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Can Boosting Minority Car-Ownership Rates Narrow Inter-Racial Employment Gaps?

DURING THE PAST three decades, considerable effort has been devoted to assessing the importance of spatial mismatch in determining racial and ethnic differences in employment outcomes. The hypothesis posits that persistent racial housing segregation in U.S. metropolitan areas coupled with the spatial decentralization of employment have left black and, to a lesser extent, Latino workers physically isolated from ever-important suburban employment centers. Given the difficulties of reverse commuting by public transit and the high proportions of blacks and Latinos that do not own cars, this spatial disadvantage literally removes many suburban locations from the opportunity sets of inner-city minority workers.

Mismatch proponents argue that closing racial and ethnic gaps in employment and earnings requires improving the access of spatially isolated minorities to the full set of employment opportunities within regional economies. Improving accessibility can be accomplished through a combination of community development, residential mobility, and transportation programs.[1] Among the latter set of options, a potential tool for enhancing

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1. Examples include such federal government programs as Empowerment Zones, the experimental residential mobility program "Moving to Opportunities" (MTO), and the Department of Transportation's "Access to Jobs" program. For evaluations of MTO, see Ludwig (1998); Ludwig, Ladd, and Duncan in this volume; Katz, Liebman, and Kling (forthcoming). For a description of the Access to Jobs program, see GAO (1999). For an evaluation of the job creation effects of state enterprise zone programs, see Papke (1993).

accessibility would be to increase auto access for racial and ethnic minorities. Racial differences in car-ownership rates are large, comparable in magnitude to the black-white difference in home-ownership rates documented by Melvin L. Oliver and Thomas M. Shapiro.[2] Moreover, car-ownership rates for low-skilled workers are quite sensitive to small changes in operating costs, suggesting that moderate subsidies may significantly increase auto access for racial and ethnic minorities.[3]

In this chapter, we assess whether boosting minority car-ownership rates would narrow inter-racial employment rate differentials. We pursue two empirical strategies. First, we explore whether the effect of auto ownership on the probability of being employed is greater for more spatially isolated populations. The housing segregation literature demonstrates that blacks are highly segregated from the majority white population and in a manner that isolates blacks from new employment opportunities. Latino households are also segregated, though to a lesser degree than black households. If mismatch reduces minority employment probabilities, and if auto ownership can partially undo this effect, the employment effect of auto ownership should be greatest for the most segregated populations (that is, blacks, then Latinos, then whites).[4] We test this proposition using microdata from the Survey of Income and Program Participation (SIPP).

Next, we investigate whether the differences in the car-employment effects between blacks and whites increases with the severity of spatial mismatch. If spatial mismatch yields a car-employment effect for blacks that is larger than that for whites, then the black-white difference in the car-employment effect should be larger in metropolitan areas where blacks (relative to whites) are particularly isolated from employment opportunities. To test this proposition, we first estimate the black-white difference in the car-employment effect for 242 metropolitan areas in the United States. Next, we construct corresponding metropolitan-area measures of the relative spatial isolation of blacks from employment opportunities. We then test for a positive relationship between these two metropolitan-area level variables.

We find strong evidence that having access to a car is particularly important for African Americans and Latinos. We find a difference in employment rates between car-owners and non-car-owners that is considerably larger among blacks than among whites. Moreover, the car-employment effect for

2 . Oliver and Shapiro (1997).

3. Raphael and Rice (2000).

4. Massey and Denton (1993); Stoll and others (2000); Frey and Farley (1996); Massey and Denton (1989).

Latinos is significantly greater than the comparable effect for non-Latino whites yet significantly smaller than the effect for blacks. Finally, the black-white difference in the car-employment effect is greatest in metropolitan areas where the relative isolation of blacks is most severe. Our estimates indicate that raising minority car-ownership rates to that of whites would considerably narrow inter-racial employment rate differentials.

Auto Access, Race, and Labor Market Prospects

During the past three decades, household access to automobiles in the United States has increased considerably. Between 1969 and 1995, the average number of automobiles per household doubled from one to two. Moreover, this increase coincided with a 17 percent reduction in household size. Over the same period, the number of households with zero vehicles declined from 13 million (21 percent of the 1969 household population) to 8 million (8 percent of the 1995 household population). Hence near the end of the century, household access to automobiles in the United States is nearly universal.[5]

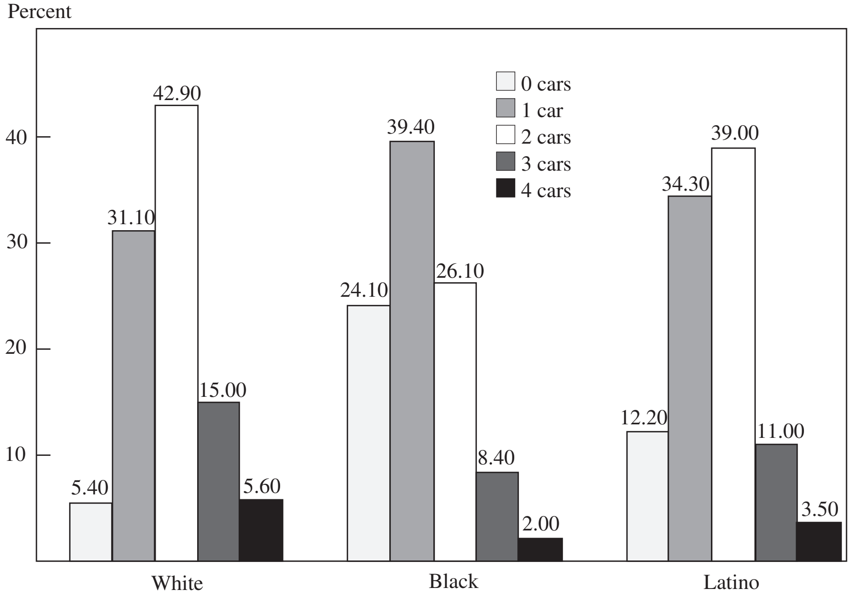
These aggregate figures, however, mask sharp differences in auto ownership across households of different racial and ethnic groups. Figure 1 presents 1995 distributions of the number of cars per household for white, black, and Latino households. The data are drawn from the 1995 Nationwide Personal Transportation Survey, which provides a large representative sample of the U.S. population. The differences evident in the figure are glaring. While 5.4 percent of white households have zero automobiles, 24 percent of black households and 12 percent of Latino households do not own a single car. These differences indicate that black and Latino households are disproportionately represented among households with no automobiles.[6] In addition, among households with at least one car, 51 percent of black households and 39 percent of Latino households have only one vehicle, compared with 33 percent of white households.[7]

5. These figures come from *Our Nation's Travel: 1995 Nationwide Transportation Survey Early Results Report*, Department of Transportation, 1999.

6. While black households were 12 percent of all households in 1995, they accounted for 35 percent of households with no vehicles. Latino households were 7.8 percent of all households in 1995 but 12 percent of households with no vehicles.

7. There are also large differences in auto access rates by household income. For households with incomes of less than $25,000, $25,000 to $55,000, and $55,000 plus, the percent with zero vehicles in 1995 is approximately 18, 4, and 1 percent, respectively. Hu and Young (1999).

Figure 1. Distribution of the Number of Household Automobiles by Race and Ethnicity, 1995



Source: Tabulated from the1995 Nationwide Personal Transportation Survey.

Several factors may contribute to these large differences in automobile ownership. Household incomes and wealth (in savings and equity in housing) are much lower among minority households.[8] This should surely limit one's ability to make large purchases and limit access to capital markets.[9] In addition, some researchers have raised the possibility that blacks face systematic price discrimination in the market for new cars. In an audit study of Chicago auto dealerships, Ian Ayres and Peter Siegelman document that car salespersons make initial and final offers that are consistently and substantially higher for black auditors than for white auditors. However, in an analysis of consumer expenditure survey data, Goldberg finds no evidence that blacks pay

8. Oliver and Shapiro (1997).

9. There is some indirect evidence that the low car-ownership rates among low-income households is the result in part of capital constraints. In a survey of Earned Income Tax Credit recipients, Smeeding, Ross Phillips, and O'Connor (forthcoming) find that recipients of the substantial lump-sum payments under the program often use the money to purchase an automobile. There are also some media reports of racial discrimination in the financing terms that black car buyers experience at car dealerships. See Diana B. Henriques, "New Front Opens in Effort to Fight Race Bias in Loans," *New York Times,* October 22, 2000, and "Hidden Charges: A Special Report; Extra Costs on Car Loans Draw Lawsuits," *New York Times,* October 27, 2000, sec. A1.

higher prices for new cars (holding car attributes constant).[10] An alternative factor may be differences in insurance costs faced by minority households. Scott E. Harrington and Greg Neihaus provide evidence for the state of Missouri that insurance premiums are much higher in predominantly minority neighborhoods.[11] While the authors find that these higher premiums are justified by higher realized loss ratios in minority neighborhoods (and hence, that the higher premiums do not reflect discriminatory behavior by insurers), the results still indicate that insuring a car costs more for residents of predominantly minority, urban communities. These cost differentials should influence those black and Latino individuals that are on the margin between owning and not owning a car.

The proposition that having access to a reliable car provides real advantages in finding and maintaining a job is not controversial. In most U.S. metropolitan areas, one can commute greater distances in shorter time periods and, holding distance constant, reach a fuller set of potential work locations using a privately owned car rather than public transit.[12] For low-skilled workers, being confined to public transit may seriously worsen employment prospects for many reasons. First, public transportation is slower than private transportation and thus substantially increases the time cost of travel. Second, suburban employer locations are less accessible by public

10. Ayres and Siegelman (1995); Goldberg (1996). The difference in the results between these two studies may be attributed to the fact that while Ayres and Siegelman study the offer distribution faced by black car buyers, Goldberg examines the price distribution conditional on a transaction occurring. Specifically, if potential black car buyers that receive very high price offers from dealers drop out of the market, the offer-price distribution and the transaction-price distribution will not be similar. Hence, measuring discrimination by the mean price differential using the latter distribution will underestimate the degree of price discrimination against blacks. Goldberg explores this possibility using standard sample-selection methods and concludes that her estimates are not affected by sample selection. The selection-correction results, however, are not explicitly presented. Hence, one cannot assess the precision of the selection models (in particular, the estimate of the covariance between the residuals from the selection equation and the price equation). Other differences between the two studies include the fact that while Goldberg analyzes a national sample, Ayres and Siegelman analyze a sample of Chicago dealers. In addition, information from the Consumer Expenditure Survey used in the Goldberg study on auto make, model, and options purchased, while detailed, is far from complete, while the auditors in the Ayres and Siegelman study bargain over the exact same models in the same dealerships. The mixed results of these two very well-done studies indicates that further research on this question is warranted.

11. Harrington and Neihaus (1998).

12. Stoll (1999) analyzing a sample of adults in Los Angeles and Holzer and others (1994) analyzing a national sample of youths show that car owners search greater geographic areas and ultimately travel greater distances to work than do searchers using public transit or alternative means of transportation.

transit. Thus, not having access to an automobile geographically constrains low-skilled workers, especially minority workers. Finally, public transit schedules tend to offer more frequent service during traditional morning and afternoon peak commute periods, while low-skilled workers are more likely to work irregular hours.[13] This incongruity in schedules may result in longer commutes, a relatively high probability of being late, or both.

Moreover, the residential location choices of low-skilled workers are likely to be geographically constrained by zoning restrictions limiting the location and quantity of low-income housing. Such constraints may limit the ability of low-skilled workers to choose residential locations within reasonable public-transit commutes of important employment centers. For minority workers, residential location choices are constrained by relatively low incomes and pervasive racial discrimination in housing rental and sales markets.[14] The existing mismatch literature clearly demonstrates that low- and semi-skilled employment opportunities are scarce in minority neighborhoods relative to the residential concentration of low-skilled and semi-skilled labor, and that these differences in accessibility affect the employment rates of minority workers.[15] In addition, several authors have demonstrated intrametropolitan patterns of employment growth that favor nonminority neighborhoods.[16] Hence, one might argue that having access to a car would be especially important in determining the employment outcomes of minority workers.

Several researchers have found large differences in employment outcomes between those with and without access to an automobile. Harry J. Holzer, Keith R. Ihlanfeldt, and David L. Sjoquist find that youths with cars experience shorter unemployment spells and earn higher wages than youths without cars. This study also finds differential effects of auto access by race, showing car effects on unemployment spells that are larger for black than for white youth. Paul Ong analyzes a sample of welfare recipients residing in Califor-

13. Stoll (1999); Holzer and others (1994); Stoll and others (2000); Holzer and others (2001); Holzer and Ihlanfeldt (1996); Ihlanfeldt and Young (1996); Hughes (1995). Hamermesh (1996) analyzes the likelihood of working irregular hours in the United States. Both education and age have strong negative effects on the probability of working shifts from 7 P.M. to 10 P.M. and 10 P.M. to 6 A.M. for both men and women. Hence the young and the less educated are more likely to work nontraditional schedules. Black men are also significantly more likely to work these irregular hours, while for women there is no effect of race.

14. Yinger (1995).

15. Stoll and others (2000); Mouw (2000); Raphael (1998a, 1998b); Weinberg (2000). Extensive reviews of the spatial mismatch literature are provided by Holzer (1991); Ihlanfeldt and Sjoquist (1998); Kain (1992); and Pugh (1998).

16 . Mouw (2000); Raphael (1998a, 1998b); Stoll and Raphael (2000); Glaeser and Kahn, this volume.

nia and finds substantial differences in employment rates and hours worked between those with and without cars. Ong fails to find effects of auto access on wages and argues that the lack of a wage effect indicates that unobserved heterogeneity is not a factor in explaining the employment results. Katherine M. O'Regan and John M. Quigley find large car-employment effects for recipients of public aid using data from the 1990 decennial census. Finally, Steven Raphael and Lorien Rice estimate car-employment effects using geographic variation in auto insurance premiums and state gasoline taxes as instruments for car ownership.[17] The authors find two-stage-least-squares (2SLS) car-employment effects that are comparable in magnitude to OLS estimates and car effects that are generally larger for workers with lower earnings potential.

To the extent that transportation barriers constrain the employment opportunities available to minority populations, relaxing these constraints may improve the employment prospects of minority workers. In this chapter we explore the potential impact of improving minority access to private transportation.

Modeling the Effects of Auto Ownership on Employment: Two Empirical Strategies

Our empirical strategy makes use of a simple linear probability model of employment determination. Assume that the categorical variable, E_i, indicating whether individual i is employed depends on individual skills, S_i, and one's spatial accessibility to employment locations, A_i. Spatial accessibility is akin to the density of one's employment opportunity set, where accessible employment opportunities are those within a reasonable commute distance of one's residence. We assume that both accessibility and skills positively affect the probability of being employed according to the linear equation

$$E_i = \alpha_1 A_i + \alpha_2 S_i + \alpha_3 B_i + \varepsilon_i. \tag{1}$$

where ε_i is a mean-zero, randomly distributed disturbance term and B_i is an indicator for black individuals.

Car ownership (denoted by the indicator variable, C_i) affects employment status by improving accessibility—that is, car owners can have access to a greater proportion of a regional labor market than can non-car-owners. This

17. Holzer, Ihlanfeldt, and Sjoquist (1994); Ong (1996); O'Regan and Quigley (1999); Raphael and Rice (2000).

implies that $E(A|B, C=1) > E(A|B, C=0)$. For blacks, the expected difference in employment rates between car owners and non-car-owners is given by the expression

$$\Delta_B = E(E \mid B=1, C=1) - E(E \mid B=1, C=0)$$
$$= \alpha_1[E(A \mid B=1, C=1) - E(A \mid B=1, C=0)]$$
$$+\alpha_2[E(S \mid B=1, C=1) - E(S \mid B=1, C=0)]$$

(2) $$\Delta_B = \alpha_1 \Delta_B^A + \alpha_2 \Delta_B^S,$$

where Δ_B^A is the expected accessibility difference between black car owners and non-car-owners and Δ_B^S is the comparable expected skill differential. The "true" car effect is given by the first term (the accessibility boost multiplied by the effect of accessibility) while the second term is the portion of the difference in employment rates between black car owners and non-car-owners owing to inherent productivity differences.

Identifying the true car effect requires statistically distinguishing the portion of the employment rate differential caused by improved accessibility from the portion of the differential reflecting differences in average skill endowments. One approach to tackling this issue would estimate an adjusted employment difference between car owners and non-car-owners holding constant all factors that determine employment and that differ systematically across these two groups. Unfortunately, the set of covariates included in most microdata sources is likely to be incomplete and, hence, such regression-adjusted estimates of the car-employment effect may be biased by the omission of important unobservable factors.

An additional problem that is likely to bias estimates of the car-employment effect concerns the fact that auto ownership and employment are likely to be simultaneously determined. If the probability of owning a car depends positively on the probability of being employed, it is simple to show that OLS estimates of a car-employment effect will be biased upward.[18] Moreover, this

18. Suppose that employment is determined by $E_i = \alpha_0 + \alpha_1 C_i + \varepsilon_i$, while car ownership is determined by $C_i = \beta_0 + \beta_1 E_i + \eta_i$. Assume that α_1 and β_1 are both greater than zero. The probability limit of the OLS estimate of α is equal to $\text{cov}(E,C)/\text{var}(C) = \text{cov}(\alpha_0 + \alpha_1 C + \varepsilon, C)/\text{var}(C) = \alpha_1 + \text{cov}(\varepsilon, C)/\text{var}(C)$. The first term in this expression is the true car-employment effect while the second is the simultaneity bias. Since an increase in the employment probability increases the likelihood of owning a car (by assumption), $\text{cov}(\varepsilon, C)$ is positive and hence the OLS estimate of α_1 is positively biased. Solving for the reduced form for C and calculating the relevant covariance yields the exact expression of the bias $\text{cov}(\varepsilon, C)/\text{var}(C) = [\text{var}(\varepsilon)/\text{var}(C)]\ [\beta_1/(1 - \alpha_1\beta_1)]$. One estimation strategy that would correct for both simultaneity and omitted-variables bias would be to find instruments for car ownership and estimate employment effects using a two-stage-least-squares (2SLS) estimator. Below we supplement our basic OLS results with estimates of car-employment effects using 2SLS estimators.

simultaneity bias cannot be fixed by controlling for all relevant determinants of employment.

Our empirical strategy identifies lower-bound estimates of the car-employment effect for blacks by comparing the empirical boost to black employment rates associated with owning a car to the comparable boost to white employment rates. If omitted variables and reverse causality account for comparable portions of the black and white empirical car-employment effects, the observed car effect for whites can be used to net out these biases for blacks. Specifically, define Δ_W as the employment rate difference between car owners and non-car-owners for whites comparable to the difference for blacks defined above. If we assume that the effects of skills and accessibility on employment are comparable across races, then subtracting this difference for whites from that for blacks yields the expression

$$\Delta_B - \Delta_W = \alpha_1(\Delta_B^A - \Delta_W^A) + \alpha_2(\Delta_B^S - \Delta_W^S), \tag{3}$$

where Δ^A_W and Δ^S_W are the expected differences in accessibility and skill endowments between whites with and without cars. If we assume that the skill differential between car owners and non-car-owners is comparable across races, the term involving skills drops out of the equation, eliminating the omitted-variables bias. In other words, assuming that $\Delta^S_B = \Delta^S_W$, equation 3 reduces to

$$\Delta_B - \Delta_W = \alpha_1(\Delta_B^A - \Delta_W^A). \tag{4}$$

This final expression gives the differential effect of cars on the probability of being employed caused by racial differences in the accessibility boost of having access to a car.

Equation 4 is a lower-bound estimate of the car-employment effect for blacks since it "differences-away" the accessibility improvement realized by white car owners. If we were to assume that the entire employment rate differential between white car owners and white non-car-owners was because of unobservable heterogeneity (that is to say, $\Delta^A_W = 0$, $\Delta^S_W > 0$), then equation 4 provides an accurate estimate of the black car-employment effect. This, however, is unlikely. For reasons discussed above, even the residents of jobs-rich suburban communities are likely to benefit from access to a car. Nonetheless, using this net estimate of the car-employment effect for blacks should partially mitigate concerns about omitted-variables bias.

The quantity in equation 4 will be greater than zero if two conditions are satisfied. First, accessibility must matter (that is, $\alpha_1 > 0$). Otherwise, there would be no employment benefit to car ownership. Second, the accessibility benefits of owning a car must be greater for blacks than for whites—that is, $\Delta^A_B > \Delta^A_W$. This latter condition may fail to hold for several reasons. First, blacks may be no more spatially isolated from employment opportunities than are whites, and hence, there would be no differential benefit associated with having access to a car. Alternatively, the spatial isolation of blacks may be so extreme that even having access to a car does not neutralize the deleterious employment consequences of mismatch. If this were the case, there may still be some benefit to car access for both blacks and whites, but there would be no differential improvement in black accessibility. Hence, testing for a positive double-difference estimate as described by equation 4 provides a rather strict test of the mismatch hypothesis.

The estimate in equation 4 requires assuming that the skill differentials between car owners and non-car-owners are comparable across racial and ethnic groups. We can relax this assumption somewhat by holding constant those skill and demographic variables that are readily observable. A regression adjusted double-difference comparable to that in equation 4 comes from estimating the equation

$$E_i = \beta_0 + \beta_1 B_i + \beta_2 C_i + \beta_3 C_i * B_i + \delta \mathbf{X}_i + \nu_i, \tag{5}$$

where all observable determinants are included in the vector $\mathbf{X}_i$, and the adjusted double-difference is given by the coefficient β_3 on the interaction term between the indicator variables for car owners and black workers. This coefficient measures the extent to which the car-employment effect for blacks exceeds that for whites. In equation 5, the identification assumption concerning relative skills reduces to assuming comparable differences across racial groups in unobserved skills between those with and without cars and comparable returns to observable and unobservable skills. The assumption of comparable returns to observable skills can be relaxed by interacting race with all other control variables. This model is given by the equation

$$E_i = \beta_0 + \beta_1 B_i + \beta_2 C_i + \beta_3 C_i * B_i + \delta \mathbf{X}_i + \gamma B_i * \mathbf{X}_i + \nu_i. \tag{6}$$

The main argument underlying the double-difference estimates in equations 4 through 6 is that the effect of auto access on employment status should be larger for more spatially isolated populations. We employ two empirical strategies designed to assess this proposition. Our first strategy exploits the differences in the extent of segregation between blacks and whites and between Latinos and whites. The second strategy makes use of intercity variation in spatial mismatch conditions.

Interracial and Interethnic Comparisons of the Car-Employment Effects

Both blacks and Latinos are residentially segregated from the majority non-Latino white population. In addition, the intrametropolitan patterns of segregation are similar, with both Latinos and blacks more likely to reside in older inner-city and inner-ring suburban communities.[19] However, conventional segregation indexes show that blacks are much more segregated, and in turn, spatially isolated from high-growth suburban employment centers, than are Latinos.[20] Hence, if car ownership partially neutralizes the adverse employment effects of being spatially isolated, we would expect the largest employment differentials between those with and without cars for black workers, the next largest differential for Latinos, and the smallest differential for non-Latino white workers.

In this section, we estimate the double-difference car effects in equations 4 through 6 using a black-white comparison, a black-Latino comparison, and a Latino-white comparison.[21] The simplest test of the mismatch hypothesis would assess whether the black-white double-difference estimate is positive and statistically significant. The more stringent test of the mismatch hypothesis would be to test for positive significant double-difference estimates in the black-white, Latino-white, and black-Latino comparisons. Affirmative findings in all three comparisons would suggest that the ordering of the car-employment effects is statistically significant and associated with the degree of housing segregation.

We draw data from the fourth waves of the 1991, 1992, and 1993 Survey of Income and Program Participation (SIPP). These surveys provide large nationally representative samples that include standard labor force participation, demographic, and human capital variables. The fourth wave topical modules collect information on the number of cars present in a household and,

19. Massey and Denton (1993).

20. This can be seen by comparing values of the black-nonblack and Latino–non-Latino dissimilarity indexes for metropolitan areas with large Latino populations. The dissimilarity index measures the proportion of either of the populations being characterized that would have to move to yield a perfectly integrated metropolitan area. The black-nonblack and Latino–non-Latino dissimilarity indexes in 1990 were 86 and 66 for Chicago, 66 and 53 for Los Angeles, 74 and 56 for Miami, 71 and 54 for New York, and 61 and 45 for San Francisco. Frey and Farley (1996).

21. In all models, we define exclusive racial/ethnic categories—that is, non-Latino black, non-Latino white, and Latino.

for up to three cars per households, the person identifiers of the owners of each automobile.

We use these data to construct three measures of automobile access. The first uses the person numbers attached to the autos of each household to explicitly identify individuals that own a car. The survey provides person numbers for up to two owners. Hence in a household with two adults and one car in which both adults self-identify as being the owner, both adults are coded as owning a car. Our second measure is another binary indicator that is coded to one if anyone in the household owns a car. The final measure accounts for differences in household size. Specifically, we calculate the ratio of the number of cars present in a household to the number of working-age adults per household (18 to 65).

We restrict the sample to civilians, 18 to 65 years of age, with no work-preventing disabilities. We also restrict the sample to whites, blacks, and Latinos. For models using the indicator of individual car ownership, we further restrict the sample to individuals in households with three or fewer cars present. This restriction is needed for this variable only since the survey collects information on person numbers for up to three cars maximum. This additional restriction eliminates 6 percent of the observations.

Table 1 presents mean auto accessibility rates for whites, blacks, and Latinos calculated from the combined 1991, 1992, and 1993 SIPP samples.[22] For each of the three measures of auto access, the table presents figures for the three racial/ethnic groups overall and stratified by educational attainment and age. There are large and statistically significant differences in car access rates, regardless of how they are defined. For the indicator of individual car ownership, 76 percent of whites own cars, compared with 49 percent of blacks and 50 percent of Latinos. The household level measure of auto access indicates smaller yet significant and substantial differentials. There is an approximate 20 percentage point difference between the percent of white and black households that own at least one car and a 15 percentage point difference between white and Latino households. The largest differences are observed for the

22. Each wave of the SIPP provides longitudinal monthly labor market, demographic, and program participation information for four months. During the early 1990s, each complete panel provides monthly longitudinal data for slightly more than two years. Since we use the fourth waves of each panel, the data correspond to the year following the start date of the samples. Hence, the data from the 1991 panel correspond to 1992, the 1992 panel to 1993, and the 1993 panel to 1994. For each survey, we use labor market information as of the thirteenth month of the panel. The topical module information on auto ownership does not correspond to a given month within the wave and hence applies to the entire four-month period corresponding to the fourth wave of the survey.

Table 1. Means of the Alternative Measures of Automobile Access, by Race/Ethnicity, Educational Attainment, and Age, 1992–94[a]

	White	*Black*	*Latino*
	Panel A: Indicator of individual car ownership		
All	0.756 (0.002)	0.491 (0.006)	0.504 (0.007)
Less than 12 years	0.651 (0.007)	0.342 (0.014)	0.449 (0.011)
12 years	0.742 (0.003)	0.470 (0.010)	0.480 (0.011)
13 to 15 years	0.753 (0.004)	0.520 (0.013)	0.575 (0.015)
16 years	0.798 (0.005)	0.683 (0.020)	0.639 (0.027)
More than 16 years	0.853 (0.005)	0.751 (0.023)	0.722 (0.031)
18–25	0.498 (0.005)	0.163 (0.010)	0.275 (0.012)
26–35	0.789 (0.004)	0.547 (0.012)	0.584 (0.011)
36–45	0.836 (0.003)	0.598 (0.013)	0.581 (0.014)
46–55	0.825 (0.004)	0.649 (0.016)	0.603 (0.019)
56–65	0.817 (0.005)	0.648 (0.020)	0.520 (0.025)
	Panel B: Indicator of the presence of a car in the household		
All	0.951 (0.001)	0.749 (0.006)	0.803 (0.005)
Less than 12 years	0.906 (0.004)	0.563 (0.015)	0.771 (0.009)
12 years	0.956 (0.001)	0.746 (0.009)	0.793 (0.009)
13 to 15 years	0.961 (0.002)	0.808 (0.010)	0.841 (0.011)
16 years	0.953 (0.002)	0.907 (0.012)	0.823 (0.014)
More than 16 years	0.952 (0.003)	0.897 (0.016)	0.862 (0.023)
18–25	0.940 (0.002)	0.663 (0.013)	0.785 (0.011)
26–35	0.951 (0.002)	0.772 (0.010)	0.824 (0.009)
36–45	0.952 (0.002)	0.766 (0.011)	0.788 (0.011)
46–55	0.962 (0.002)	0.782 (0.014)	0.833 (0.014)
56–65	0.954 (0.003)	0.809 (0.016)	0.761 (0.021)
	Panel C: Cars per adult household member		
All	1.135 (0.003)	0.671 (0.007)	0.725 (0.008)
Less than 12 years	1.052 (0.011)	0.438 (0.015)	0.620 (0.012)
12 years	1.146 (0.006)	0.648 (0.011)	0.692 (0.013)
13 to 15 years	1.153 (0.007)	0.747 (0.014)	0.867 (0.017)
16 years	1.110 (0.008)	0.880 (0.021)	0.965 (0.029)
More than 16 years	1.160 (0.010)	0.967 (0.028)	1.021 (0.047)
18–25	1.042 (0.009)	0.486 (0.014)	0.629 (0.015)
26–35	1.080 (0.006)	0.737 (0.014)	0.749 (0.012)
36–45	1.178 (0.007)	0.677 (0.013)	0.730 (0.017)
46–55	1.211 (0.009)	0.741 (0.019)	0.844 (0.024)
56–65	1.230 (0.010)	0.813 (0.026)	0.739 (0.028)

a. Standard errors are in parentheses. The sample combines the fourth waves of the 1991, 1992, and 1993 Survey of Income and Program Participation.

ratio of automobiles to adult household members. Here, there is a mean white-black difference of 0.46 and a white-Latino difference of 0.41.

The patterns within educational and age groups are comparable, although the largest differences are evident among the young and relatively less educated. For example, the black-white difference in the mean of the indicator of individual car ownership is over 0.30 for high school dropouts and 0.10 for those with more than sixteen years of school. The black-white difference in this variable for individuals 18 to 25 years of age is approximately 0.34, while the difference for those 56 to 65 is 0.17.

To the extent that owning a car has real employment effects, the large differences evident in table 1 indicate that closing these gaps may narrow inter-racial employment differentials. In the remainder of this section, we first discuss estimates of the double-difference car effects based on equations 4 through 6 above using the entire sample. Next, we assess whether the relative importance of auto access in determining minority employment rates varies by observable measures of human capital such as age and educational attainment. Finally, as a robustness check, we present estimates of the importance of automobile access using instrumental variables as an alternative identification strategy.

Double-Difference Estimates Using the Entire Sample

Table 2 presents the employment rate tabulations needed to calculate the unadjusted double-difference estimates. The table provides employment rates for whites, blacks, and Latinos overall and by car access status. Panel A presents results using the indicator of individual car ownership, panel B presents comparable results for the household car variable, while panel C makes use of the ratio of cars to adult household members. Since this latter variable is not dichotomous, for the purposes of this table we split the sample into those respondents with values of the ratio that are above and below the median value.

Starting with the overall employment rates in the first row of each panel, blacks and Latinos have considerably lower employment rates than do whites.[23] The white employment rate exceeds the black and Latino employment rates by 9.5 and 11 percentage points, respectively. For individuals with cars, these differences are nonexistent or much smaller. In panels A and C, black car owners have higher employment rates than white car owners, while for the household car variable, the comparable differential is only 3 percentage points. This pattern is striking given that black car owners are, on average,

23. The overall employment rates differ slightly between panel A and panels B and C owing to the additional restriction needed to compute this measure of auto accessibility.

Table 2. Employment Rates by Race/Ethnicity and Car-Ownership Status and the Unadjusted Double-Difference Estimates

Item	*White*	*Black*	*Latino*	$\Delta^2_{Black\text{-}White}$	$\Delta^2_{Black\text{-}Latino}$	$\Delta^2_{Latino\text{-}White}$
			Panel A: Indicator of individual car ownership			
All	0.763 (0.002)	0.668 (0.006)	0.653 (0.006)	—	—	—
With car	0.803 (0.005)	0.827 (0.007)	0.773 (0.007)	—	—	—
Without car	0.623 (0.005)	0.493 (0.007)	0.503 (0.010)	—	—	—
Difference	0.179 (0.005)	0.334 (0.011)	0.270 (0.012)	0.155 (0.012)	0.065 (0.017)	0.091 (0.012)
			Panel B: Indicator of the presence of a car in the household			
All	0.764 (0.002)	0.672 (0.006)	0.658 (0.006)	—	—	—
With car	0.771 (0.009)	0.741 (0.006)	0.698 (0.007)	—	—	—
Without car	0.641 (0.009)	0.468 (0.013)	0.476 (0.007)	—	—	—
Difference	0.130 (0.008)	0.273 (0.013)	0.222 (0.016)	0.143 (0.015)	0.051 (0.021)	0.092 (0.017)
			Panel C: Cars per adult household member			
All	0.764 (0.002)	0.672 (0.002)	0.658 (0.006)	—	—	—
Above median*	0.785 (0.002)	0.807 (0.008)	0.752 (0.009)	—	—	—
Below median**	0.702 (0.004)	0.573 (0.008)	0.593 (0.008)	—	—	—
Difference	0.083 (0.004)	0.234 (0.012)	0.159 (0.012)	0.151 (0.012)	0.075 (0.017)	0.076 (0.012)

Source: The data come from combining the fourth waves of the 1991, 1992, and 1993 Survey of Income and Program Participation. Standard errors are in parentheses.
* Indicates observations with values of cars per adult household members that are above the sample median for this variable.
** Indicates observations with values of cars per adult household members that are below the sample median for this variable.

slightly less educated than white car owners (see appendix table A-1). The white-Latino employment rate differentials among car owners are also considerably narrower than the overall difference, ranging from 3 to 7 percentage points. In contrast, the employment rate differentials among workers without cars are pronounced. For this group, white employment rates exceed black employment rates by 13 to 17 percentage points and Latino employment rates by 11 to 16 percentage points.

These patterns translate into larger car-employment effects for blacks and Latinos than for whites. In the bottom row of each panel, the first three figures present unadjusted, group-specific estimates of the car-employment effect. For the individual car ownership variable, the percentage point differences in employment rates between those with and without cars are 18 for whites, 33 for blacks, and 27 for Latinos. For the household variable in panel B, the comparable figures are 13, 27, and 22, while the similar differences for the cars-per-adult ratio results in panel C are 8, 23, and 16. Recall, the spatial mismatch hypothesis predicts that the effect of car access should be largest for those workers who are most isolated from employment opportunities. If segregation from whites proxies for such spatial isolation, the patterns evident in table 2 for each of the auto access measures confirm this prediction.

To test whether the relative differences in the car-employment effects are significant, the last three columns of table 2 present calculations of three unadjusted double-difference estimates. The first subtracts the white car effect from the black car effect, the second subtracts the Latino car effect from the black car effect, while the final estimate subtracts the white car effect from the Latino car effect. All nine double-difference estimates are positive and significant at the 1 percent level. Hence, for all measures of auto access, the car-employment effect for blacks is larger and statistically distinguishable from that for Latinos and whites, while the effect for Latinos is larger and statistically distinguishable from that for whites.

To be sure, the estimates in table 2 do not adjust for differences in skills and other characteristics that affect labor market outcomes and that may differ inter-racially and between those with and without cars. Appendix table A-1 presents average values for several variables for the sample stratified by race-ethnicity and by the individual car ownership variable. The patterns in table A-1 indicate that the car owner–non-car-owner differences in observable variables such as education and age are comparable for whites, blacks, and Latinos. This pattern is reassuring and suggests that our identifying assumption is reasonable. Nonetheless, there are slight differences across groups.

Table 3. Regression-Adjusted Double-Difference Estimates of the Effects of Car Ownership on Minority Employment Prospects[a]

	$\Delta^2_{Black\text{-}White}$	$\Delta^2_{Black\text{-}Latino}$	$\Delta^2_{Latino\text{-}White}$
Panel A: Indicator of individual car ownership			
Specification 1	0.155 (0.012) ***	0.065 (0.017) ***	0.091 (0.012) ***
Specification 2	0.155 (0.012) ***	0.059 (0.016) ***	0.085 (0.012) ***
Specification 3	0.102 (0.013) ***	0.035 (0.019) *	0.067 (0.013) ***
Panel B: Indicator of the presence of a car in the household			
Specification 1	0.143 (0.015) ***	0.051 (0.021) ***	0.092 (0.016) ***
Specification 2	0.125 (0.014) ***	0.033 (0.019) *	0.081 (0.016) ***
Specification 3	0.094 (0.015) ***	0.032 (0.020)	0.044 (0.017) ***
Panel C: Cars per adult household member			
Specification 1	0.146 (0.009) ***	0.041 (0.013) ***	0.105 (0.009) ***
Specification 2	0.120 (0.008) ***	0.047 (0.012) ***	0.067 (0.008) ***
Specification 3	0.092 (0.009) ***	0.041 (0.014) ***	0.050 (0.009) ***

* Significant at the 10 percent level of confidence.
** Significant at the 5 percent level of confidence.
*** Significant at the 1 percent level of confidence.
a. Standard errors are in parentheses. Specification 1 includes a dummy variable for black (or Latino in the white/Latino comparisons), the auto access variable, and an interaction term between the access variable and the minority variable. Specification 2 adds to specification 1 controls for gender, marital status, school enrollment, whether an infant is present in the household, dummies for five educational categories, dummies for nine age categories, a complete set of interaction between the age and education dummies, and 135 state-year dummy variables. Specification 3 interacts the black (Latino) dummy variable with all of the explanatory variables including the 135 state-year dummy variables.

Moreover, the marginal effects of each of these variables on the likelihood of being employed may vary across racial and ethnic groups.

To account for these possibilities, table 3 presents adjusted double-difference estimates based on equations 4 through 6.[24] The table presents three panels of results corresponding to the three measures of auto access. The three columns of figures consecutively present the black-white, black-Latino, and Latino-white double-difference estimates using three model specifications. Specification 1 only includes a dummy variable for race (or ethnicity), car ownership, and an interaction between the two. These estimates are equal to the unadjusted double-differences presented in table 2.[25] Specification 2 adds controls for gender, marital and school enrollment status, whether an infant is present, dummy variables for the five educational attainment categories listed in appendix table A-1, a set of dummies for the nine age categories

24. Each figure in the table is a double-difference estimate from a separately estimated model. The figures are the coefficients on the interaction term between race and the car-ownership variable as illustrated in equations 5 and 6.

25. For the cars-to-adults measure, the unadjusted figures in table 3 deviate from those presented in table 2, because for these models we do not dichotomize this variable.

listed in this table, and a complete set of interactions between the educational and age dummies. The model also includes 135 dummy variables for state-years, hence adjusting for differences in state economic conditions that might affect employment probabilities.[26] Specification 3 fully interacts race (or ethnicity in the Latino-white models) with all of the explanatory variables, including the 135 state dummies. This latter specification is equivalent to estimating separate models by race and calculating the double-difference estimate from the difference in the race-specific coefficients on auto access.

For the black-white comparison, adding the variables in specification 2 does not appreciably affect the double-difference estimates. For models using the individual car ownership variable, the double-difference estimate from specification 2 is exactly equal to the unadjusted estimate. For the other two variables, adding the controls of specification 2 reduces the double-difference estimates slightly. Adding interactions between black and all of the explanatory variables (specification 3) yields larger declines in the double-difference estimates. The relative car effects decline to 0.102, 0.094, and 0.092 for the models using the individual car owner, household car, and cars-per-adult-household-member variables, respectively. Nonetheless, these effects are still two-thirds the size of the unadjusted estimates and are significant at the 1 percent level of confidence.[27]

The results for the black-Latino and Latino-white double-difference estimates are comparable. The adjusted estimates from specifications 2 and 3 are slightly less than the corresponding unadjusted double-difference estimates. For the Latino-white comparisons, all differences are statistically significant at the 1 percent level. For the black-Latino comparisons, the significance level varies across the three auto access measures, though in general these effects are statistically significant at either the 1 or 10 percent level of confidence. Hence, as with the unadjusted estimates, the regression-adjusted employment effect of autos for blacks is larger and statistically distinguishable from the comparable effects for whites and Latinos, as are the differences between Latinos and whites.

The results in table 3 combined with the figures on car-ownership rates in table 1 and the overall employment rate differences in table 2 can be used to

26. For each year of the SIPP, we created 45 state dummy variables, giving us 135 in all. We cannot create dummy variables for the full fifty states because the SIPP aggregates some states with small populations into larger groups.

27. Note the regressions using specification (3) include more than 300 control variables.

characterize the importance of racial and ethnic differences in auto access rates in explaining employment rate differentials. We start by making the conservative assumption that the entire base car effect (the effect for whites in each model) captures unobserved skill differentials between car owners and non-car-owners (and by extension, that there is no employment effect of car ownership for whites). Under this assumption, the differential effects for blacks and Latinos present estimates of the impact of car ownership on the probability of being employed for members of these groups. Hence, multiplying the difference in car ownership rates between blacks and whites by the differential effect of car ownership provides a lower bound estimate of the effect on black employment rates of eliminating the racial gap in car-ownership rates.

The figures in table 2 indicate a black-white employment rate differential of 9 to 9.5 percentage points and a Latino-white differential of 11 percentage points. For the most detailed specification of the models using the individual car-ownership variable, the double-difference estimate suggests that gaining access to a car increases black employment probabilities by 0.102. Multiplying this figure by the black-white mean difference in this auto access variable (which is calculated from the figures presented in table 1) indicates that raising the black auto ownership rate to the level of whites would increase the black employment rate by 0.027. This corresponds to a 28 percent reduction in the black-white employment rate differential. Similar calculations for the household auto variable (again, using the smallest estimates of the double-difference from specification 3) indicates that closing the racial gap in this variable would increase the black employment rate by 0.019. This corresponds to a 21 percent reduction in the black-white employment rate differential. The results from the cars-per-adults model yields the largest predictions. Specifically, the double-difference estimate from specification 3 of this variable suggests that closing the black-white gap in this auto access measure would increase the black employment rate by 0.043. This accounts for 43 percent of the black-white employment rate differential.

Similar calculations using the Latino-white double-difference estimates suggest that closing the gaps in auto ownership rate between Latinos and whites would have much smaller effects on the Latino-white employment rate gap. Estimates of the proportion of this employment rate gap attributable to differences in auto access range from 6 percent based on the model using the household auto variable to 19 percent based on the model using the cars-per-adults measure.

Heterogeneity in the Relative Car Effects

The results presented above indicate that, on average, having access to a car has disproportionately large effects on the employment rates of minorities, with the largest effects on African Americans. Here, we explore whether these relative car effects vary by age and educational attainment. There are several reasons to suspect that the employment effects of auto access may be heterogeneous. The employment prospects of low-skilled and young workers would be more sensitive to automobile access if such workers rely heavily on informal search methods such as looking for help wanted signs and submitting unsolicited applications. Moreover, since employment opportunities in central cities tend to be skewed toward the skilled, the car effects for low-skilled minority workers may be particularly large since these workers may be best matched to suburban job markets.[28]

To test for heterogeneity in the relative car effects, we define four educational attainment categories (high school dropout, high school graduate, some college, and college graduate) and four age categories (18 to 31, 31 to 40, 41 to 50, and 51 to 65). We then use these categories to stratify the sample into sixteen age-educational subsamples. For each subsample, we separately estimate linear employment probability models comparable to equation 5. The specification for each regression includes dummies for race, auto access, and the interaction between the two, linear age and educational attainment variables (when possible) and the interaction between these two variables and race, controls for gender, marital status, school enrollment, whether an infant is present, and the 135 state-year dummy variables. The coefficient on the interaction term between race and auto access provides the subsample estimates of the double-difference car effect.

Table 4 presents results for the black-white double differences. The table presents separate results for each auto access measure. The clearest pattern is the relationship between the double-difference estimates and age. With few exceptions, the differential impact of owning a car on black employment rates (relative to that for whites) is small and statistically insignificant for workers over 40 years of age. For individuals 40 and under, the relative car effects for blacks are generally positive and significant.

28. Kasarda (1985, 1989) documents the change in the composition of central city employment bases over the first thirty or so years of the postwar period. This research shows general declines in central city employment in industries that employ low- and semi-skilled workers and increases in employment in industries employing relatively high-skilled workers. More recent evidence on continuing decentralization of employment is presented in Glaeser and Kahn in this volume.

The patterns across education groups vary across the alternative measures of auto access. For the indicator of individual auto ownership, the relative effects are largest for high school graduates and workers with some college education. The relative ordering of these effects, however, differs across age categories. For the models using the indicator of a household automobile, only three of the estimates are significant at the 1 percent level, two for the youngest workers with some college education and the point estimate for college graduates that are 31 to 40 years of age. The results using the cars-per-adult measure indicate a more uniform relationship with education. For workers with a high school education or greater, the relative car effects roughly decline with educational attainment. For high school graduates, there are positive relative effects for all age groups that decline with age. The double-difference estimates are generally positive for high-school dropouts and significant for the two middle-age categories. In summary, the results in table 4 indicate that the black-white double-difference estimates are largest for young workers and workers with educational attainment levels that are less than a college degree.

We also estimated comparable double-difference models for the Latino-white comparisons. These results are presented in appendix table A-2. There are few consistent patterns. When positive, the double-difference estimates are generally smaller than the comparable black-white estimates.

Race-Specific Car-Employment Effects Using Instrumental Variables

The identification strategy employed thus far relies on the assumption that the unobserved skill differentials between car owners and non-car-owners are similar across racial groups. Under this assumption, the double-difference car effect for blacks is purged of the effect of omitted variables. In the discussion of the problems associated with OLS, we noted that besides omitted-variables bias, the simultaneous determination of employment and auto access is likely to bias OLS estimates upward. If this bias is comparable in magnitude across racial groups, the differencing strategy will also eliminate this problem. However, there is little reason, a priori, to believe that this is so. The simultaneity bias is a complicated function of the group-specific car-employment effect, the effect of employment on car ownership, the variance in car ownership, and the variance of the residual from the structural employment equation.[29] Since the evidence thus far suggests that several of these

29. See note 18.

Table 4. Regression-Adjusted Double-Difference Estimates of the Black-White Relative Employment Effect of Auto Access by Age-Education Categories[a]

	High school dropout	*High school graduate*	*Some college*	*College graduate*
		Panel A: Indicator of individual car ownership		
18–30 years old	0.073 (0.079)	0.129 (0.035) ***	0.119 (0.041) ***	0.066 (0.050)
31–40 years old	0.158 (0.075) **	0.079 (0.032) ***	0.247 (0.040) ***	0.121 (0.047)***
41–50 years old	0.013 (0.074)	0.024 (0.040)	0.078 (0.056)	-0.036 (0.063)
51–65 years old	0.000 (0.064)	0.044 (0.057)	-0.125 (0.111)	0.063 (0.104)
		Panel B: Indicator of the presence of a car in the household		
18–30 years old	0.047 (0.061)	0.060 (0.038)	0.125 (0.048) ***	0.014 (0.074)
31–40 years old	0.130 (0.080) *	0.035 (0.040)	0.226 (0.051) ***	0.176 (0.062)***
41–50 years old	-0.033 (0.089)	-0.023 (0.052)	-0.042 (0.071)	-0.037 (0.077)
51–65 years old	0.011 (0.078)	0.084 (0.071)	-0.135 (0.135)	0.095 (0.126)
		Panel C: Cars per adult household member		
18–30 years old	0.088 (0.060)	0.182 (0.031) ***	0.108 (0.030) ***	0.159 (0.049)***
31–40 years old	0.089 (0.043) **	0.163 (0.125) ***	0.126 (0.025) ***	0.085 (0.031)***
41–50 years old	0.116 (0.061) **	0.078 (0.031) **	0.047 (0.040)	-0.029 (0.036)
51–65 years old	0.023 (0.032)	0.081 (0.033) **	0.036 (0.043)	-0.028 (0.050)

* Significant at the 10 percent level of confidence.
** Significant at the 5 percent level of confidence.
*** Significant at the 1 percent level of confidence.
a. Standard errors are in parentheses. Separate regressions are estimates for each age-education cell. Each figure is the coefficient on the interaction term between a black dummy variable and the relevant auto access variable from a regression including the auto access variable, the black indicator, the interaction between these variables, linear controls for education and age and interactions of these two variables with the black dummy variable, controls for gender, marital status, school enrollment, whether there is an infant in the household, and 135 state-year dummies.

factors differ by race and ethnicity, the differencing strategy is unlikely to adequately address simultaneity bias.

One estimation strategy that would break the simultaneity between car ownership and employment is to find instruments for auto ownership and reestimate the race-specific car-employment effects using a 2SLS estimator. Raphael and Rice pursue this strategy using state-year level variation in state gasoline taxes and average automobile insurance premiums.[30] The results from this study indicate that the estimated effects of auto access on employment status and on weekly hours worked using 2SLS are comparable in magnitude to OLS estimates. Here, we make use of these instruments to estimate race-specific 2SLS estimates of the car employment effect in order to assess whether the relative ordering of the car-employment effects remains after accounting for potential simultaneity bias.[31]

30. Raphael and Rice (2000).

31. Raphael and Rice (2000) provide a detailed analysis of the first-stage relationship between automobile ownership, state gas taxes, and average auto insurance premiums. They

Table 5 presents race-specific OLS and two-stage-generalized least squares (2SGLS)[32] estimates of the effect of car access on employment for each of the three measures of auto access. To conserve space, the table only reports the coefficients on the car access variable, the first-stage coefficients for the two instruments, and the results from F-tests of the joint significance of the two instrumental variables in the first-stage regressions.[33] In all models, the OLS estimates of the car-employment effects are smaller than the 2SGLS estimates. However, the standard errors on the car effects in the instrumented estimates are quite large, and the OLS estimates are generally within one standard deviation of the 2SGLS point estimates. For whites, the OLS estimates are significant at the 1 percent level in all three models, while the 2SGLS estimates are significant at the 5 percent level for the indicator of individual car ownership and the car-per-adult variable. The results for whites support the contention that the double-difference estimates are likely to be lower bounds of the car access effects on black employment rates since it implicitly assumes that whites experience no accessibility advantage from owning a car.

For black workers, both the OLS and 2SGLS estimates of the car-employment effects are significant at the 1 percent level for all models. Moreover, both the OLS and instrumented results yield point estimates of the car effects that are larger than those for white workers. Similarly, the OLS and 2SGLS estimates for Latinos are all significant at the 5 percent level.[34]

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demonstrate strong first-stage correlations between the two instruments and auto ownership rates that are not being driven by outlier states, and that are generally stronger for low-earning potential workers (that is, the negative effects of the instruments on car ownership rates are generally larger for low-skilled workers). The authors also present discussion of the determinants of these instruments and argue that state-level variation in these variables are unlikely to be related to unobservable determinants of employment probabilities.

32. Since the instruments vary between state-years but not within, any correlation within state-years of the residuals from the employment equation will lead to 2SLS estimates of the coefficient standard errors that are biased downward. See Shore-Sheppard (1998). Although this does not affect the consistency of the parameter estimates, this does affect statistical inference. To account for this problem, we estimate a 2SGLS model that allows state-year error components in the second stage. This estimator is discussed in detail in Raphael and Rice (2000) and Shore-Sheppard (1998). The 2SGLS estimates yield standard errors that are larger than the standard errors from ordinary 2SLS.

33. The model specifications are similar to those used above with one exception. Since the instruments vary at the state-year level, we cannot include the 135 state dummy variables in the specification. To account for variation in economic condition across states, we control for the state-level unemployment rate for the year corresponding to the observation. The full details of the model specifications are discussed in the notes to table 5.

34. Concerning the first-stage relationships, the gas tax and insurance costs variables exert negative and individually significant effects at the 1 percent level of confidence in each model. Moreover, the minimum *F*-statistic for the tests of the joint significance of the instruments in the first stage is 20.

Table 5. Ordinary Least Squares and Two-Stage Generalized Least-Squares Estimates of the Car-Employment Effect, by Race and Ethnicity[a]

	White			*Black*			*Latino*		
		2SGLS			*2SGLS*			*2SGLS*	
	OLS	*Second stage*	*First stage*	*OLS*	*Second stage*	*First stage*	*OLS*	*Second stage*	*First stage*
A. Indicator of Individual Car Ownership									
Car access	0.129 (.005)	0.203 (.109)	–	0.230 (.013)	0.372 (.154)	–	0.199 (.013)	0.392 (.101)	–
Gas taxes	–	–	-0.002 (.0006)	–	–	-0.007 (.001)	–	–	-0.008 (0.001)
Insurance	–	–	-0.0002 (.00002)	–	–	-0.0002 (.00005)	–	–	-0.0003 (.00006)
F statistic*	–	–	44.894 (.0001)	–	–	20.410 (.0001)	–	–	34.808 (.0001)
B. Indicator of the Presence of a car in the household									
Car access	0.107 (.008)	0.322 (.240)	–	0.196 (.013)	0.348 (.147)	–	0.163 (.015)	0.266 (.132)	–
Gas taxes	–	–	-0.001 (.0003)	–	–	-0.008 (.002)	–	–	-0.010 (.001)
Insurance	–	–	-.0006 (.00001)	–	–	-0.0002 (.00005)	–	–	-0.0003 (.00006)
F statistic*	–	–	26.558 (.0001)	–	–	25.920 (.0001)	–	–	32.998 (.0001)
C. Cars per adult household member									
Car access	0.012 (.002)	0.089 (.040)	–	0.105 (.008)	0.203 (.080)	–	0.073 (.010)	0.197 (.095)	–
Gas taxes	–	–	-0.003 (.001)	–	–	-0.013 (.002)	–	–	-0.011 (.003)
Insurance	–	–	-0.0005 (.00004)	–	–	-.0004 (.00007)	–	–	-0.0007 (.0001)
F statistic[b]	–	–	81.182 (.0001)	–	–	39.806 (.0001)	–	–	32.57 (.0001)

a. Standard errors are in parentheses. Both the OLS models and the two stage generalized least-squares models include controls for five education categories, nine age categories, interactions between the age and education categories, gender, marital status, school enrollment, whether there is an infant in the household, and the unemployment rate defined at the state-year level.

b. This row provides results from a test of the joint significance of the instruments in the first-stage regression.

While the 2SGLS results presented in table 5 are measured somewhat imprecisely, the estimates tend to support the results from our differencing strategy presented in tables 2 through 4. We find statistically significant car effects in nearly all of the models after instrumenting. Moreover, the point estimates of these effects indicate that cars matter more for blacks and Latinos than for whites. While the standard errors on these estimates are large, the consistency between these results and those presented in the previous section should, we hope, allay some of the concerns about simultaneity bias.

Cross-City Comparisons of the Relative Importance of Car Access

Our first empirical strategy infers differential spatial isolation by assuming that segregation from whites and being spatially isolated from employment opportunities are synonymous. Based on this indirect inference, we then test for an interaction between the car-employment effect and mismatch by comparing the car effects for groups that differ with respect to their degree of residential segregation from whites. An alternative approach would directly measure the degree of spatial isolation from employment and test for a positive relationship between empirically observed car effects and the direct measure of mismatch. Our second empirical strategy takes this form.

Specifically, for the black-white comparisons only,[35] we estimate the adjusted double-difference car effect (equation 5) separately for 242 U.S. Primary Metropolitan Statistical Areas (PMSAs) using data from the 5 percent Public Use Microdata Sample (PUMS) of the 1990 Census of Population and Housing. We restrict the PUMS sample to civilian black and white observations that are 18 to 65 years of age with no work-preventing disabilities. Unlike the detailed information about household autos in the SIPP, the census only identifies whether someone in the household owns a car. Hence, our estimates of the car effects using the PUMS are based on this measure only.

The model specification used to estimate the PMSA-level measure of the double-difference is shown in appendix table A-3. The table provides regression results using the entire census sample for two model specifications: a basic model with controls for race, auto access, and an interaction term, and a more complete model with a specification very similar to those used in the

35. For this strategy we focus on the black-white comparisons only because in many PMSAs, the number of Latino observations is prohibitively small.

analysis of the SIPP data.[36] The results correspond closely to the SIPP results. Access to a car has a much larger effect for blacks than for whites. Moreover, adjusting for observable covariates does not alter the size of the relative car effect. We use the latter specification to estimate separate equations for each of 242 PMSAs. The coefficients on the interaction terms between race and car access from these 242 regressions provide our dependent variable.

Next, we construct several race-specific, PMSA-level measures of spatial isolation from employment opportunities using zip code place-of-work employment data from the 1992 Economic Census and zip code population counts from the 1990 Census Summary Tape Files 3B. We construct two MSA-level indexes by race that measure the imbalance between residential distributions and employment distributions. The first index is a jobs-people dissimilarity index.[37] The dissimilarity index ranges from zero to one and gives the proportion of people (or jobs) that would have to move to yield a perfectly even distribution of persons and jobs across zip codes within the metropolitan area. Hence, higher values indicate poorer spatial accessibility to jobs. For example, our dissimilarity index value between blacks and retail jobs in Chicago is 0.74. This indicates that 74 percent of blacks would have to move (across zip codes) to be spatially distributed in perfect proportion with the spatial distribution of retail employment.[38]

The second index is a jobs-people measure of exposure to employment opportunities. The exposure index measures the number of jobs per 100 zip code residents in the zip code of the average black (or white) resident of the PMSA.[39] The index is a weighted average (multiplied by 100) of the zip code level jobs-to-population ratios using the number of blacks in each zip code (or

36. Two minor differences in the PUMS specifications are that we do not control for the presence of an infant and that we add an indicator variable for work-limiting disabilities.

37. Define $Black_i$ as the black population residing in zip code i, $Employment_i$ as the number of jobs located in zip code i, *Black* as the total black population in the metropolitan area, and *Employment* as the total number of jobs in the metropolitan area. The dissimilarity score between blacks and jobs is given by $D = \frac{1}{2}\sum|Black_i / Black - Employment_i / Employment|$, where the summation is over all zip codes in the PMSA.

38. Martin (forthcoming) constructs a similar index for thirty-nine PMSAs using county-level data. The author finds that job decentralization between 1970 and 1990 increased the dissimilarity between blacks and jobs while the residential mobility of black households decreased dissimilarity. The net effects of these offsetting employment and population changes were increases in the spatial isolation of black households from employment over the time period studied.

39. Using the variable definitions in note 37 above, the employment exposure index is calculated using the equation $E = 100*\sum(Black_i/Black) * (Employment_i/Population_i)$. We thank Ken Small for suggesting this alternative index.

Table 6. Means of the Spatial Mismatch Indices Measuring Segregation between Population and Employment Opportunities for Metropolitan Areas Identified in the 1990 PUMS[a]

Item	*Blacks/jobs indexes*	*Whites/jobs indexes*	*Difference (black-white)*
	Retail employment dissimilarity indexes		
Levels, 1992	0.59 (0.007)	0.31 (0.003)	0.28 (0.008)
Net growth, 1987–92	0.81 (0.006)	0.63 (0.006)	0.18 (0.005)
	Retail employment exposure indexes		
Levels, 1992	5.86 (0.12)	7.65 (0.06)	-1.79 (0.11)
Net Growth, 1987–92	0.50 (0.03)	0.98 (0.03)	-0.47 (0.02)

a. Standard errors are in parentheses. Each figure is the mean for the 242 PMSAs for which we were able to estimate indexes. The figures are weighted by the number of black observations observed in each PMSA. The levels indexes are calculated using zip-code level information on the number of jobs located in the zip code in 1992 and the number of people of the relevant race residing in the zip code in 1990. The net growth indexes use net job growth between 1987 and 1992, setting growth to zero for zip codes that lose employment over this time period. Information on population by zip code comes from the 1990 Census of Population and Housing Summary Tape Files 3B. Information on job counts by zip codes comes from the Economic Census for 1987 and 1992.

whites) as the weights. Here, lower values indicate poorer accessibility. Again, using Chicago as an example, the value of our retail exposure index for blacks is 4.07. Hence, in the zip code of the average black resident of Chicago there are approximately 4 retail jobs per 100 residents.

We construct these two indexes separately for blacks and whites using two alternative measures of employment opportunities: the 1992 levels of retail employment and the number of new retail jobs added between 1987 and 1992.[40] Table 6 presents weighted averages of our race-specific jobs-people mismatch indexes for 242 PMSAs.[41] All four measures indicate that blacks are more segregated from employment opportunities than are whites. Moreover, the differences in accessibility are highly significant. Comparisons of individual cities indicate that, for the most part, the jobs-people dissimilarity indexes are uniformly higher for blacks than they are for whites, while the jobs-people

40. We set net new jobs to zero in zip codes experiencing net employment losses. This tends to overstate the economic health of predominantly black zip codes, since blacks are more likely to reside in zip codes with net job loss than are whites. In results not reported here, we also constructed comparable indexes using service employment in 1992 and new service industry jobs added between 1987 and 1992. The results are qualitatively similar to those presented below. In fact, all of these measures of mismatch are highly correlated with one another.

41. We cannot calculate indexes for the full 272 PMSAs identified in the PUMS owing to differences in geography between the Economic Census and Census of Population and Housing. The thirty metropolitan areas that we are missing are generally small with relatively small black populations. The figures presented in table 6 are weighted by the black populations of the MSAs. Hence, these figures indicate the isolation from employment experienced by blacks and white in the PMSA of the average black resident in these 242 PMSAs.

exposure indexes are uniformly lower for blacks relative to whites. Appendix table A-4 presents such comparisons for the twenty metropolitan areas with the largest black populations in 1990 (accounting for roughly 60 percent of the black metropolitan population in this year). In all comparisons, blacks have poorer spatial accessibility to employment opportunities than whites.

For each of the four mismatch measures, we subtract the white-jobs index from the black-jobs index to arrive at a PMSA-level measure of the isolation of blacks *relative* to the spatial isolation of whites. *This is our key explanatory variable*. If mismatch is important, and if having a car partially undoes the consequences of mismatch, then the relative employment effect of car access for blacks should be largest in those PMSAs where blacks are most isolated (relative to whites) from employment opportunities.

Our principal empirical test entails bivariate regressions of the PMSA-level double-differences on the black-white differences in the four mismatch indexes. Figures 2 and 3 present the results from these bivariate regressions. Figures 2A and 2B present scatter plots of the double-difference car effects against the black-white differences in the retail employment level and the retail employment growth dissimilarity indexes, respectively. Figures 3A and 3B provide similar scatter plots using the black-white differences in the retail level and retail growth employment exposure indexes. In each figure we include the regression line as well as the coefficient estimates and R^2 from a weighted regression of the double-difference car effects on the differences in the isolation indexes.[42] We weight each regression by the number of black observations for the PMSA used to compute the double-difference estimate.[43] The relative weight placed on each observation is indicated by the size of the bubble in the scatter plot.

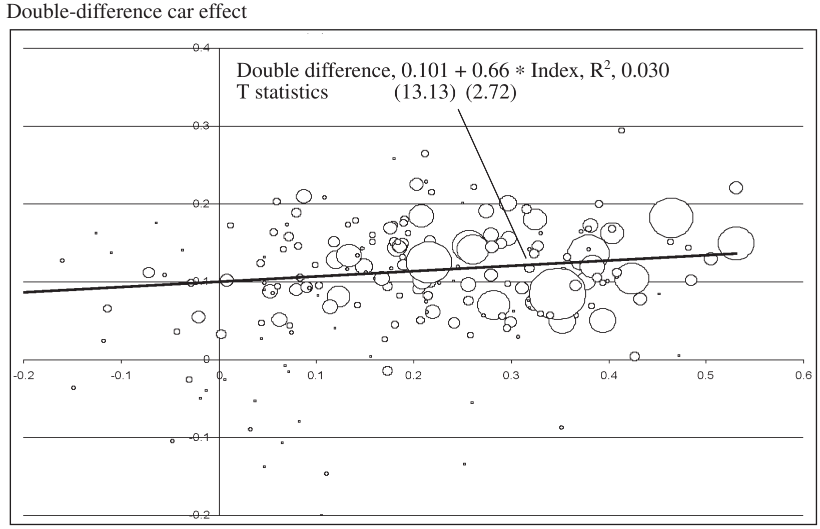
Before discussing the regression results, we should highlight a few notable aspects of the distributions of the explanatory and dependent variables that are revealed in the scatter plots. First, in figures 2A and 2B the mass of the distribution of observations lies to the right of the vertical axis, while in figures 3A and 3B the mass of the distribution of observation lies to the left of the vertical axis. Since higher values of the dissimilarity index and lower values of the exposure index indicate greater spatial isolation from employment opportunities, the patterns in the black-white differences in the indexes indicate that in nearly all metropolitan areas (with the exception of a handful) blacks

42. We also ran regressions of the double-difference car effect on the ratio of the black-to-white jobs/people indexes. This specification yields nearly identical results.

43. We also estimated the models in figures 2 and 3 without weighting. This uniformly leads to larger and more statistically significant coefficient estimates.

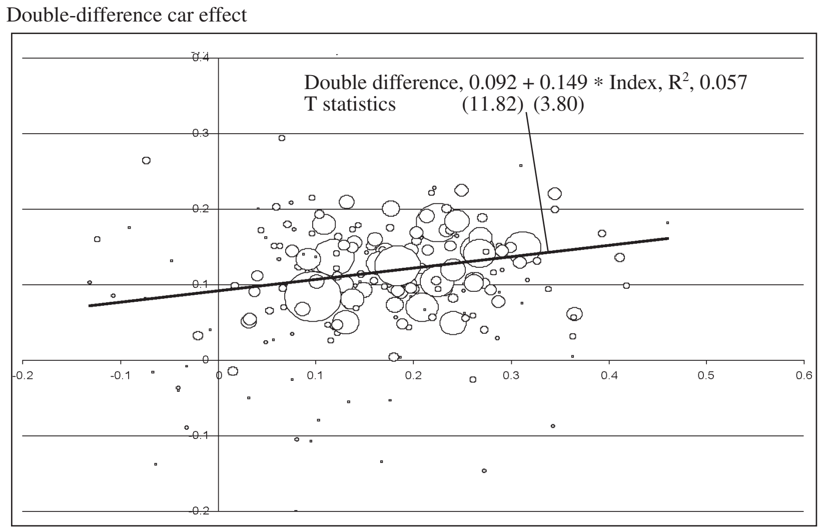
Figure 2. Scatter Plots of the Double-Difference Car Effects Against Black-White Differences in the Retail Dissimilarity Indexes

Part A. Using the retail employment dissimilarity index



Black-white difference in retail employment dissimilarity index

Part B. Using the retail employment growth dissimilarity index

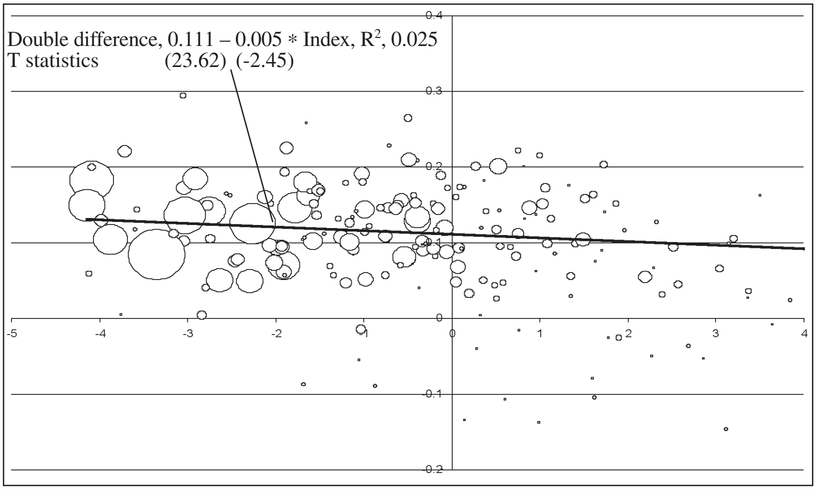


Black-white difference in retail employment growth dissimilarity index

Figure 3. Scatter Plots of the Double-Difference Car Effects Against Black-White Differences in the Retail Exposure Indexes

Part A. Using the retail employment exposure index

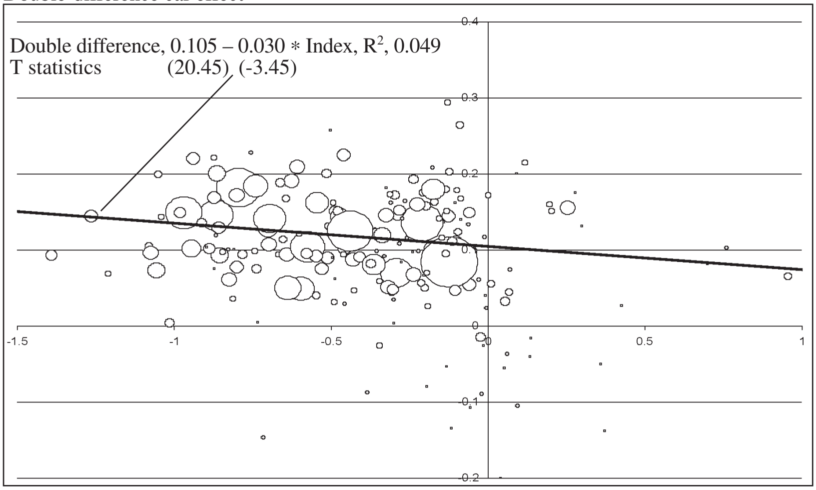
Double-difference car effect



Black-white difference in retail exposure index

Part B. Using the retail employment growth exposure index

Double-difference car effect



Black-white difference in retail growth exposure index have poorer spatial accessibility to employment than do whites. Moreover, for those areas where the reverse is true (leading to negative black-white differences in the dissimilarity indexes and positive black-white differences in the exposure indexes) black populations are quite small (as is evident from the small bubbles). Hence, figures 2 and 3 demonstrate the nearly uniform inferior access of blacks to employment opportunities.

For the distribution of the dependent variable, the mass of observations lies above the horizontal axis. This indicates that in all but a few metropolitan areas, the effect of car ownership on the employment rates of blacks exceeds the comparable effects for whites. Moreover, the size of the bubble plots where the reverse is true (white car effects are larger than black car effects, yielding adjusted double differences that lie below the horizontal axis) is generally small. These results complement the findings of the SIPP analysis by showing that fully interacting the model with geography does not eliminate the relatively greater importance of auto access in determining black employment rates.

In figures 2A and 2B there are clear positive relationships between the PMSA-level relative car effects and the relative isolation of blacks from retail employment opportunities. The coefficient on the difference in dissimilarity indexes is positive and significant for both the retail levels difference (p value of 0.007) and the retail growth difference (p value of 0.000). In figures 3A and 3B we observe statistically significant negative relationships between the relative car effects and differences in the retail employment level exposure index ($p = 0.015$) and the retail employment growth index ($p = 0.001$). Hence, these bivariate relationships indicate a statistically significant relationship between the relatively large car-employment effects for blacks and the degree of relative spatial isolation from employment opportunities.

One might argue that the bivariate regressions presented in figures 2 and 3 do not control for possible selection across metropolitan areas along personal and human capital characteristics that may be driving these significant relationships. However, the double-differences used as the dependent variable are already purged of the effect of educational attainment, age, and the other covariates listed in appendix table A-3. Moreover, since our dependent variable measures the *differential* car effect for blacks after eliminating the base car effect for whites, any inter-PMSA sorting that is also occurring among white workers is netted out of the inter-PMSA variation in our dependent variable. Furthermore, since the regressions used to generate the dependent variable are estimated separately for each metropolitan area, the relative car effect estimates have also been purged of any cross-PMSA variation in the returns (in terms of the marginal effects on employment probabilities) to observable covariates.

Nonetheless, there still may be omitted metropolitan area characteristics that coincide with racial differences in spatial isolation from employment. For example, the quality of public transit may vary from area to area, or the total area covered by the PMSA may vary. Although we do not have extensive controls for PMSA characteristics, we do have a few measures that we add to the specifications of the models in figures 2 and 3. Table 7 presents weighted regression results in which the dependent variable is the PMSA-level adjusted double difference. For each segregation index we estimate two specifications: the first controlling for the racial difference in segregation scores only, and the second adding the proportion of PMSA workers that commute by private auto (calculated from our 5 percent PUMS sample), the total land area, a variable measuring the average population density,[44] and dummies for PMSA population quartiles. The first eight models present separate regressions for the four segregation indexes, while the final two models control for all of the differences in segregation scores in the same specification.

For the two indexes based on retail employment levels, adding these additional variables increases the point estimates and statistical significance of the effect of relative black spatial isolation. For the models using differences in segregation scores based on retail employment growth, adding these variables causes slight reductions, though the effects are still statistically significant and have the proper sign. Hence, the bivariate results survive adding additional covariates to the models. Controlling for all four dissimilarity scores at the same time yields rather imprecise point estimates. Nonetheless, *F*-tests of the joint significance of all four measures fail to reject the hypothesis that all of the coefficients are zero.

In summary, the results in figures 2 and 3 and table 7 strongly confirm the proposition that the relative importance of auto access on the employment prospects of blacks is more important in metropolitan areas where blacks are more spatially isolated from employment opportunities than are whites. Moreover, the positive effect of relative isolation on the relative car-employment effect survives additional controls for metropolitan area characteristics.

44. The variable measuring average population density was downloaded from the web page created by Cutler, Glaeser, and Vigdor (www. nber.org/data/segregation.html), which contains the data analyzed in Cutler, Glaeser, and Vigdor (1999).

Table 7. Regression of the Adjusted Double-Difference Car Effect on the Black-White Differences in the Dissimilarity and Exposure Indexes Measuring Segregation between Population and Employment Opportunities[a]

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
Retail dissimilarity indexes										
Black-white difference in	0.066	0.079	-	-	-	-	-	-	0.016	0.016
1992 levels	(0.024)	(0.027)							(0.040)	(0.042)
Black-white difference in	-	-	0.149	0.092	-	-	-	-	0.087	0.015
1987–92 net growth			(0.039)	(0.042)					(0.054)	(0.057)
Retail exposure indexes										
Black-white difference in	-	-	-	-	-0.005	-0.008	-	-	-0.002	-0.005
1992 levels					(0.002)	(0.002)			(0.003)	(0.003)
Black-white difference in	-	-	-	-	-	-	-0.030	-0.019	-0.014	-0.004
1987–92 net growth							(0.009)	(0.009)	(0.011)	(0.011)
Proportion commuting to work	-	-0.049	-	-0.045	-	-0.023	-	-0.024	-	-0.031
by private auto		(0.089)		(0.089)		(0.087)		(0.089)		(0.089)
Land area[b]	-	0.003	-	-0.002	-	-0.002	-	-0.002	-	-0.001
		(0.013)		(0.013)		(0.013)		(0.013)		(0.013)
Population density[c]	-	-0.004	-	-0.003	-	-0.004	-	-0.002	-	-0.003
		(0.002)		(0.002)		(0.002)		(0.002)		(0.002)
R^2	0.030	0.119	0.057	0.106	0.025	0.133	0.049	0.106	0.071	0.135
F statistic[d]	-	-	-	-	-	-	-	-	4.555	3.115
(P value)									(0.002)	(0.016)
N	242	242	242	242	242	242	242	242	242	242

a. Standard errors are in parentheses. All regressions include a constant and a set of dummy variables for MSA population quartiles. The regressions are weighted by the number of black observations used to calculate the double difference.

b. Land area is measured in tens of thousands of acres.

c. This variable gives the number of people per square kilometer in thousands.

d. This row presents the test-statistics and p-values from a test of the joint significance of the four segregation indexes.

Conclusion

The results of this paper show that having access to a car has disproportionately large effects on the employment rates of workers that are spatially isolated from employment opportunities. We find the largest car-employment effects for the most segregated minority populations. Moreover, we find strong evidence that the difference between the black and white car-employment effect is greatest in metropolitan areas where the relative isolation of blacks from employment opportunities is most severe. Given the large differences in car-ownership rates that we document, these results indicate that lack of access to transportation plays a large role in explaining black-white, and to a lesser degree Latino-white, differences in employment rates. By extension, these results also suggest that increasing car access may be an effective policy tool for narrowing these employment gaps.

To be sure, employment policies that increase auto-ownership rates will also increase the externalities associated with increased private auto work commutes and nonwork trips. Nearly all metropolitan areas in the United States suffer from traffic congestion that exceeds the social optimum, given the challenges associated with optimally pricing road usage. Increasing auto ownership through a subsidy to operating costs would surely increase traffic congestion. In addition, more autos will certainly translate into more air pollution.

There are reasons, however, to suspect that increasing auto access for blacks and Latinos would not add appreciably to congestion and pollution. Since black and Latino residential distribution is centralized and concentrated, those who commute to jobs in city centers are unlikely to increase congestion on inbound freeway routes. Moreover, those who locate employment in the suburbs will have commutes that are in the reverse direction of the largest peak-period flows. Katherine M. O'Regan and John M. Quigley have made a similar point quite decisively in their discussion of the possible congestion consequences of increasing car-ownership rates among welfare recipients.[45] Another factor limiting the addition to congestion costs concerns the fact that many of these individuals work nonstandard schedules and, hence, would be making private auto commutes at times of the day when the external costs of an additional trip are low. Finally, even an extreme policy that raises minority car-ownership rates to the level of whites would purchase new autos for a minority of a minority of the U.S. working-age population. Hence, both the

45. O'Regan and Quigley (1999).

congestion and pollution externalities caused by such policies are likely to be small.

Finally, the results presented here do not provide enough information to compare the relative efficacy (in terms of alleviating inner-city employment problems) of community development initiatives, residential mobility programs, training programs, and policies designed to increase automobile accessibility. Of course, to the extent that all such policies alleviate the spatial imbalance between labor supply and demand, these policy tools may be thought of as complements rather than substitutes, with the effects of one initiative increasing the probability of success of alternatives. Nonetheless, a careful comparative analysis of the marginal benefits per dollar spent may indicate that certain policy options dominate. The strong results presented indicate that transportation policies geared toward fostering greater auto access should most definitely be considered in any comparative benefit-cost analysis of policy initiatives designed to alleviate the spatial concentration of joblessness.

Appendix

Table A-1. Means of Demographic and Human Capital Variables, by Race/Ethnicity and by the Indicator of Individual Car Ownership

	White			*Black*			*Latino*		
	Without car	*With car*	*Difference*	*Without car*	*With car*	*Difference*	*Without car*	*With car*	*Difference*
Years of schooling									
Less than 12	0.151	0.080	-0.071	0.236	0.140	-0.096	0.411	0.324	-0.086
12	0.383	0.364	-0.019	0.443	0.387	-0.056	0.379	0.347	-0.032
13 to 15	0.270	0.258	-0.012	0.240	0.266	0.026	0.157	0.204	0.047
16	0.122	0.160	0.038	0.053	0.118	0.065	0.035	0.073	0.038
16 +	0.073	0.138	0.064	0.028	0.089	0.061	0.018	0.052	0.033
Mean years of schooling	12.875	13.676	0.801	12.207	13.095	0.889	10.655	11.392	0.738
Age									
18 to 25	0.354	0.113	-0.241	0.302	0.073	-0.228	0.332	0.124	-0.208
26 to 30	0.136	0.139	0.004	0.138	0.132	-0.007	0.162	0.188	0.026
31 to 35	0.111	0.159	0.048	0.148	0.170	0.023	0.118	0.177	0.059
36 to 40	0.083	0.149	0.066	0.110	0.165	0.055	0.097	0.159	0.062
41 to 45	0.070	0.124	0.054	0.075	0.146	0.071	0.068	0.126	0.058
46 to 50	0.051	0.099	0.048	0.058	0.110	0.052	0.056	0.076	0.020
51 to 55	0.040	0.081	0.041	0.036	0.077	0.040	0.040	0.065	0.026
56 to 60	0.036	0.065	0.030	0.032	0.070	0.039	0.029	0.046	0.017
61 to 65	0.040	0.065	0.025	0.027	0.053	0.026	0.032	0.035	0.004
Mean age	31.863	39.741	7.877	32.212	40.372	8.159	31.853	37.409	5.555
Female	0.580	0.523	-0.057	0.625	0.565	-0.060	0.616	0.490	-0.125
Married	0.335	0.709	0.373	0.194	0.588	0.394	0.367	0.725	0.358
In school	0.252	0.074	-0.178	0.192	0.057	-0.135	0.157	0.071	-0.085
Infant	0.076	0.095	0.019	0.132	0.104	-0.027	0.187	0.171	0.016

Source: The sample combines the fourth waves of the 1991, 1992, and 1993 Surveys of Income and Program Participation.

Table A-2. Regression-Adjusted Double-Difference Estimates of the Latino-White Relative Employment Effect of Auto Access by Age-Education Categories[a]

	High school dropout	*High school graduate*	*Some college*	*College graduate*
		Panel A: Indicator of individual car ownership		
18–30 years old	0.097 (0.045)**	0.065 (0.032)**	-0.035 (0.043)	0.044 (0.058)
31–40 years old	-0.145 (0.050) ***	0.004 (0.038)	0.190 (0.053)***	0.168 (0.066) ***
41–50 years old	0.074 (0.067)	0.033 (0.050)	0.293 (0.069)***	-0.003 (0.075)
51–65 years old	0.026 (0.062)	0.126 (0.066) ***	-0.164 (0.137)	-0.023 (0.139)
		Panel B: Indicator of the presence of a car in the household		
18–30 years old	0.071 (0.051)	0.011 (0.041)	0.044 (0.059)	0.128 (0.078)
31–40 years old	0.001 (0.068)	-0.087 (0.050) *	0.209 (0.070)***	0.193 (0.101)*
41–50 years old	0.024 (0.084)	-0.056 (0.067)	0.277 (0.088)***	-0.142 (0.151)
51–65 years old	0.057 (0.081)	0.039 (0.084)	-0.292 (0.173)	-0.033 (0.199)
		Panel C: Cars per adult household member		
18–30 years old	0.056 (0.042)	0.050 (0.027)*	0.041 (0.032)	0.056 (0.051)
31–40 years old	0.053 (0.039)	0.017 (0.023)	0.056 (0.025)**	0.078 (0.044)*
41–50 years old	0.074 (0.050)	0.117 (0.034)***	0.069 (0.043)*	-0.073 (0.029)***
51–65 years old	0.072 (0.051)	0.141 (0.049)***	-0.025 (0.070)	0.018 (0.061)

* Significant at the 10 percent level of confidence.
** Significant at the 5 percent level of confidence.
*** Significant at the 1 percent level of confidence.

a. Standard errors are in parentheses. Separate regressions are estimates for each age-education cell. Each figure is the coefficient on the interaction term between a Latino dummy variable and the relevant auto access variable from a regression including the auto access variable, the Latino indicator, the interaction between these variables, linear controls for education and age and interactions of these two variables with the Latino dummy variable, controls for gender, marital status, school enrollment, whether there is an infant in the household, and 135 state-year dummies.

Table A-3. Linear Probability Employment Models Using the 1990 5 Percent PUMS and the Household Level Car-Ownership Variable

Item	*1*	*2*
Black	0.134 (0.001)	0.098 (0.001)
Car	–0.148 (0.002)	–0.124 (0.002)
Black*car	0.116 (0.002)	0.107 (0.002)
Female	–	–0.158 (0.000)
Married	–	0.011 (0.000)
In school	–	–0.112 (0.001)
Disabled	–	–0.048 (0.001)
Age	–	
18–25	–	0.139 (0.002)
26–30	–	0.228 (0.002)
31–35	–	0.272 (0.002)
36–40	–	0.299 (0.002)
41–45	–	0.325 (0.002)
46–50	–	0.326 (0.002)
51–55	–	0.304 (0.002)
56–60	–	0.244 (0.002
Education		
High school	–	0.024 (0.002)
Some college	–	0.088 (0.002)
College graduates	–	0.110 (0.003)
College +	–	0.217 (0.003)
High school*18–25	–	0.151 (0.002)
High school*26–30	–	0.111 (0.003)
High school*31–35	–	0.082 (0.003)
High school*36–40	–	0.085 (0.003)
High school*41–45	–	0.074 (0.003)
High school*46–50	–	0.064 (0.003)
High school*51–55	–	0.041 (0.003)
High school*56–60	–	–0.003 (0.003)
Some college*18–25	–	0.132 (0.002)
Some college*26–30	–	0.121 (0.003)
Some college*31–35	–	0.076 (0.002)
Some college*36–40	–	0.066 (0.003)
Some college*41–45	–	0.055 (0.003)
Some college*46–50	–	0.045 (0.003)
Some college*51–55	–	0.031 (0.003)
Some college*56–60	–	–0.012 (0.003)
College graduate*18–25	–	0.195 (0.003)
College graduate*26–30	–	0.144 (0.003)
College graduate*31–35	–	0.070 (0.003)
College graduate*36–40	–	0.047 (0.003)
College graduate*41–45	–	0.034 (0.004)
College graduate*46–50	–	0.030 (0.003)
College graduate*51–55	–	0.017 (0.003)
College graduate*56–60	–	–0.022 (0.004)
College +*18–25	–	0.054 (0.006)
College +*26–30	–	0.043 (0.004)
College +*31–35	–	0.004 (0.004)
College +*36–40	–	–0.016 (0.004)
College +*41–45	–	–0.031 (0.004)
College +*46–50	–	–0.031 (0.004)
College +*51–55	–	–0.030 (0.004)
College +*56–60	–	–0.051 (0.004)
R^2	0.017	0.138
N	4,272,520	4,272,520

Standard errors are in parentheses. Both regressions include a constant term.

Table A-4. Dissimilarity Scores and Exposure Indexes Measuring Segregation between Population and Employment for the 20 Metropolitan Areas with the Largest Black Population in 1990

	Retail employment dissimilarity indexes				*Retail employment exposure indexes*			
	Levels, 1992		*Net growth, 1987–92*		*Levels, 1992*		*Net growth, 1987–92*	
	Black	*White*	*Black*	*White*	*Black*	*White*	*Black*	*White*
Atlanta	0.59	0.33	0.80	0.53	7.25	9.03	0.63	1.49
Baltimore	0.57	0.29	0.88	0.67	5.90	7.81	0.10	0.40
Birmingham	0.60	0.42	0.73	0.56	6.36	7.34	0.52	1.00
Charlotte	0.47	0.35	0.85	0.75	7.37	7.77	0.70	1.41
Chicago	0.74	0.28	0.89	0.67	4.07	8.16	0.53	1.32
Cleveland	0.67	0.26	0.84	0.57	6.13	7.76	0.37	0.91
Dallas	0.53	0.31	0.85	0.68	7.35	7.74	0.57	0.99
Detroit	0.79	0.26	0.94	0.63	4.07	8.21	0.17	1.14
Houston	0.57	0.31	0.76	0.49	5.48	8.24	0.59	1.28
Los Angeles	0.66	0.28	0.88	0.76	4.03	7.06	0.20	0.41
Memphis	0.54	0.33	0.80	0.55	5.72	8.63	0.34	1.08
Miami	0.60	0.25	0.82	0.58	5.75	8.04	0.45	1.05
New Orleans	0.49	0.35	0.69	0.60	7.81	8.20	0.87	1.33
New York	0.71	0.36	0.87	0.77	2.50	5.86	0.07	0.20
Newark	0.69	0.30	0.89	0.76	3.72	6.36	0.34	0.98
Norfolk	0.43	0.31	0.69	0.55	6.91	7.45	0.58	0.94
Oakland	0.61	0.28	0.79	0.68	5.47	7.13	0.33	0.50
Philadelphia	0.72	0.29	0.91	0.68	3.61	7.49	0.18	0.75
St. Louis	0.67	0.29	0.83	0.59	5.93	8.18	0.48	0.93
Washington, D.C.	0.56	0.35	0.82	0.64	5.82	8.09	0.28	0.72

The levels indexes are calculated using zip code level information on the number of jobs located in the zip code in 1992 and the number of people of the relevant race residing in the zip code in 1990. The net growth indexes use net job growth between 1987 and 1992, setting growth to zero for zip codes that lose employment over this time period. Information on population by zip code comes from the 1990 Census of Population and Housing Summary Tape Files 3B. Information on job counts by zip codes comes from the Economic Census for 1987 and 1992. Approximately 60 percent of the 1990 black population living in metropolitan areas resided in one of the twenty PMSAs listed above.

Comments

Kenneth A. Small: Spatial mismatch has long posed a challenge to researchers on urban affairs. Empirical evidence from many angles suggests that it is important in the United States for explaining racial differences in employment outcomes and for suggesting potent policy interventions. At the same time, so many of the decisions involved are simultaneous that, as pointed out by Richard Arnott , it is difficult to sort out which factors are truly the causal ones.[46]

Steven Raphael and Michael A. Stoll make a convincing case that even without fully sorting out the theoretical chain of causation, one can isolate a particular facet of the problem empirically. This facet is the role of automobile ownership in ameliorating problems caused by spatial mismatch. The work reported provides direct evidence on how the transportation system affects the employment experience of spatially isolated groups. It thereby addresses nicely one of the policy tools often considered for dealing with spatial mismatch, offering strong evidence that policy intervention could make a significant difference. At the same time, the demonstration is made in such a way that it provides additional indirect evidence that spatial mismatch operates more or less according to conventional views.

The authors accomplish these advances through an insight that is clever and well targeted. The consensus view of spatial mismatch (and of the efficacy of policies involving improved transportation) implies that automobile ownership affects different groups differently in terms of employment. If spatial mismatch affects blacks more than other groups, and if it is partly responsible for blacks' higher unemployment rates, then we should see differences in the marginal impact of personal or household ownership of automobiles on employment rates.

46. Arnott (1998).

Such differences are found, and the authors strengthen their case by checking for robustness to specification along many different dimensions. It is encouraging that after all this checking, the basic result given by the simplest computation holds up well. That computation in table 2 in the paper states simply that the effects of automobile ownership on employment are greatest for blacks, intermediate for Latinos, and least for whites. Nor are these effects trivial: even after accounting for some covariates that reduce them substantially, they imply that between 21 and 43 percent of the black-white employment rate differential is explained by the difference in automobile ownership. If true, this is a remarkable finding: a problem often thought intractable can perhaps be addressed through measures that are rather mundane and well within the nation's fiscal capabilities.

The second line of empirical evidence presented looks at these car-ownership effects across metropolitan areas. This is a useful and again clever approach. Ultimately, though, I find it less convincing, partly because as the sample sizes diminish for measuring the car-ownership effects, they are estimated less precisely, and partly because I am not fully satisfied with the measures of spatial isolation used. I think the "dissimilarity index" has little to do with accessibility to jobs, being rather a measure of how segregated the minority group is; it could measure great dissimilarity even if the effects of segregation were to put blacks within closer reach of jobs than whites. The exposure index is better but hampered by the limited employment sectors available in the Economic Census. Still, most likely the effects described by the authors are indeed due to job accessibility, just as they claim.

The authors rightly worry that car ownership is endogenous. They correct for this possibility appropriately, but the instruments apparently are weak ones and using them greatly reduces the statistical confidence in the results. That the results do not disappear (indeed, they grow stronger in magnitude) leaves their case intact, though a more stringent test would be desirable. A good topic for further research would be to more fully specify the joint decision processes involved and find data to estimate them.

A type of simultaneity not addressed is that of car ownership and location. Edward L. Glaeser, Matthew E. Kahn, and Jordan Rappaport argue that a chief cause of poor people living disproportionately in city centers is that the better transit service there allows them to choose a commuting mode that is cheaper than owning a car.[47] The spatial mismatch argument used by Raphael and Stoll relies on a different mechanism—racial discrimination—causing a higher pro-

47. Glaeser, Kahn, and Rappaport (1999).

portion of poor people to live in city centers. It is not obvious, to me at least, what kind of confounding of effects might occur when both factors are operating. Still, the reliance on black-white differentials in the effects is likely to alleviate whatever confounding influence this mechanism might have on their results.

So in the end, I am left agreeing that increasing car ownership among spatially segregated minorities would improve their employment prospects. What then can we conclude about policy intervention? As the authors point out, one cannot simply recommend a policy because it would make a difference in an important social problem—costs, administrative feasibility, and incentives must be be worked out, to name just a few concerns. Still, there are other grounds to be optimistic about automobile ownership subsidies. Studies in other contexts have found automobile transportation a relatively cheap way to provide accessibility to urban residents.[48] Improving reverse-commute transit is an alternative, but it tends to be very expensive per rider, partly because of its very success—-those riders who use it to land a suburban job tend to quickly abandon it in favor of buying a car as soon as accumulated earnings permit. Other types of targeted special-purpose transit, such as dial-a-ride, often cost more than providing single-occupant automobile service, even with a paid driver. So within the realm of transportation policy, encouraging car ownership seems often to be a cost-effective and flexible way of addressing social problems arising from barriers to accessibility. Given Raphael and Stoll's results, car ownership is a prime candidate for addressing minority unemployment in metropolitan areas.

Much work remains before spatial mismatch is fully understood as a general-equilibrium phenomenon. But enough is known to make it clear that minority groups, especially blacks, are hurt by it. Raphael and Stoll now give us strong evidence that the damage can be notably lessened if we can bring minorities up to the levels of car ownership typical of whites. This objective may not be simple to accomplish, but it is a lot easier than dealing with the multiple problems of poor schooling, drug addiction, crime, family disintegration, and alienation that infect many minority communities. So it is nice to know that aside from providing desperately needed attention to those more underlying problems, there is something more routine that can be done.

Clifford Winston: Steven Raphael and Michael A. Stoll conclude that transportation policies fostering greater access to automobiles should be considered

48. Examples include Summer Myers, "New Volks for Poor Folks," proposal and cost comparisons between demand-responsive transit and taxi service in Kain (1970, p. 85).

in an effort to alleviate the spatial concentration of joblessness. In my view, before it can be concluded that any transportation policy will be helpful, a number of steps should be taken.

To begin with, the policy objective has to be clarified: should the government strive to improve the lives of the poor by increasing their access to jobs or raising their retention of jobs? While the authors confine their analysis to the first approach, it is not clear why such a narrow focus is appropriate. Indeed, the conclusion from experiments that seek to increase employment by improving transport is that it is much more important for inner-city residents to be able to retain jobs than to have greater accessibility to them.[49]

Moreover, several current policies, including poverty programs, job training, and tax credits, already attempt to spur people to join and maintain a place in the work force. What additional benefits would a new transportation policy provide? The issue at hand does not involve a market failure but a social goal—reducing unemployment at acceptable social cost. One must therefore compare the costs and benefits of all potential policies, determine which one or combination is the most cost effective, and then assess whether the optimal policy package offers sufficient economic and political returns to merit policymakers' support.

Assuming that improved transportation is found to be the appropriate instrument for increasing employment, several policies besides subsidizing automobile ownership are worth considering: providing additional subsidies to public transit; allowing private transit operators the opportunity to serve low-income and suburban areas; subsidizing employers who offer transport for their employees; subsidizing housing near suburban job centers; strengthening antidiscrimination policy in housing and credit markets, and so on. The authors only provide a basis for estimating the benefits from subsidizing auto ownership; the costs of this policy are not estimated, and the potential costs and benefits of other policies are not even acknowledged. Thus it is premature to conclude that subsidizing automobile ownership merits serious consideration.

Automobile ownership, labor force participation, and residential location are endogenous decisions. People who choose not to own a car, not to work, and reside where they cannot walk or take public transit to get to a job are in the tail of any urban population distribution. Such behavior is idiosyncratic and undoubtedly explained by many subtle influences. Structural *disaggregate* models of labor force participation, mode choice (including automobile own-

49. Winston and Shirley (1998).

ership), and residential location were developed to capture these influences. (James Heckman and Daniel McFadden were recently awarded the Nobel Prize in economics for their work in this area.) The attractiveness of individual choice models stems from the recognition that ad hoc aggregate models obscure and ignore many key influences on consumer and household behavior in product and labor markets. Choice models are also attractive because they allow one to apply standard welfare metrics, such as the compensating variation, to estimate benefits from a policy that affects consumers' utility. These models could provide a rich specification of minorities' decision to enter the labor force by accounting for the role of AFDC (now TANF) benefits, prior employment, contacts with potential employers and wages in suburban areas, available transport alternatives (public transit, carpool, van pool), and so on. An automobile ownership and mode choice model could illuminate whether minorities are financially constrained from owning a car or simply choose not to own one, and how auto ownership relates to their labor force participation. A residential location model could shed light on why low-income groups tend to live where they have difficulty finding work close to home. Even this obstacle is not always an insurmountable barrier to employment because evidence suggests that the working poor are willing to hold down jobs that require very long commutes involving multiple transfers on public transport or car pooling.[50]

The authors do not even hint at these models and simply present a reduced form aggregate model of employment differentials. Their finding that increasing auto ownership can substantially reduce minority unemployment invites disbelief and assertions that it reflects deficiencies in their modeling and econometrics. To be sure, it is difficult to predict how the authors' findings would have been affected had they used disaggregate choice models. The essential point is that estimates of the benefits from transport policies that seek to raise employment will be viewed as more credible if they are based on models that have widespread professional acceptance.

I have little doubt that a research program following these guidelines will conclude that subsidizing automobile ownership ranks at the bottom of policies that seek to increase employment in a cost-effective manner. Whether *any* transport-related policy has the potential to produce significant reductions in joblessness at socially acceptable costs is a more open question.

50. Winston and Shirley (1998).

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