DRAFT Technical Background Document on Impacts of Regional Accessibility Based on a Review of the Empirical Literature

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Study Selection

Regional accessibility has been considered in several studies that examine the association between the built environment and travel behavior. While several studies were identified that report associations between regional accessibility and vehicle miles traveled (VMT), no studies were identified that report associations between regional accessibility and greenhouse gas emissions and none that directly tests the effect of a *change* in regional accessibility on vehicle miles traveled (VMT) using a longitudinal design.

The key criterion for including studies in this research brief was reporting of the effects of regional accessibility on VMT for all purposes, while controlling for socio-demographic characteristics and other built environment characteristics. Additional considerations included a location in the United States and data from 1990 or later. Studies that employed travel demand models rather than empirical data to estimate the effect were excluded, given the dependence of their results on the assumptions build into the models. Studies that used aggregate data (e.g. zone- or zip-code-level data) rather than disaggregate data (e.g. individual- or household-level data) were also excluded, because of the possibility that aggregate relationships mask the true effects of regional accessibility on individual or household travel behavior and the difficulty of adequately controlling for socio-demographic factors in aggregate studies. Those studies that used only measures of accessibility via transit were excluded as well because this measure has an indirect rather than direct effect on driving. It encourages increased transit use, but increased transit use does not necessarily translate into an equal decrease in driving.

Studies meeting the criteria were Bento, et al (2003), Cervero and Kockelman (1997), Ewing and Cervero (2010), Kuzmyak, et al. (2006), and Zegras (2010). Most common are measures of accessibility to jobs and distance to the Central Business District (CBD). Note that distance to the CBD is inversely related to regional accessibility: the closer the location is to the CBD, the higher its regional accessibility. The two measures used in Bento, et al. (2003) compare regional accessibility in one region versus another, rather than at different locations within a region.

Table 1: Measures Used and Sources of Effect Sizes

Study	Study Location	Regional Accessibility Measures	Travel Behavior Measures	Effect Size and Source
Cervero and Kockelman, 1997	Bay Area	Accessibility to jobs, using exponential gravity measure using uncongested driving times between zones (see footnote in Table 8 in cited paper)	Vehicle miles traveled in personal vehicles by all household members for all trips, from 1990-01 Bay Area Travel Survey	Elasticity between VMT and accessibility to jobs for all trips is -0.247 (see Table 14 in cited paper) Linear regression model used to estimate relationship between regional accessibility and VMT Elasticities calculated using mid-point value for VMT and accessibility to jobs
Kuzmyak, et al., 2006	Baltimore Region, MD	Accessibility to jobs, using simple gravity measure (impedance equal to travel time), using both auto and transit travel times	Daily weekday total household VMT, from the 2001 Nationwide Household Transportation Survey	Elasticity between VMT and accessibility to jobs is -0.127 (see Table 2 in cited paper) Linear regression model used to estimate relationship between regional accessibility and VMT Calculation of elasticities is not explained
Zegras, 2009	Santiago de Chile	Distance to CBD (km) measured based on household's census block centroid; unclear whether study uses network or straightline distance	Household total automobile km (VKT) on day of survey, from 2001 SECTRA survey	Net elasticity between VKT and distance to CBD is 0.234 (see Table 5 in cited paper) Net elasticity reflects combined effect on auto ownership and use Linear regression model used to estimate relationship between regional accessibility and VKT Elasticities calculated based on the simulation of changes in VKT assuming a 10 percent change in distance to CBD for households in the sample (see Appendix in cited paper)

Study	Study Location	Regional Accessibility Measures	Travel Behavior Measures	Effect Size and Source
Ewing and Cervero, 2010	Multiple locations – 3 California, 5 other U.S., 2 international	Multiple measures of job accessibility by auto	Multiple measures of VMT from multiple sources	Weighted average elasticity between VMT and job accessibility by auto is -0.20, based on 5 studies (see Table 3 in cited paper)
		Multiple measures of job accessibility by transit	Multiple measures of VMT from multiple sources	Weighted average elasticity between VMT and job accessibility by transit is -0.05, based on 3 studies (see Table 3 in cited paper)
		Multiple measures of distance to downtown	Multiple measures of VMT from multiple sources	Weighted average elasticity between VMT and inverse of distance to downtown is 0.22, based on 3 studies (see Table 3 in cited paper) We assume that the elasticity between VMT and distance to downtown is 0.22

Study	Study Location	Regional Accessibility Measures	Travel Behavior Measures	Effect Size and Source
Bento et al., 2003	Nationwide	Population centrality, measured at the level of metropolitan regions (see pp. 11-12 in cited paper); higher values mean a greater share of the population living near the CBD	Annual total VMT per vehicle from the 1990 Nationwide Personal Transportation Survey (NPTS), excluding New York City	Marginal total impact, excluding NYC, of 10% increase in population centrality is decrease of 281 miles, equal to a decrease of 1.5% of annual total VMT per vehicle (see Table 10 in cited paper) Linear regression model used to estimate relationship between regional accessibility and natural log of VMT, with separate models for one-, two-, and three-or-more vehicle households
		Jobs-housing imbalance, measured at the level of metropolitan regions (see pp. 12-13 in cited paper); higher values mean a less even distribution of jobs relative to housing and thus greater average distances from residences to jobs	Annual total VMT per vehicle, from the 1990 nationwide Personal Transportation survey (NPTS), excluding New York City	Marginal total impact, excluding NYC, of 10% increase in jobs-housing imbalance is increase of 107 miles, equal to an increase of 0.6% of annual total VMT per vehicle (see Table 10 in cited paper) We assume that a 10% *decrease* in jobs-housing imbalance yields a *decrease* of 0.6% of annual total VMT per vehicle Linear regression model used to estimate relationship between regional accessibility and natural log of VMT, with separate models for one-, two-, and three-or-more vehicle households

Effect Size, Methodology and Applicability Issues

In applying the estimated effects, several methodological limitations should be considered. Every study uses a different measure of regional accessibility. Little work has been done to compare these measures, and it is not possible to prioritize one study over another based on its measure of regional accessibility.

There are also several limitations with the regional accessibility measures used in these studies. Measures of accessibility that use access to jobs as a proxy do not capture all potentially relevant activities. Service and retail jobs can serve not only as a measure of potential employment opportunities but also as a measure of the quantity of shopping, entertainment, and other activities available to consumers. But jobs may not be an accurate way to assess the value of these destinations to the consumer, and some job-poor destinations, such as parks, will be undervalued or omitted altogether.

Measures of distance to the CBD are more appropriate for monocentric regions, i.e. those with one dominant center. But if a region is polycentric, i.e. has many centers of activity, proximity to subcenters may have a more important influence on vehicle travel than proximity to the CBD.

Simple measures also may mask important differences in the nature of accessibility. Consider two locations with the same number of jobs within 5 miles (a cumulative opportunities measure), but jobs are on average 4 miles away at one location and 3 miles away at the other. The implications for VMT would likely be very different. A study from the Bay Area shows that accessibility owing to short distances to destinations results in different outcomes than accessibility owing to a greater number of destinations within a given area (Handy 1994).

In addition, simple measures of both jobs accessibility and distance to the CBD do not account for the match or mismatch between demand and supply. For example, a narrow range of jobs will realistically be relevant for any particular individual, and her travel will be influenced by accessibility to this subset of jobs rather than to all jobs. Jobs and other activities in the CBD may not be of interest or relevant to certain segments of the population.

Regional accessibility is likely to be correlated with other characteristics of the built environment, given the general outward pattern of development in most regions. Neighborhoods close to the center tend to be older, with characteristics reflective of older eras of development – rectilinear street grids, narrower streets, neighborhood stores, better transit access, and so on. Neighborhoods far from the center tend to be newer, with greater separation of land uses and street networks in which cul-de-sacs are common. Most studies reviewed control for some, but not all, such characteristics.

Similarly, characteristics of the neighborhood can mediate the effect of regional accessibility. Areas with many local destinations can capture trips that otherwise would have been attracted to more distant destinations within the region. Conversely, the

effects of neighborhood characteristics are moderated by regional accessibility. Good regional accessibility can draw residents away from more local destinations. Studies should account for both regional accessibility and neighborhood characteristics.

Finally, the studies all use cross-sectional designs that compare VMT for locations or regions with different accessibility at one point in time, rather than longitudinal designs that measure changes in VMT in response to changes in accessibility within a region. Cross-sectional designs leave open the possibility that the observed effects are partly attributable to the "self-selection" of residents that balance households' needs and preferences. One study in the Ewing and Cervero study controls for self-selection.

The use of simple measures of regional accessibility is likely to produce an under-estimate of the true effect of regional accessibility, while the failure to control for other built environment characteristics or for self-selection is likely to produce an over-estimate of the true effect of regional accessibility.

References

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