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Job accessibility and the modal mismatch in Detroit

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ABSTRACT

Transportation scholars are challenging traditional formulations of the spatial mismatch hypothesis because previous studies have disregarded the considerable difference between travel modes. This case study of the Detroit metropolitan region uses 2000 census data and a gravity-based model of transportation accessibility to test differences in access to jobs among places and people, and provides support for recent calls for reconceptualizing spatial mismatch. It shows that even though Detroit experiences the greatest distance between African Americans and jobs of any region in the country, most central city neighborhoods offer an advantage in accessibility to jobs compared to most other places in the metropolitan region – as long as a resident has a car. Policies aimed at helping carless people gain access to automobiles may be an effective means of improving the employment outcomes of inner-city residents.

1. Introduction

The spatial mismatch hypothesis explains concentrated poverty among African Americans in central cities as a result of dispersing jobs that place a growing share of metropolitan jobs in distant suburbs, racial discrimination in housing that confines racial minorities to the urban core, and inadequate transportation that offers poor linkage between the central city and suburbs. Transportation scholars have recently challenged traditional formulations of the spatial mismatch hypothesis on the grounds that it places too much emphasis on the physical distance to employment without proper regard to travel mode (Bauder, 2000; Blumenberg and Ong, 2001; Ong and Miller, 2005; Preston and McLafferty, 1999; Shen, 1998). They contend that the barrier preventing would-be workers from reaching distant suburban jobs is not so much geographic distance as a lack of reliable personal transportation that owning a car brings. Even John Kain, the late Harvard economist who originated the spatial mismatch hypothesis, concluded after surveying the latest scholarship that the disparities in access to autos had been overlooked by researchers: "none of the spatial mismatch studies, including my original 1968 study, does a good job of dealing with mode choice" (Kain, 1992, p. 394). Some are now suggesting that we rethink the spatial mismatch as an "automobile mismatch" (Taylor and Ong, 1995), or a "modal mismatch, a drastic divergence in the relative advantage between those who have access to automobiles and those who do not" (Blumenberg and Manville, 2004, p. 186).[1] Several recent works have demonstrated that travel mode makes a substantial difference in accessing jobs (Hess, 2005; Horner and Mefford, 2007; Kawabata and Shen, 2007). And studies of welfare recipients have concluded that car ownership significantly increases the likelihood of unemployed people finding and holding jobs (Blumenberg, 2002; Cervero et al., 2002; Ong, 1996).

If travel modes are more central to job accessibility than is location, then our public policy responses to spatial barriers to employment may be misguided if the focus is exclusively on geographic distance. The conventional understanding of spatial mismatch has largely produced public policy aimed at linking workers to jobs with "reverse commutes" using public transit (Transit Cooperative Research Program, 1999). Examples range from notably unsuccessful demonstration projects in the 1960s (Meyer and Gómez-Ibañez, 1981; Rosenbloom, 1992) to the federal government's Jobs Access and Reverse Commute program started in 1998 with the Transportation Equity Act for the 21st Century. A new conception of spatial mismatch raises the question of whether policy makers are relying too heavily on transit as a solution for overcoming the spatial barriers that harm the job prospects of inner-city African Americans, and places more emphasis on identifying the appropriate role for public transit among a diverse set of policy responses (Blumenberg

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[1] "Modal mismatch" and "automobile mismatch" are in reference to "spatial mismatch," first coined by John Kain (1968). The term 'mismatch' is unfortunate because it suggests that the conditions of inner-city isolation are inadvertent, downplaying the extensive role of private and public actions in creating the conditions in the first place (Massey and Denton, 1993; Farley, Danziger, Holzer, 2000).

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and Hess, 2003). In particular, policies aimed at helping carless people gain access to automobiles may be one of the more effective means of improving the employment outcomes of inner-city residents (Blumenberg and Ong, 2001; Cervero et al., 2002; Lucas and Nicholson, 2003; O'Regan and Quigley, 1998; Raphael and Stoll, 2001; Shen, 1998; Taylor and Ong, 1995; Wachs and Taylor, 1998).

The purpose of this paper is to examine the conditions of poor access to jobs in light of these recent claims about reconceptualizing spatial mismatch. I investigate the case of Detroit, a place that experiences the greatest distance between African Americans and jobs of any metropolitan region in the country (Stoll, 2005), and a place that has come to symbolize spatial mismatch conditions (Kain, 1968). Detroit offers a stark contrast to the cases of Boston, Los Angeles, and San Francisco where recent studies by Shen (1998) and Kawabata (2003) have uncovered the surprising finding that low-income central-city residents are not disadvantaged by their geographic location but instead are disadvantaged by what Blumenberg and Manville (2004) call a "modal mismatch". Detroit may be an entirely different story. If I can confirm with the extreme case of Detroit the recent results found elsewhere then the recent calls for reconceptualizing spatial mismatch may also apply to older, deindustrializing regions of the Rustbelt as well. In Detroit, I confirm that poor people living in inner-city neighborhoods are not disadvantaged by the growing distance to suburban jobs but rather are disproportionately without cars in a metropolis deliberately designed for cars. Thus getting cars into the hands of poor people may be the best hope of overcoming what we call spatial mismatch.

2. Reconceptualizing spatial mismatch with the concept of accessibility

Some sensibly contend that the spatial mismatch problem is not even one primarily of transportation: a poor physical connection to jobs is relatively unimportant compared to problems associated with local neighborhood conditions such as an absence of positive role models, weakly developed informal job contacts, lack of supportive social institutions (Chapple, 2006; O'Regan and Quigley, 1996). Nevertheless, one of the most important tasks of a transportation system is to connect workers to jobs. But when it comes to linking poor residents to suburban jobs, transportation planners are stuck with an outdated understanding of what the problem is.

The vast literature on the spatial mismatch hypothesis investigates a rather narrow – though complicated – question: does the growing distance between ghetto neighborhoods and suburban jobs explain high unemployment among African Americans? The question has generated hot debate, and "the idea remains as controversial today as it was … when it was first proposed" (Holzer, 1991, p. 105). The controversy stems in part from the fact that this seemingly straightforward research question has evolved into a "somewhat amorphous concept" (Blumenberg and Manville, 2004, p. 184) because the meaning of "spatial mismatch" has not been well defined. Decades of empirical tests have resulted in widely divergent results, with contradictory evidence that both supports and refutes the existence of spatial mismatch. The most likely explanation for these contradictory results is the use of crude measures of jobs access as the independent variable (Holzer, 1991). Reflecting the lack of clarity in what "spatial mismatch" means is the range of measures commonly used in studies, including straight-line distance, job density, jobs-to-housing ratios, residential segregation indices, and commute time.

Not only is the concept of spatial mismatch ill-defined, but scholars have done a poor job of presenting their findings to an audience of planners and policy makers (Pugh, 1998). While scholars embrace the complexity of social phenomena by accepting competing theories with multiple causal explanations, in the world of policy making, practitioners face the task of taking action to address social problems. Policy makers therefore prefer simple answers to difficult questions. Where scholars have been vague, policy makers have been left to fill in the blanks. Four shortcomings in scholarship illustrate how policy making is misguided by empirical studies of spatial mismatch.

First, because scholars have been vague in defining the relevant independent variable in spatial mismatch studies, policy makers have interpreted the primary problem as geographic distance. But a person's job prospects depend on the land-use arrangements of housing and jobs, the location of competing workers in filling a job, the availability of a car, and the effectiveness of transportation infrastructure and services. In other words, the problem is one of accessibility (Handy and Niemeier, 1997; Hansen, 1959; Wachs and Kumagai, 1973) rather than distance itself.

A second major problem with spatial mismatch scholarship is that it ignores the substantial difference between cars and transit (Blumenberg, 2004; Ong and Miller, 2005). Among the considerable literature on spatial mismatch, one rare example that acknowledges the difference in travel mode is Kasarda (1989) who notes that limited automobile ownership contributes to high rates of unemployment in the inner-city. But even here, despite this notable insight, the issue of carlessness is not addressed among his seven policy recommendations, illustrating the tendency to underappreciate the crucial difference between cars and transit. Without clear guidance on the role of travel mode, policy makers have little to judge whether public transit offers a reasonable substitute for a car in reaching jobs.

Third, spatial mismatch studies are typically focused narrowly on unemployed or low-wage African Americans living in the inner-city – and often exclusively on men – because of the extreme systemic disadvantages they face in the job market. As a result, policy makers have come to rely on the case of inner-city African Americans when seeking transportation solutions for a broader range of disadvantaged people who experience poor access to jobs. Other groups like welfare recipients, women-headed households with children, and teenagers too young to drive are known to face serious transportation difficulties considerably different than the case of inner-city African Americans (Blumenberg, 2004). To illustrate, women-headed households with children are generally more dispersed in space and rely heavily on trip-chaining to meet daily household needs, two conditions that are not well served by public transit.

A fourth shortcoming is that many scholarly studies on spatial mismatch have been surprisingly simplistic in their geographical categories – that is, they tend to use crude contrasts such as "central city" and "suburbs". By focusing narrowly on the case of inner-city African Americans, these studies implicitly restrict the geographic scope of the analysis to a small portion of a metropolitan region. Not only does this geographic focus lead to the mistaken assumption that people affected by poor job accessibility are reasonably concentrated in space, but it also fails to inform policy makers about the relative differences in jobs access across the space of a metropolitan region. A transportation planner needs to know about such differences because transportation infrastructure and services work as a regional system. Instead of limiting the question to whether inner-city African Americans are harmed in their employment prospects by their residential location, transportation planners might ask more broadly how the condition of people living in the inner-city compares relative to people living elsewhere in the metropolitan territory. Then if the inner-city location is found to offer an advantage for car owners, policy makers may be more inclined to take seriously recent proposals to subsidize cars for poor people.

Recognizing the shortcomings of the conventional spatial mismatch model, several recent empirical studies invite us to rethink the meaning of spatial mismatch by using the concept of accessibility. What studies like those of Boston by Shen (1998) and of Los Angeles and San Francisco by Kawabata (2003) suggest is that even though the distance between the inner-city and jobs is worsening as more jobs move toward the metropolitan periphery, when we superimpose on this growing physical distance a dense and radially oriented freeway system that favors central locations, few if any other places in a region are as strategically located as the inner-city for reaching jobs. As Shen (2004) notes, "the central city is a geographically advantaged residential location but . . . central city residents are spatially disadvantaged commuters".

The cities studied by Shen and Kawabata are not prototypical hollowed-out regions – that is, depopulated and impoverished urban cores surrounded by growing and prosperous suburbs – so it is hard to know whether inner-city residents in other places are similarly well positioned in their urban spatial structure. When compared with some of the nation's most distressed central cities, all three of these cases – Boston, Los Angeles, and San Francisco – enjoy relatively healthy regional economies, with reasonably vibrant central cores despite pockets of high-poverty, and public transportation systems that include rail rapid transit. By contrast, many distressed regions in the industrial Northeast and Midwest face worse degrees of racial segregation, job sprawl, and poor public transit service.

This study differs from previous work by examining explicitly the assumptions underlying the conventional formulation of spatial mismatch. I address three main questions. (1) Are inner-city residents disadvantaged in accessing metropolitan jobs even in a hollowed-out region like Detroit? Counter to what the conventional spatial mismatch model would suggest, I find support for previous findings elsewhere that the inner-city is not disadvantaged by its location, but that substantial differences exist within the inner-city itself. (2) How much difference does a car make? By quantifying the difference in the ability to reach jobs by auto and transit, I find that the car's advantages over transit are more extreme than suggested by a spatial mismatch model that implicitly discounts modal differences. (3) How do traditionally disadvantaged populations experience accessibility to jobs throughout the region? I find that several vulnerable populations are not well served by public transit, and yet they tend to live where automobile access to jobs is among the best in the metropolitan region.

3. Transportation and geography in the Detroit metropolitan region

The three-county region of the Detroit metropolitan area consists of Macomb, Oakland, and Wayne Counties, illustrated in Fig. 1, with a 2000 population of 4.8 million. By any measure, Detroit has been one of the nation's most distressed central cities for decades, with severe rates of poverty, unemployment, and

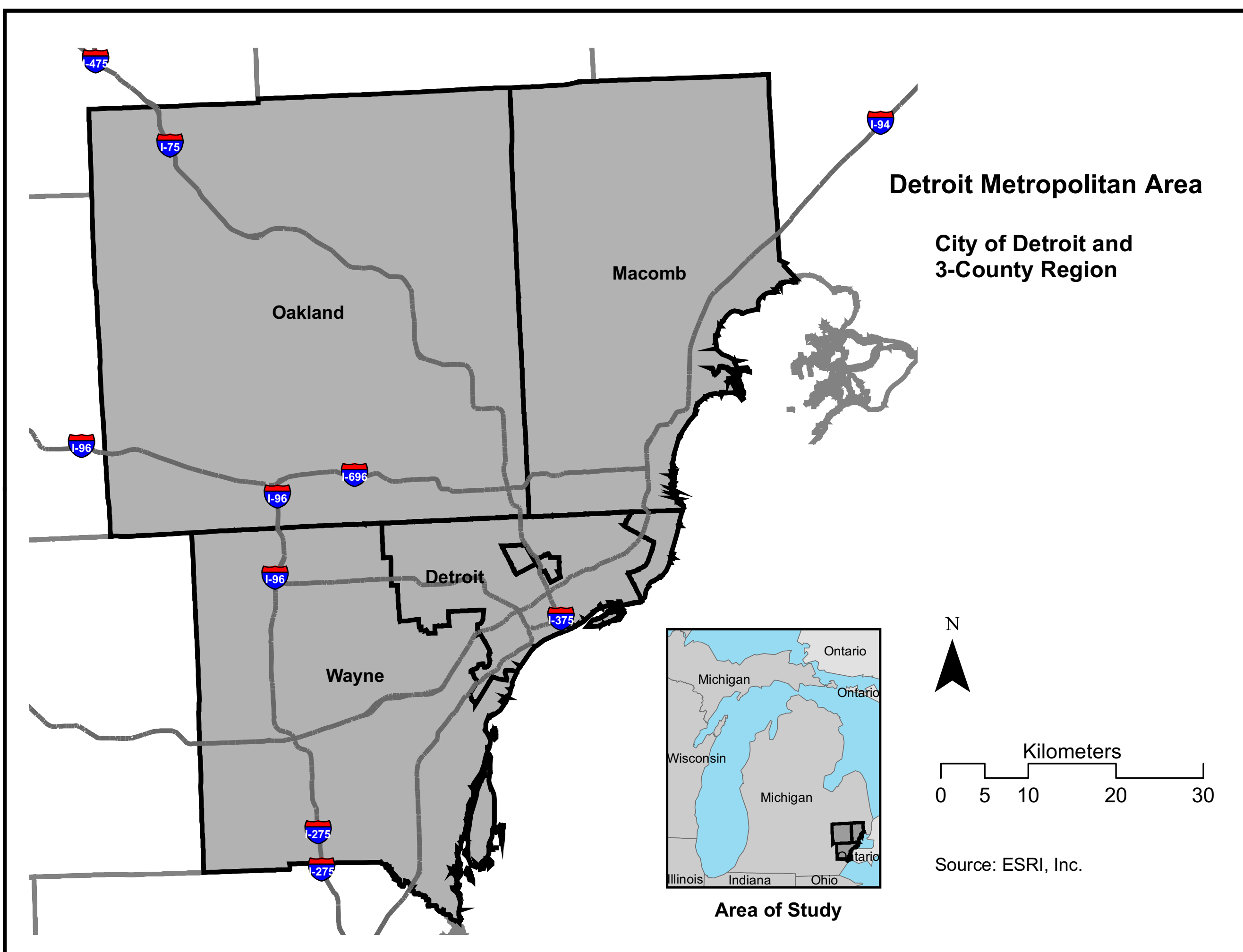

Fig. 1. Three-county Detroit metropolitan area.

neighborhood abandonment (Furdell et al., 2005). Detroit was by far the most impoverished city in the nation in 2003, with more than one in three residents living below the federal poverty line (US Bureau of the Census, 2005, Table R1701). The region exemplifies the older, industrial city of the Northeast and Midwest with a hollowed-out, distressed urban core surrounded by prosperous suburbs. It is among just a few metropolitan regions that show extreme decentralization in employment, with four out of every five jobs located beyond 10 miles (16 km) of the central business district (Glaeser et al., 2001; Lang, 2000). And according to 2000 data, the Detroit region faces the most severe residential segregation between African Americans and whites of any metropolitan region in the country (Iceland et al., 2002; Lewis Mumford Center, 2003). Taken together, job sprawl and racial segregation lead to the most troubling distance between African Americans and jobs in the nation (Stoll, 2005).

The region is well served by interstates and highways but public officials have not emphasized investing in public transit. It is an unusually automobile-dependent region, especially compared to its peers of the Midwest and Northeast. Among the 15 most populous urbanized areas nationwide in 2004, Detroit ranked third for the highest vehicle-miles-traveled per capita, with only Houston and Atlanta showing higher rates of daily driving (US Department of Transportation, 2005, calculated by author, Table HM-71). And Detroit has an extremely high share of workers commuting alone by private vehicle, with 84% of workers over age 16 driving alone in 2000, higher than any other metropolitan area with a population over 1 million (US Bureau of the Census, 2003a).

Public transit service is unusually poor compared to that of peer regions of similar population and historical development. Detroit is the largest urban area in the nation without regionally-oriented heavy or light rail transit, so that residents must rely exclusively on buses to meet their transit needs. Although an automated guideway called the "Detroit People Mover" operates in the city, it consists of only three miles of elevated track that provides no accessibility benefits from residential areas because it is restricted to a one-way loop around the central business district.

Public transit's mode share nationally correlates positively with metropolitan population, but Detroit remains an outlier: it ranks 64th among metropolitan areas nationwide in the share of commuters traveling to work by public transit, even though its population ranks as the eighth largest. To place this ranking in context, among the 10 largest metropolitan areas in the Northeast or Midwest – the older, industrialized regions traditionally oriented to transit – no other region ranks lower than 24th (Cleveland) in the transit share of the commute (US Bureau of the Census, 2003a). Transit in Detroit is underserved and underfunded. Among the 20 largest urbanized areas by population, Detroit ranks 13th in the amount of local funding provided per person and ranks 19th in service provided per capita (measured in vehicle revenue miles) (US Department of Transportation, 2002).

Aside from the performance indicators, Detroit's public transit is also unusual for its institutional arrangement. Transit service is not coordinated by a regional authority as in most places. Indeed, two major transit agencies provide bus service to the region, but their services are not integrated; one serves the central city and the other serves the suburbs. The Detroit Department of Transportation (DDOT) provides service in the City of Detroit, while the Suburban Mobility Authority for Regional Transportation (SMART) provides primarily suburb-to-suburb service, with some peak-hour services to bring suburban commuters downtown. The main transit agency serving Detroit terminates its services at the central city border. So the geography that separates African Americans from jobs is made even more severe with a public transit system that impedes a reverse commute. Many efforts to integrate this system of separate transit services have been unsuccessful for decades because of an inability to cooperate across municipal borders (Gerritt, 1998). Furthermore, the central city agency, DDOT, is also atypical in that it does not have a dedicated source of funding and instead relies on the city's general fund to support public transit. This situation does not bode well for those who depend on transit because a depopulating and impoverished city like Detroit is in constant financial trouble for lack of sufficient tax revenues.

4. Method: refining the spatial mismatch model with measures of accessibility

Transportation planners have recently responded to the need for a better way to measure spatial mismatch by drawing on the concept of accessibility (Blumenberg and Ong, 1998; Cervero et al., 2002; Helling, 1998; Sanchez et al., 2004). Accessibility has been defined as the "potential of opportunities for interaction" (Hansen, 1959, p. 73) or the "ease of reaching places" (Cervero 1996, p. 1), and its power lies in its ability to evaluate the success of a transportation system by simultaneously accounting for both land-use patterns and transportation infrastructure (Handy and Niemeier, 1997). Planners and engineers have traditionally focused not on accessibility but on mobility. A mobility-based perspective disregards land-use patterns and focuses exclusively on transportation infrastructure, with the fundamental aim of facilitating movement to reduce travel time. An accessibility-based perspective, in contrast, recognizes that land-use patterns influence the ultimate goal of transportation: helping people interact more easily with one another in different locations. Indeed, in places where destinations are nearby because of land-use arrangements, high accessibility can be achieved even with low mobility.

Gravity models are among the more sophisticated approaches to measuring accessibility (Isard, 1960; Wilson, 1971). An accessibility index derived from a gravity model is commonly used by planning scholars to evaluate the relative ease of reaching jobs in a metropolitan region (Cervero et al., 1999; Shen, 2000), and can be thought of as a summation of the number of jobs reachable from a zone or neighborhood, adjusted according to the relative difficulty of travel.

A common and simple form of the gravity model was proposed by Hansen (1959) as follows:

$$A_i = \sum_j E_j f(c_{ij}) \tag{1}$$

where:

A_i is the accessibility score for people living in location i;
E_j is the number of employment opportunities in zone j;
$f(c_{ij})$ is the impedance function associated with the cost of travel c for travel between zones i and j;
For a metropolitan region with N zones, $i, j = 1, 2, \ldots, N$.

A major limitation of the simple gravity model for studying jobs access is that it only considers the supply of jobs, neglecting any spatial difference in the demand for jobs. Shen (1998) modified the simple form of the gravity model, recognizing that the workers who compete for a job are not evenly distributed in space. To account for the spatial difference in job demand, he proposed the following accessibility index:

$$A_i^G = \alpha_i A_i^{auto} + (1 - \alpha_i) A_i^{tran} \tag{2}$$

where:

A_i^G is the general accessibility score for people living in residential zone i;

α_i is the proportion of workers in zone i living in a household with at least one automobile;
A_i^{auto} and A_i^{tran} are defined below.

$$A_i^{auto} = \sum_j \frac{E_j f(c_{ij}^{auto})}{\sum_k \left[\alpha_k P_k f(c_{kj}^{auto}) + (1-\alpha_k) P_k f(c_{kj}^{tran})\right]} \quad (3)$$

$$A_i^{tran} = \sum_j \frac{E_j f(c_{ij}^{tran})}{\sum_k [\alpha_k P_k f(c_{kj}^{auto}) + (1-\alpha_k) P_k f(c_{kj}^{tran})]} \quad (4)$$

where:

A_i^{auto} and A_i^{tran} are accessibility scores for people living in residential zone i and traveling by automobile and transit, respectively;
E_j is the number of employment opportunities in zone j;
P_k is the number of job seekers living in zone k;
$f(c_{ij}^{auto})$ and $f(c_{ij}^{tran})$ are the impedence functions associated with the cost of travel c for travel by automobile or transit between zones i and j; equal to $\exp(-\beta T_{ij})$, where *exp* is the base of natural logarithms, β is a parameter empirically derived separately for each travel mode to maximize the fit between predictions of the gravity model and the observed distributions of travel times, T_{ij} is the travel time (minutes) between zones i and j.
For a metropolitan region with N zones, $i, j, k = 1, 2, \ldots, N$.

Eq. (2) provides the convenience of a single measure, a *general accessibility index*, constructed as a weighted average that combines the joint contribution of each travel mode. The equation has two important properties that are essential for addressing transportation questions in Detroit. First, it accounts for the relative contribution of residential location in the competition for regional jobs. That is, in addition to other well-established determinants of employment such as skill level, education, and experience, a worker's probability of securing employment is partly determined by his or her spatial position in the regional geography. Detroit is an unusually segregated region, so people are separated by great physical distances from jobs based partly on race, income, and carlessness, and this model takes residential segregation into account. Second, by accounting for the separate contributions from auto and transit, the equation provides a basis of comparison between travel modes. Because Detroit is an unusually automobile-dependent region, people who have no choice but to travel by transit are likely to endure substantial disadvantage in the competition for jobs relative to their automobile-driving counterparts.

To interpret the index, the higher the general accessibility index the greater the advantage a person has in reaching jobs. Compared to a zone with smaller values, a zone with high values of A_i^G suggests that a person living in the zone either has more jobs nearby, or that traveling to those jobs is easier, or fewer competing workers live nearby. I calculate accessibility scores for workers who travel to "low-wage" jobs. I define low-wage jobs as those for which workers earned less than $20,000 in 1999. One in three workers in the region falls below this earning limit (US Bureau of the Census, 2003a).

Data come from the 2000 Census Transportation Planning Package (CTPP), with automobile ownership from Part 1 (US Bureau of the Census, 2004a), the number of employment opportunities and job seekers from Part 2 (US Bureau of the Census, 2004b), and the impedance functions calculated from travel times from travel demand modeling data provided by the Southeast Michigan Council of Governments. Note that the ideal measure of employment would be job vacancies, but these data are extremely difficult to obtain so this study uses all low-wage jobs as the indicator for attractiveness in the gravity model. Zones are transportation analysis zones (TAZs), delineated by local transportation officials for tabulating traffic-related census data. A TAZ typically consists of one or more census blocks, block groups, or census tracts.

To address my questions of which people and places experience poor accessibility, I use geographic information systems (GIS) and demographic data drawn from the CTPP, Part 1 (US Bureau of the Census, 2004a). For demographic data more detailed than the CTPP, I use the 5% Public Use Microdata Sample (PUMS) at the geographic level of a Public Use Microdata Area, or PUMA (US Bureau of the Census, 2003b). The advantage of using PUMS data is the ability to identify highly specialized population groups, but the disadvantage is that they require geographic aggregations much larger than a TAZ. I link PUMS data to job accessibility by converting the TAZ-derived accessibility scores to the PUMA level using a population-weighted average.

5. Results and findings

Starting with a macro view of the region, Detroit reveals two central traits consistent with the conventional spatial mismatch model: low-wage workers are worse off in reaching jobs than workers in general, and the zones of highest accessibility are unusually dispersed and distant from the central core of the region.

For the first of these two traits, Fig. 2 compares accessibility for low-wage workers to all workers throughout the region. The figure shows the accessibility index on the x-axis and the cumulative share of population on the y-axis. To illustrate, the curve for All Jobs indicates that about 90% of the population of all workers experience job accessibility with an index of 1.50 or less. A shift in a curve to the right indicates an improvement in job accessibility. Above about 30% on the y-axis, the curve for low-wage workers is appreciably to the left of the curve for all workers, suggesting that most low-wage workers are slightly worse off than the average worker in reaching jobs.

To demonstrate a second trait consistent with conventional mismatch conditions, I compare the overall geographic pattern of job accessibility to other metropolitan regions, and find that in Detroit, places with the best accessibility to jobs are more decentralized and dispersed than in other places. Seven case study regions

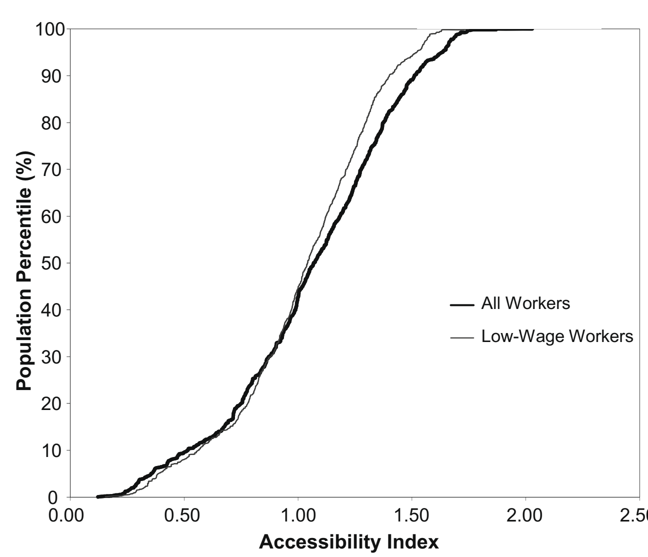

Fig. 2. Share of regional population by general accessibility index, for two job categories, Detroit three-county region, 2000.

offer a stark contrast to Detroit, suggesting that the urban cores of other metropolitan regions enjoy a greater advantage in job accessibility than Detroit's urban core. The studies – all using the same technique I use here – include Shen (1998) for Boston, and Sanchez et al. (2004) for the six cases of Atlanta, Baltimore, Dallas, Denver, Milwaukee, and Portland. In all seven of the other cases, maps show that the main central business district sits where accessibility is highest, and in most cases forms the core of a concentrated agglomeration of the highest accessibility. In all of the other cases, places of good accessibility are more centralized, more concentrated, and more clustered than in Detroit.

To illustrate the case of Detroit, Fig. 3 shows job accessibility classified in six categories, with high accessibility scores shown in the darkest shading. The central business district does not lie within the highest accessibility zone, in contrast to the other case studies in Sanchez et al. (2004). Instead, most of the highest accessibility zones occur several kilometers from the CBD, most outside the central city, with some beyond 30 km from the CBD. Furthermore, the highest accessibility zones are widely dispersed throughout the Detroit region. The six cases studied by Sanchez et al. (2004) clearly show that high accessibility is centralized. That is, the mean center – the "center of gravity" – of the highest accessibility falls near the CBD. By contrast, Detroit's high accessibility zones are decentralized, with the dark-shaded zones of the best accessibility scattered across the region at great distance from the CBD.

Detroit appears to be a classic case of spatial mismatch, with unusually high job sprawl accompanied by extreme residential segregation and a public transit system that does not serve reverse commutes well. A macro view of job accessibility measures confirms that the region has traits that are consistent with the conventional spatial mismatch model. However, closer inspection will reveal several other features that run counter to the conventional spatial mismatch model.

5.1. Are inner-city residents disadvantaged in accessing metropolitan jobs?

Even though the zones of highest accessibility in Detroit are more decentralized and dispersed than in other metropolitan regions, the inner-city still remains a place of relatively good accessibility. Although most of the zones with the highest accessibility sit beyond its borders, the map indicates that the central city remains on average more accessibility-rich than most of the rest of the region.

For a more focused look, I examine job accessibility in three particularly distressed inner-city "neighborhoods." The three neighborhoods, shown in Fig. 4, consist of clusters of TAZs with high rates of poverty and unemployment and represent the kinds of places where we would most expect that spatial barriers would harm job prospects. Characteristics of the neighborhoods are pro-

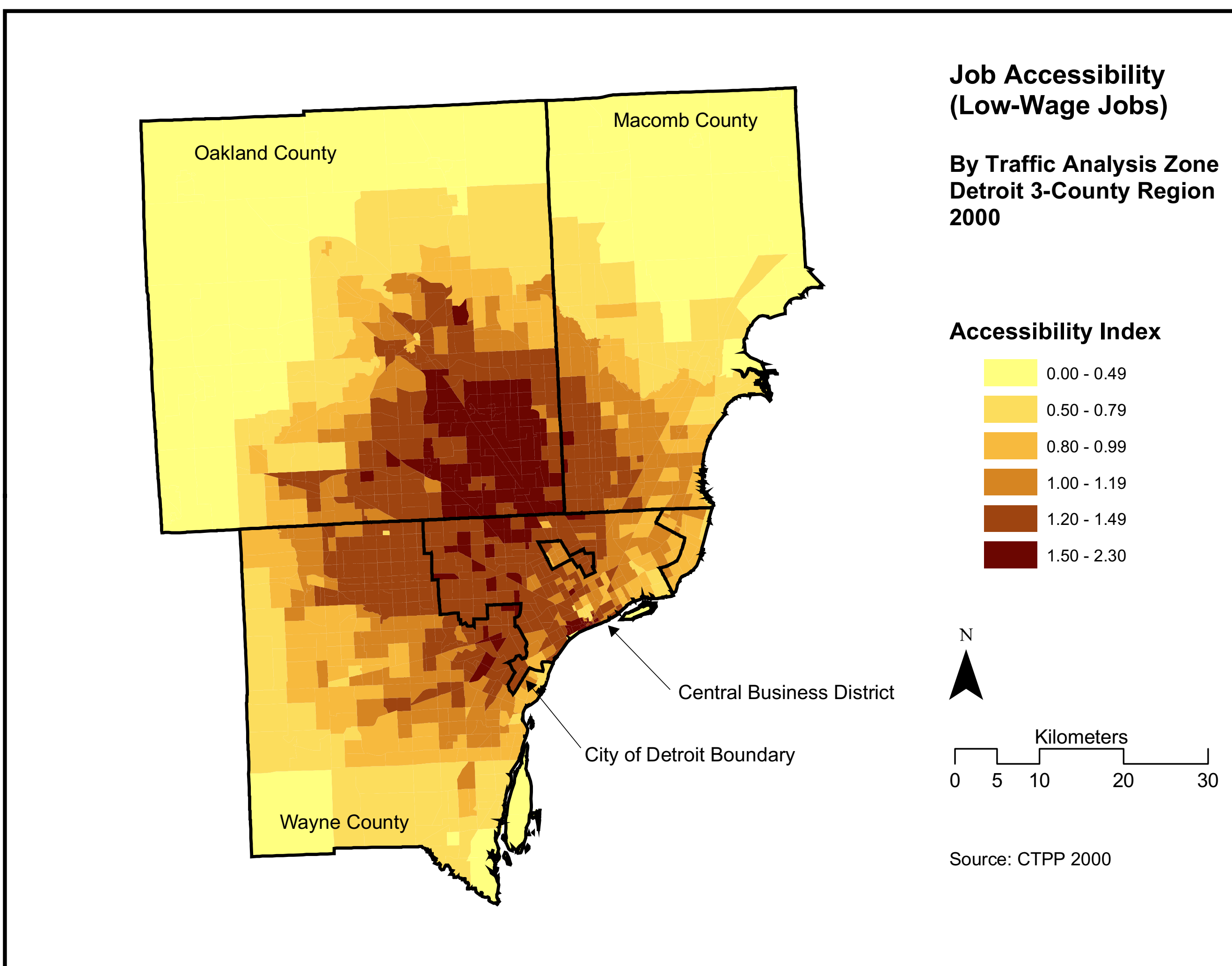

Fig. 3. General accessibility index for low-wage jobs, Detroit three-county region, 2000.

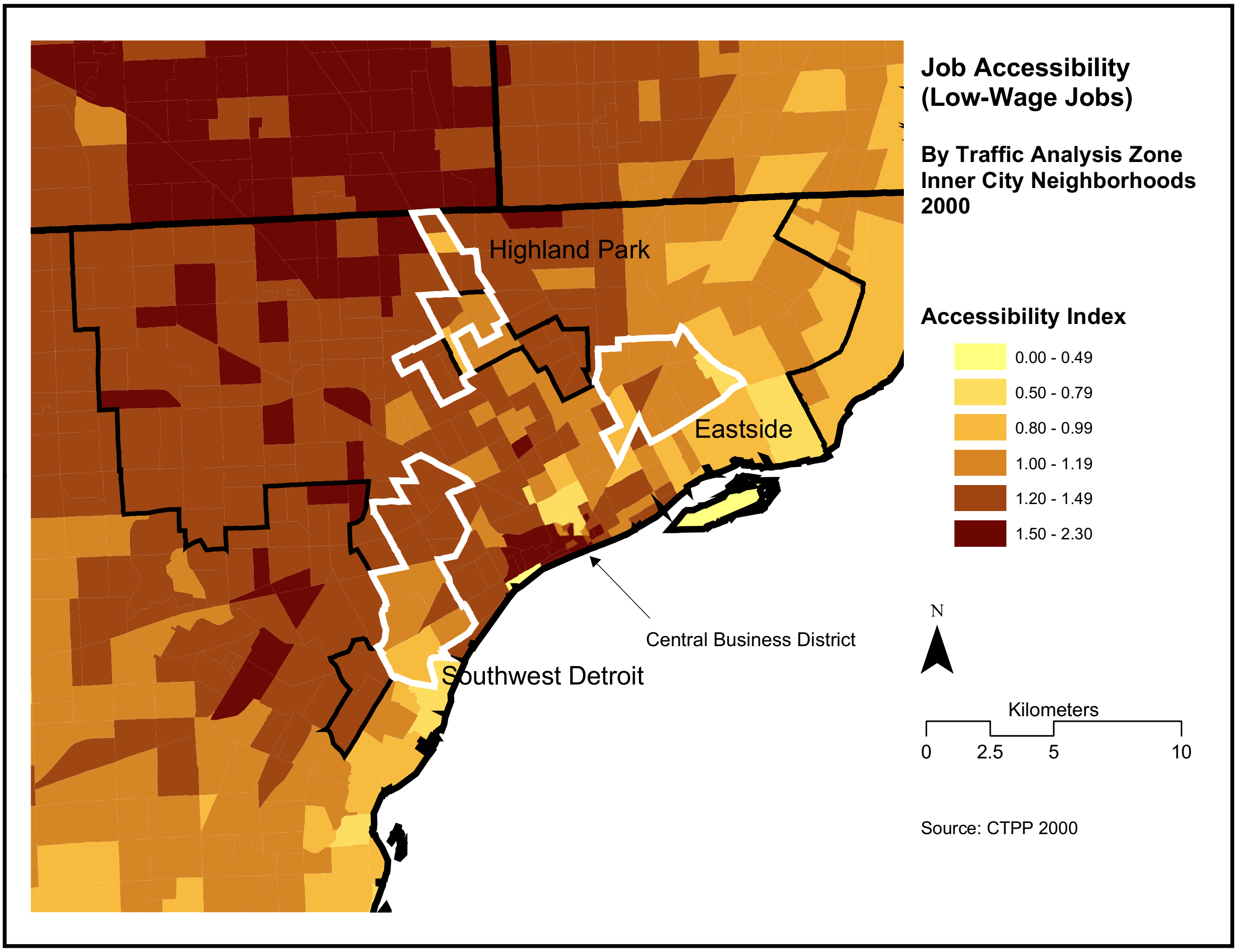

Fig. 4. General accessibility index for low-wage jobs, three neighborhoods in Detroit, 2000.

Table 1
Neighborhood characteristics, city of Detroit, 2000.

Neighborhood	Neighborhood population	Percent African American population	Percent hispanic population	Percent in poverty
Eastside	34,040	97.83	0.61	36.35
Highland park	32,440	87.30	0.37	36.46
Southwest Detroit	35,270	52.50	39.53	33.61

Source: US Bureau of the Census (2004a).

Table 2
Weighted average general accessibility index by territory, Detroit neighborhoods, 2000.

Territory	TAZ frequency	Accessibility index (low-wage jobs)
Neighborhoods		
Eastside	10	1.06
Highland park	12	1.24
Southwest Detroit	11	1.23
Rest of Detroit	219	1.26
Outside Detroit	908	1.02

Source: US Bureau of the Census (2004a,b,c).

vided in Table 1, showing similar population sizes and poverty rates, but with different racial and ethnic compositions. The neighborhoods I refer to as Highland Park and Eastside are made up of almost entirely African Americans, while Southwest Detroit has high shares of both African Americans and Hispanics (primarily of Mexican ancestry). Job accessibility from these inner-city neighborhoods is shown in Table 2, suggesting that these places are by no means among the worst off in the region. Two neighborhoods – Highland Park and Southwest Detroit – are relatively accessibility-rich, with scores of 1.24 and 1.23, respectively. Looking back to the chart in Fig. 2, this means that on average people living in these neighborhoods are experiencing a level of job accessibility at least as good as about 65% of all people living in the metropolitan region.

But inner-city neighborhoods also experience considerably different levels of accessibility. Between neighborhoods, residents of the Eastside neighborhood, with an average score of 1.06, are substantially worse off than their counterparts in the other two neighborhoods, with scores of 1.23 and 1.24. Within neighborhoods, Fig. 4 shows that each neighborhood experiences varying degrees of job accessibility. For instance, accessibility within Eastside ranges from 0.98 to 1.52. These findings are consistent with other studies such as Shen's (1998) in Boston that concluded that the inner-city remains relatively accessibility-rich despite the sprawl of suburban jobs, but that neighborhoods of the inner-city experience considerable variation in accessibility. Transportation planners might use such a detailed analysis to help them prioritize scarce resources when targeting services to neighborhoods.

5.2. How much difference does a car make?

While cars are generally good for reaching jobs, people without cars typically turn to the second best alternative of public transit. Public transit's disadvantages relative to a car are well-known: it requires more travel time, offers less flexibility in scheduling, is less comfortable and convenient, and does not allow for carrying cargo. Unfortunately, in addition to these well-known disadvantages, public transit service in Detroit is also at a serious disadvantage in offering access to jobs. It does not come close to making up the difference between owning and not owning a car.

So far, the analysis has investigated job accessibility through the general accessibility index of Eq. (2), allowing us to make comparisons among people and places across the geography of the region. The power of the general accessibility index is in describing the overall spatial structure of a region by providing a convenient, single score for geographic zones within the region. But by attributing a score to a geographic zone, we risk assuming that all people living in that zone experience similar job accessibility. This "ecological fallacy" – whereby we mistakenly infer characteristics of individuals from aggregate data (Robinson, 1950) – is especially dangerous in cases where the attribute shows considerable variance within any single zone. And the ability to reach jobs varies substantially within any zone depending on whether a person can use a car or not.

How much difference does owning a car make for reaching jobs? By decomposing the index into contributions from automobile and transit travel using Eqs. (3) and (4), I find that the difference is substantial. Table 3 illustrates this difference by showing separately for auto and transit the distribution of TAZs falling within a common scale of six categories of job accessibility. It shows that most people live where auto access is high. Fully 70% of the region's population lives in zones where accessibility by auto is greater than a score of 1.0, the weighted average accessibility for the region. And few people live where accessibility by auto is low: just 8% of the population – all on the periphery of the region – fall into the lowest auto accessibility category. Accessibility by transit, by contrast, is so universally low that every TAZ in the region falls into the lowest accessibility category. So while only 8% of people in the region live where auto access is the poorest, every person in the region experiences a comparably low level of accessibility by transit.

The magnitude of the difference between auto and transit accessibility is striking. The scatter plot of Fig. 5 shows the difference between travel modes for every TAZ in the region. Each TAZ has a pair of points, one for transit (denoted in the figure with a triangle) and one for auto (denoted with a circle). Two observations emerge from the figure. First, transit accessibility is very low even in the central city where transit service is most prevalent, and it varies little throughout the region. The difference between the best locations for transit and the worst (where transit does not exist) is so small that it represents just a fraction of the full range between

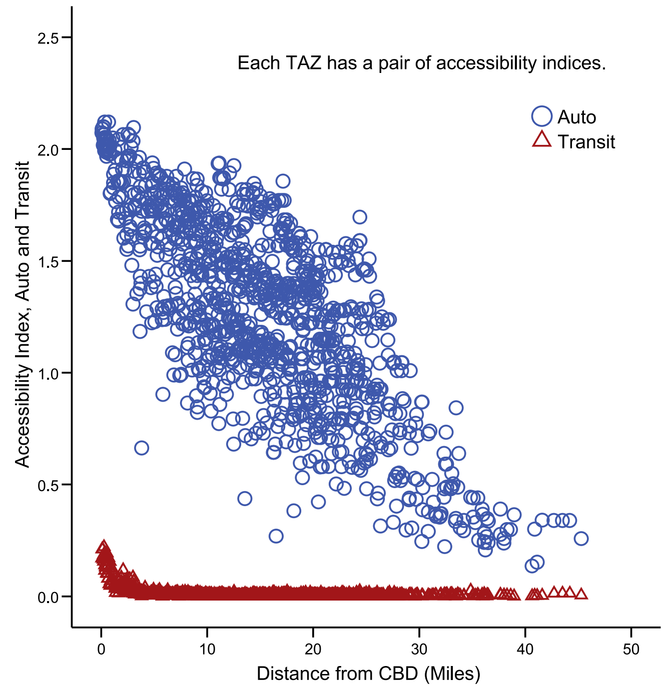

Fig. 5. Comparing auto to transit accessibility: accessibility indices by distance from central business district, Detroit three-county region, 2000.

the best and worst locations for auto. Second, not only is transit accessibility universally poor, but the best locations for transit fall short of even the worst locations for auto accessibility. With just a few exceptions, nearly every zone offers better accessibility by auto than the zone with the best accessibility by transit.

Carless workers living in the central city are clearly better off than carless workers living at the periphery because having some ability to reach jobs (small accessibility) is better than having no ability to reach jobs (zero accessibility). But public transit is such a severely inferior substitute for owning a car in Detroit, that even if carless persons relying on public transit live where transit service is best, they can do little better in reaching jobs than the worst off among their counterparts who live in the farthest reaches of the metropolitan periphery and travel by car.

5.3. How do disadvantaged populations experience accessibility to jobs?

The spatial mismatch hypothesis originated with the aim of explaining high rates of unemployment among urban African Americans. This study suggests that poor African Americans already live where job accessibility is high *if* they do not rely on public transit. Even though Detroit experiences the greatest distance

Table 3
Distribution of automobile vs. transit accessibility (low-wage jobs), Detroit three-county region, 2000.

Accessibility	Accessibility category	Accessibility index range	Auto		Transit	
			TAZ frequency	Regional population share (%)	TAZ frequency	Regional population share (%)
High	1	1.50–2.30	371	29.2	0	0.0
	2	1.20–1.49	302	23.9	0	0.0
	3	1.00–1.19	186	16.6	0	0.0
	4	0.80–0.99	123	11.7	0	0.0
	5	0.50–0.79	106	11.0	0	0.0
Low	6	0.00–0.49	72	7.7	1160	100.0
	Total		1160	100.0	1160	100.0

Source: US Bureau of the Census (2004a,b,c).

between African Americans and jobs of any region in the country (Stoll, 2005), most central city neighborhoods offer an advantage in accessibility to jobs compared to most other places in the metropolitan region – as long as a resident has a car.

To illustrate how much difference a car would make for poor, carless African Americans, I turn to PUMS microdata at the geographic unit of a PUMA (US Bureau of the Census, 2003a). Microdata offer the advantage of investigating the highly specific case of African Americans who are (a) carless, (b) unemployed, and (c) living in poverty – a group of people I will refer to in shorthand as Group A. The original conception of spatial mismatch was derived from data in the 1950s (Kain, 1968). At the time, poor African Americans were restricted by housing discrimination not only to the central city, but to particular neighborhoods within the central city. But Fig. 6 shows that the geographic distribution of carless, unemployed, poor African Americans, although mostly confined to the inner portions of the region, is not nearly as concentrated in space as might be expected. Indeed, one-third of such people in Group A live outside the central city, beyond the reach of the central city transit system. And the four most populous PUMAs, consisting of 58% of Group A in the region, cover 220 km^2 of territory.

How much difference would a car make in the neighborhoods where these particularly vulnerable African Americans live? Table 4 illustrates the advantage of the car. As expected, if traveling by transit, everyone in Group A would experience job accessibility far inferior to the regional average of 1.0. But if traveling by car, every one of these vulnerable people would experience job accessibility at least as good as the regional average of 1.0, and more than one in three would experience the best accessibility the region has to offer. Indeed, if a planner's task were to find neighborhoods that offer better access to jobs for poor African Americans, few places would emerge. This is not to say that poor African Americans necessarily experience good job accessibility but rather that few places are better than the urban core – if a car is available.

Other disadvantaged populations are even more widely dispersed than the people in Group A, and they too tend to live where automobile accessibility is high. Group B, a set of people of great interest to transportation planners since welfare reform in 1996, consists of people who are (a) carless, and (b) receiving public assistance income. Group C is made up of women who are (a) heading a household without a partner and with children, (b) carless, and (c) living below the poverty line. These are people for whom public transit is particularly troublesome because they carry out the many household and primary care activities requiring such nonwork travel as grocery shopping and day care. I find that both Groups B and C are even less concentrated in space than Group A, suggesting difficulties for designing public transit solutions for such populations. The case of Group C is shown in

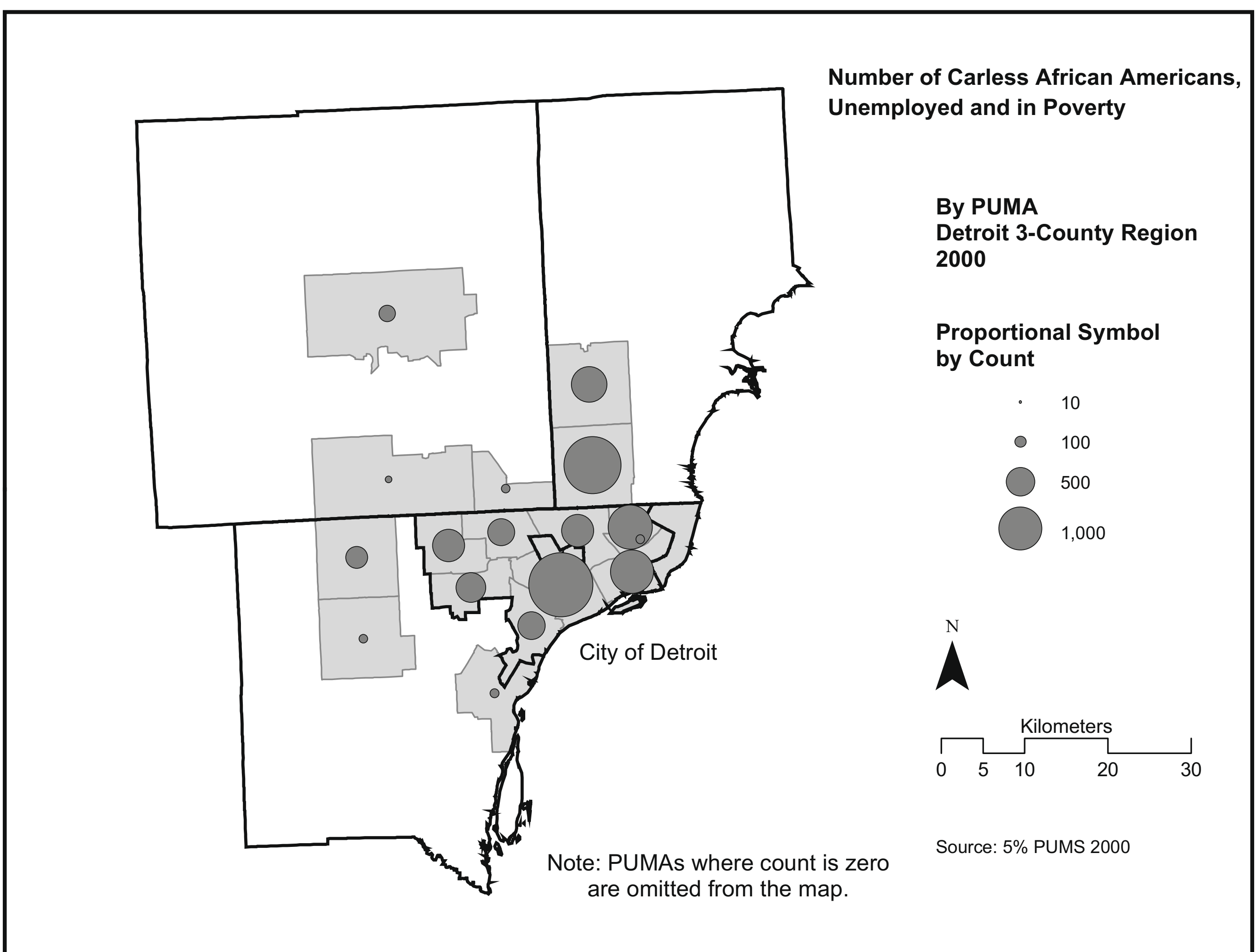

Fig. 6. Count of African Americans who are carless, unemployed, and living in poverty, Detroit three-county region, 2000.

Table 4
Distribution of automobile vs. transit accessibility for transportation-disadvantaged populations, Detroit three-county region, 2000.

Accessibility	Accessibility category	Accessibility index range	(A) Carless African Americans, unemployed, in poverty		(B) Carless, receiving public assistance income		(C) Carless women-headed households with children, in poverties	
			Auto access.	Transit access.	Auto access.	Transit access.	Auto access.	Transit access.
High	1	1.50–2.30	3653	0	8573	0	5735	0
	2	1.20–1.49	3164	0	14,645	0	11,920	0
	3	1.00–1.19	3117	0	8430	0	6725	0
	4	0.80–0.99	0	0	549	0	1113	0
	5	0.50–0.79	0	0	443	0	835	0
Low	6	0.00–0.49	0	9934	0	32,640	0	26,328
	Total		9934	9934	32,640	32,640	26,328	26,328

Source: US Bureau of the Census (2003a, 2004a,b,c).

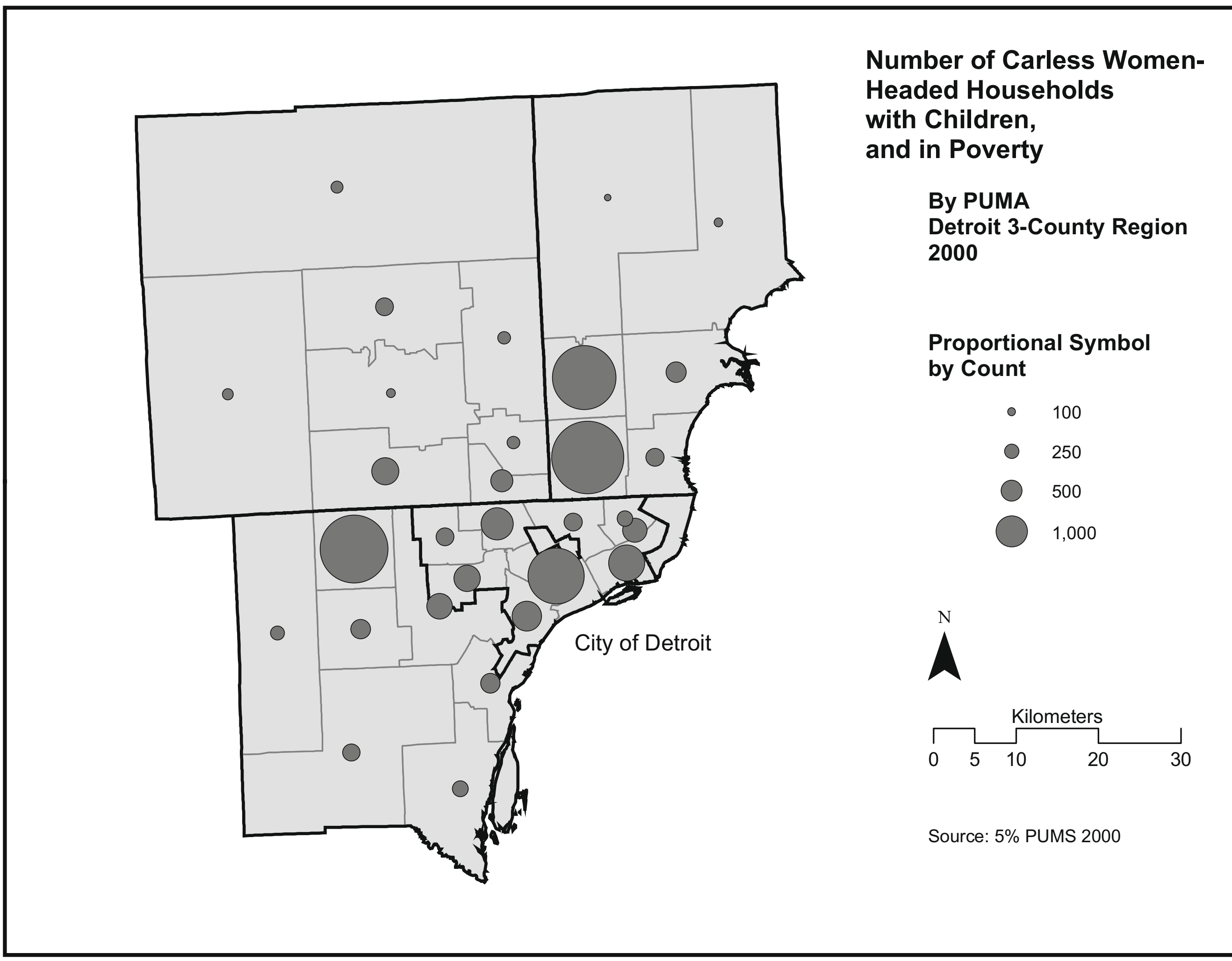

Fig. 7. Count of women-headed households with children who are carless and living in poverty, Detroit three-county region, 2000.

Fig. 7, which reveals that over 70% of such women live outside the central city and beyond the reach of the main transit system. Table 4 shows a pattern similar to the case of Group A, where nearly everyone lives in a zone with access to jobs by car better than the regional average of 1.0, with 97% of Group B and 93% of Group C living in such zones. The people in these three groups of disadvantaged travelers live in households without cars, and presumably either use public transit or share rides with car owners to carry out their daily activities. Gaining steady access to an automobile would shift the people in all three groups from the most disadvantaged to an advantaged position in the regional geography of job accessibility.

6. Conclusion

Detroit has long epitomized the conventional conception of spatial mismatch (Blumenberg and Manville, 2004; Kain, 1968), and for many reasons this is justified. It is an older, industrialized city of the monocentric variety, where jobs are decentralizing rapidly as racial segregation concentrates poverty at the urban core. But by shifting the definition of spatial mismatch to the more refined concept of job accessibility – by focusing, that is, less attention on geographic distance and more on how a complex transportation system works differently for different people in traversing that geographic distance – I find that even Detroit no longer fits with our conventional spatial mismatch understandings, despite its image as a classic case of a hollowed-out region.

The inner-city is not disadvantaged by its geographic position in regional space. On the contrary, the inner-city actually offers substantial advantages in reaching jobs, with one major qualification: a worker needs a car. To be sure, inner-city residents are disadvantaged by their geographic location for a variety of reasons, including inferior educational opportunities, higher crime rates, and inadequate public services (Goldsmith and Blakely, 1992; Jargowsky, 1997; Squires and Kubrin, 2005). And the worsening physical separation between high-poverty inner-city neighborhoods and suburban jobs is cause for concern on a number of fronts – the persistence of racial discrimination among suburban employers (Turner, 1997), the worsening fear of "the other" that comes with sharp social isolation (Sennett, 1970), and the loss of informal social networks and role models (Wilson, 1987). People living in the inner-city have good reasons for moving to the suburbs if they want to increase their life chances, but overcoming the barrier of travel to a job is not likely to be one of them. Inner-city residents in Detroit are not disadvantaged by their location, but rather are disadvantaged by a lack of cars and poor transit service. People without cars are deprived of good accessibility even if they live in the central city. Recent proposals to use public funds to help poor people gain access to cars, as a complement to other approaches like expanding public transit services, have merit in Detroit and policy makers ought to consider them (O'Regan and Quigley, 1998; Waller, 2006).

Proposing to provide cars to poor people is, however, controversial and faces considerable problems (Blumenberg and Manville, 2004). Skeptics can sensibly challenge the argument on several grounds. First, additional cars will worsen air pollution and energy consumption, undermining a major public policy thrust of the federal government that aims to minimize driving. Although scholars have yet to determine the degree to which pollution would worsen or energy would be consumed, this study of Detroit brings a sharper focus on the tradeoff between cleaner air and providing opportunities to poor people. It represents a stark illustration of the longstanding debate over the conflicting goals of improving ecology and achieving more social justice (Harvey, 1996; Paehlke, 2006; Wenz, 1988). As Dobson (1998, p. 3) warns, "it is just possible that a society would be prepared to sanction the buying of environmental sustainability at the cost of declining social justice". With each instance that conflict arises between ecology and justice, planners and policy makers face difficult political decisions (Campbell, 1996). My study aims to alter the terms of such a debate by asking whether it is fair to require poor people to endure enormous disadvantage in accessing opportunities on behalf of the middle-class and the rich who would benefit from what may be a small improvement in air quality.

A second objection to subsidizing cars is that putting more vehicles on the road will worsen traffic congestion. Raphael and Stoll (2001) offer a counter argument that congestion would not appreciably worsen because a large share of the additional cars would be used primarily for reverse commutes and at nonpeak travel periods. Furthermore, although no study has yet calculated how many extra vehicles would be required to equip poor people with cars, I estimate that in Detroit it is small indeed, amounting to no more than three percent of the total current fleet of vehicles in the three-county region.[2] As Blumenberg and Manville (2004, p. 197) argue, no policy should "deny a single car to a poor family, in the interest of traffic or pollution mitigation, when almost 60% of American households have two or more vehicles and the freedom to purchase as many more as they can afford".

Third, owning and operating a private vehicle costs too much – especially with rapidly rising fuel prices. The costs of car-ownership would undoubtedly place substantial burdens on poor households (Roberto, 2008; Surface Transportation Policy Project, 2000), and any long term policy reform would surely need to address this. The purchase or lease of a vehicle is only part of the total cost; other ongoing costs include fuel, license and registration, insurance, loan interest, maintenance, and parking. Like other recent studies (Lucas and Nicholson, 2003; Raphael and Stoll, 2001), my findings address only the benefit side of the cost-benefit evaluation: gaining access to a car immediately moves a carless resident from one of the least advantaged to one of the most advantaged positions in the spatial competition for regional jobs. More research is needed to evaluate the costs of subsidizing cars, but several commentators suggest that providing personal vehicles may be more cost-effective than other alternatives (Kain and Meyer, 1970; Myers, 1970; Small, 2001).

A fourth objection that skeptics may level against subsidizing automobiles is the one that this article addresses directly: we already subsidize an alternative to the automobile in the form of public transit. The results of this study suggest instead that in a place like Detroit, accessibility by transit is currently so low that no amount of transit investment could be implemented fast enough to address the urgent problems of joblessness and poverty. The car's advantages in job accessibility are so extreme, and the prospects for serving the most disadvantaged people with public transit are so limited, that the problem facing poor people in Detroit is a "modal mismatch" rather than a "spatial mismatch". Transportation planners and engineers have deliberately built metropolitan regions to accommodate the private automobile. A problem with recent efforts to reduce inner-city poverty with new public transit service is that public transit does not work well in cities made for cars. To fix the urgent problem of poor access to jobs with public transit is to undo decades of choices that undermined public transit: "after building urban highway and transit systems quite intentionally to segregate our metropolitan areas economically and to encourage middle- and upper-class suburbanization, we should not suddenly expect to rely on that very infrastructure to link up the poor people and the jobs we have consciously located far from one another" (Wachs and Taylor, 1998, p. 18).

Finally, the argument that accessibility to jobs by public transit is so universally poor that to fix it would require subsidizing cars may hold in places like Detroit, but not all metropolitan regions will require such intervention. Blumenberg and Manville (2004) recommend flexible policy making to accommodate the distinctive features of a region that come with age of development. They maintain that the conventional spatial mismatch model is least relevant in the newer cities of the South and West like Phoenix, Denver, Houston, and Las Vegas that "came of age when American land-use policies had been subordinated to the needs of the automobile, and the distribution of their residents and employment reflects the greater mobility that cars confer" (p. 186).

[2] I estimate the number of nonworking poor people in the 3-county region using PUMS data as anyone receiving public assistance income and living in a household with no vehicle as 33,000. The number of working poor people without cars is calculated using CTPP data and imputing between tables of workers per household and vehicles per household, and assuming a household income of less than $25,000, to arrive at 42,000 persons. The sum of these two figures is compared to the region's 3.3 million registered motor vehicles to arrive at the estimate of 2.3%.

Although the age of development goes a long way toward explaining the automobile-dependent urban form that contributes to poor job access, so too do local choices made by planners and policy makers. Detroit is a case of a region that came of age long before the cities of the South and West, yet when local officials chose to invest heavily in building freeways while discounting the importance of public transit, they created a metropolitan area with much in common with the South and West. City size and age partly determine the extent and manner in which poor jobs access plays out in a metropolitan region. But my findings indicate that appropriate policy interventions may not be so different in an older city like Detroit than in newer cities that developed according to an auto-oriented template. The reason is that many older cities in the United States are nonetheless dominated by auto-oriented suburbs. In Detroit, the age of development is less significant than the choices public officials have made about the transportation system. These choices so overwhelmingly favor the automobile over transit that the ability to reach suburban jobs from the inner-city is profoundly influenced by travel mode. Planners should be careful to distinguish between an urban form that derives from an age of development and an urban form that derives from local choices in building a transportation system, so that they can begin the work of remedying those choices.

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