of cyclic sensitivity (Tideman[1973]), the analysis across areas contemplated here could be affected by cyclic movements in labor markets. Concentrating on fulltime, full year workers comes closest to looking at wage rates (which are not available in the Census data). The analysis may, however, not be representative of the entire labor market to the extent that there are systematic differences in the wages of fulltime and part time workers (cf. Mincer[1974]).

earnings functions by race for each metropolitan area.[16] Separate estimates are obtained for whites and for blacks.[17]

The Census of Population provides information about central city and suburban employment and residential location. Complete data on earnings and metropolitan area characteristics are available for 72 SMSAs. As shown in Table 1, the distribution of employment and residences differs significantly by race. For blacks, 71 percent of employment is located in

Table 1. Proportion of Employment and Residences in Central Cities by Race[a]

	Proportion Central City	Standard Deviation
Employment		
Black	.71	.15
White	.58	.17
Residence		
Black	.76	.17
White	.41	.20

a. Calculations for 72 SMSAs.

the central city, as compared with 58 percent of white employment. The residence locations are even more disparate: 76 percent of blacks live in

[16]To be included, there must be at least 25 sampled individuals (for each race) meeting the employment conditions. The earnings functions (log earnings as a linear function of years of schooling, potential experience, and experience squared) allow efficient estimates of the systematic differences across areas. Importantly, the estimation does not constrain the parameters of the earnings functions to be the same across metropolitan areas or across racial groups.

[17]A more complete description of the data and estimation can be found in Hanushek [1981, 1982].

the central city even though only 41 percent of whites live in the central city. The variation in spatial distributions across metropolitan areas is quite dramatic. The correlation of employment locations is .84 while the correlation of residential locations is .40 for blacks and whites.

The employment and population parameters needed to estimate the wage gradient in Equation 8 (μ^e and μ^p) are calculated by the slope (as a function of distance) between the employment and population densities in the central city and ring. (These densities are normalized for the total employment and population in the area).

C. Estimation Results. Table 2 displays alternative estimates of Equation 9. These equations explain the ratio of black to white mean earnings in terms of the spatial structure of employment, the substitutability of black and white workers, and overall regional differences. The first column presents estimates of substitution elasticities for both the South and the remainder of the country while the second constrains the substitution elasticity outside of the South to be infinite.

By looking at mean wage differences within local labor markets for workers with the same measured human capital characteristics, this analysis eliminates some of the important sources of wage variations. Nevertheless, significant systematic variation remains. The typical black in the sample has a mean wage 36 percent below his white counterpart with a standard deviation of 17 percent. The spatial characteristics and aggregate labor market differences explain 55 percent of the remaining variation in relative earnings across metropolitan areas.

Two regions of the country, the South and the West, displayed

Table 2. Estimated Relative Wage Equations
Dependent variable=log $\bar{W}^b$ - log $\bar{W}^n$
(t-statistics in parentheses)

	(1)	(2)
SOUTH	-.358	-.408
	(-3.12)	(-5.90)
WEST	.100	.109
	(1.53)	(1.75)
EMP RATIO	.021	
	(0.55)	
SOUTH*EMP RATIO	.111	.132
	(2.09)	(3.54)
GRAD*($P_s^b - P_s^n$)	10.21	10.84
	(2.09)	(2.01)
Constant	-.335	-.285
	(-3.54)	(-11.54)
R^2	.559	.557
observations	72	72

VARIABLE DEFINITIONS

$\bar{W}^b$	mean earnings of a black male full time, full year worker, age 30, with 12 years of schooling
$\bar{W}^n$	mean earnings of a white male full time, full year worker, age 30, with 12 years of schooling
SOUTH	=1 if Census division is South; =0 otherwise
WEST	=1 if Census division is West; =0 otherwise
EMP RATIO	log (total white employment/total black employment)
GRAD*($P_s^b - P_s^n$)	spatial configuration in employment and residences ($\mu^e - \mu^p$) times difference in black and white central city employment times [$D_r^2/(D_r+D_{cc})$] -- see Equat. 9

systematic differences in the ratio of black to white earnings. After allowing for the characteristics of the metropolitan labor markets, black earnings were 35-40 percent lower in the South and 10 percent higher in the West.[18]

The results indicate that wages do in fact differ significantly by employment location.[19] As indicated by the significantly positive coefficient on the gradient term, more central employment is associated with higher wages. Moreover, this pattern is similar across metropolitan areas once the area specific geography of employment and residences is taken into account.

This analysis differs dramatically from previous work by its concentration on employment location (as opposed to residential location) and by its incorporation of the spatial differences in metropolitan areas. Most commonly, previous studies have simply included a dummy variable for jurisdiction or area of residence. Because the interaction of residential and employment locations differs systematically across jurisdictions (reflecting historical development patterns), there is no general prediction about how wages vary by residence. Furthermore, such an approach ignores variations in size and shape of political jurisdictions:

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[18]Dummy variables for all census regions were included in the initial estimation to capture overall mean differences in wages. Only the South and West exhibited significant differences after allowing for the systematic variations across areas.

[19]The effects of urban wage gradients were estimated in two ways, reflecting alternative functional forms of how population and employment distributions relate to wage gradients. Those presented rely upon slopes of population and employment densities between central cities and the suburban rings. The alternative considered employment and population per mile from the CBD; i.e., these were linear instead of quadratic in employment distances. The alternatives were statistically indistinguishable.

Central cities of metropolitan areas incorporate widely different proportions of the an SMSA's total population and employment. If the models are re-estimated in a form consistent with the previous work by substituting simply the proportion of black and white employment or population in the central cities for the gradient measures, employment location and residential location are uniformly insignificant determinants of relative wages.

The final explanation of relative wages is the substitutability of blacks for whites in production. Based upon a CES production function, wages should be directly related to employment ratios. For the country as a whole, blacks and whites appear close to being perfect substitutes--the coefficient on the employment ratio is insignificantly different from zero. In the South, however, this is not true.

Table 3. Estimated Elasticity of Substitution (σ) for Black and White Workers

	Point Estimate	95% Confidence Interval
NonSouth[a]	47.2	∞ - 10.2
South[b]	7.6	17.5 - 4.8

Notes: a. Calculated from Table 2, column 1.
b. Calculated from Table 2, column 2.

Table 3 displays the estimated elasticities of substitution between black and white workers. Outside the South, the point estimate of the elasticity of substitution of black and white workers (σ) is 47.2 with a 95 percent confidence interval of ∞ to 10.2. In the South, however, the

elasticity of substitution is estimated to be 7.6 with a confidence interval of 17.5 to 4.8. This latter result could either reflect imperfect measurement of the relative skills of blacks and whites or employment discrimination, but it is difficult to distinguish between these explanations on the available evidence.[20]

This analysis has assumed that whites and blacks face the same wage gradient. The analysis of segregation in housing suggests, however, that this might not be the case. Most of the previous work has concentrated on employment opportunities (see footnote 3, above), but some has also looked for wage implications (Straszheim[1980], Price and Mills[1985], Galster[1987]). Two separate approaches were taken to test the possibility that segregated housing within jurisdictions affected relative wages. First, the models in Table 2 were estimated to allow the for different black and white wage gradients. Separate coefficients for $GRAD*P_s^b$ and $GRAD*P_s^n$ were estimated. This allows the overall pattern of employment and residences to have a differential impact on black and white wages. The differences in estimated coefficients were insignificant, both statistically and quantitatively. Second, for the 64 metropolitan areas with available data, residential segregation measures were added to the relative wage equations, but showed no influence on relative wages. These

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[20]The relative earnings are based upon equivalent years of schooling. If the quality of black schooling differs from that for whites (for the same number of years completed), the earnings differences would not relate to similar workers. Some investigations have explored this by merging test score data with school completion (see Weiss[1970] and Hanushek[1978]). These analyses rely upon coarse regional differences in mean achievement scores--which are largest when one compares the South to other regions. Nevertheless, when region of schooling was included in the earnings estimates used in this analysis, no systematic pattern of empirical wage differences emerged.

measures of housing segregation were insignificant in explaining the relative wage gap both for the country as a whole and for the South versus other regions.[21]

IV. IMPLICATIONS

The estimates of relative wages for blacks and whites indicate that significant and systematic wage gradients exist within cities. Because location theory, in terms of implications for both rent and wage gradients, relates to spatial variations in prices after eliminating variations due to heterogeneity of the housing stock or differences in worker characteristics, it has been very difficult to test. This analysis provides direct confirmation of the fundamental theoretical predictions of urban location theory.

The analysis also provides further insights into wage differences between blacks and whites. The location of black employment, which is more central in metropolitan areas than that of whites, lessens the differences in black and white earnings that would be observed if they had similar employment locations. For the sample as a whole, relative earnings of blacks would be 1.5 to 2.7 percentage points less than observed if black employment was as dispersed as white employment.[22] In other words, the overall gap of 36 percent would increase by 4 to 7 percent if blacks did

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[21] Desegregation indices, based upon census block data, are found in Sørensen, Taeuber, and Hollingsworth(1974).

[22] The lower estimates correspond to the wage gradients presented in column 2 of Table 2. The higher estimates correspond to the alternative form of the wage gradient (not reported) described in footnote 18.

not maintain their more central employment locations compared with white employment. This of course does not necessarily say anything about the overall welfare effects, because blacks must also pay more for housing because of their more centrally located housing patterns. Further, this relates only to wage effects, and blacks may be hurt by lower employment opportunities. There is no indication, however, that housing segregation involves a wage penalty for blacks.

With continued dispersal of employment opportunities within metropolitan areas, blacks may face increased disadvantages in the future.[23] The wage gradients within metropolitan areas reflect the interaction of the spatial distribution of employment and housing. To the extent that employment disperses more rapidly than housing in the future, wage gradients would tend to flatten. Thus, if blacks continued to be more centrally located, they would receive less wage compensation compared to whites.

In the South, black workers appear to be less than perfect substitutes for white workers of the same measured schooling and experience. This may reflect either discrimination in southern labor markets or differences in the quality of schooling for blacks and whites. While there is evidence of lower schooling quality, it is not possible to separate the relative influences of these two factors.[24]

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[23]For analyses of differential employment dispersal, see Kain[1968a], Noll[1970], Hanushek and Song[1973].

[24]Differences in school quality are found in all regions of the country (cf. Coleman[1966]). The differences in the South, however, are much larger than those in the rest of the country.

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