DRAFT Policy Brief on the Impacts of Regional Accessibility Based on a Review of the Empirical Literature

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Policy Description

Regional accessibility can be defined as the ease with which destinations can be reached throughout a region. The proximity of a residence to potential destinations, such as jobs, shopping, and leisure-time activities, and the nature of the transportation links to those destinations together determine accessibility. In general, the closer a residence is to the center of the region, the higher the level of regional accessibility, given the concentration of jobs and other activities in the center. Close proximity to secondary centers of activity – "subcenters" – also contributes to regional accessibility. For any given residence, accessibility will vary for each type of activity (e.g. jobs, shopping, leisure, etc.) and mode of travel (e.g. driving versus transit).

Regional accessibility is the outcome of many different land use and transportation-related policy decisions over a long period of time. For example, zoning codes have traditionally determined what land uses are allowed where and at what densities, and so influence the proximity of a residence to potential destinations. Public investments in roads and transit systems, as well as the design of these facilities and services, influence the nature of transportation connections to destinations.

Impacts of Regional Accessibility

The impact of regional accessibility on travel is not straightforward. Higher regional accessibility can result in less travel since distances to potential destinations are shorter. On the other hand, higher regional accessibility can mean more frequent trips, particularly for shopping and other non-work purposes, because residents have a greater range of destinations from which to choose (Handy 1996). The level of regional accessibility by transit compared to regional accessibility by car will influence the extent to which residents choose transit over driving. The net impact of regional accessibility on vehicle miles traveled (VMT) will ultimately depend on a combination of these different effects.

Two types of regional accessibility measures are most commonly found in the literature, though other measures have been used as well. The most basic measure is the distance from the residence to the central business district (CBD) or other central location. If straight-line distance rather than network-distance is used in this measure, it reflects only land use patterns and not the transportation network. The second type of measure incorporates both land use patterns and the transportation network in one of two ways. The simpler approach is to count the number of destinations (e.g. stores) or opportunities (e.g. jobs) within a certain distance or travel time from the residence (called a "cumulative opportunities" measure). A more complicated approach is to weight destinations by distance, with closer destinations contributing more to regional accessibility than do more distant destinations (called a "gravity" measure).

Effect Size

Five studies provide eight different estimates of the effect of regional accessibility on VMT, with four studies using either measures of distance to a central location or measures of job accessibility (Table 1). 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. It is not possible to directly compare the estimated effect sizes, as regional accessibility is measured differently in each study. Two studies use more than one measure of regional accessibility and produce substantially different estimates for each measure.

Table 1: Regional Accessibility and VMT

Study	**Study Location**	**Study Year**	**Results**	
			Regional Accessibility Variable	*VMT Reduction for 1% Increase in Regional Accessibility*
Cervero and Kockelman (1997)	Bay Area, CA	1990	Accessibility to jobs (gravity measure)	-0.25%
Kuzmyak (2006)	Baltimore Metropolitan area, MD	2001	Accessibility to jobs (gravity measure)	-0.13%
Zegras (2010)	Santiago, Chile	2001	Distance to CBD (km)*	-0.23%
Ewing and Cervero (2010)	Multiple locations	Multiple years	Multiple measures of job accessibility by auto	-0.20%
			Multiple measures of job accessibility by transit	-0.05%
			Multiple measures of distance to downtown*	-0.22%
Bento, et al. (2003)	Nationwide	1990	Population centrality measure	-0.18%
			Jobs- housing spatial imbalance measure*	-0.06%

*Lower values of these variables equate to higher regional accessibility; reported effects are for a 1 percent *decline* in these variables.

The estimates vary widely, from a low of -0.05 percent VMT per 1 percent increase in regional accessibility (i.e. elasticity of -0.05) to a high of -0.25 percent VMT. Two estimates using distance to the center are similar, at -0.22 percent and -0.23 percent. Two estimates using accessibility to jobs range from -0.13 percent to -0.25 percent. The low estimate is for job accessibility by transit and can be attributed to the low use of transit relative to driving in most U.S. regions. The results thus suggest an effect size for accessibility by auto of between -0.13 percent and -0.25 percent; with more evidence at the higher end of the range. The effect sizes for job accessibility tend to be high compared to estimated effects for other land use characteristics (Ewing and Cervero, 2010).

The two measures used in Bento, et al. (2003) merit some explanation. These measures are used to compare regional accessibility in one region versus another, rather than at different locations within a region. Their results show that regions with higher overall accessibility (owing to greater centralization of population or less of an imbalance between jobs and housing) have lower VMT on average. The estimated effect sizes fall within the range of the other studies.

Evidence Quality

The studies in Table 1 use accepted statistical methods to analyze individual travel behavior. Ewing and Cervero (2010) combine the results of several of these studies. Although the studies provide the best available evidence of the effect of regional accessibility on VMT, they have some important limitations. As noted, the studies use different measures of regional accessibility, making comparisons difficult. In addition, it is not clear which measure of regional accessibility is most appropriate. For these reasons, it is not possible to narrow the range of possible effect sizes. The studies may not control for all of the characteristics of the built environment that are correlated with regional accessibility. The studies also compare VMT in locations with different levels of regional accessibility at one point in time, rather than examining changes in VMT that occur in response to changes in regional accessibility. The studies do not control for the impacts of “self-selection” on VMT; people who prefer to drive less may be more likely to move into residential locations with greater regional accessibility that enable less driving.

Caveats

The cited studies represent regional accessibility in relatively simplistic ways. For example, jobs accessibility may not accurately capture accessibility to other kinds of destinations that could lead either to an increase or decrease in VMT. Simple measures also may mask important differences in the nature of accessibility. Most of the studies use travel distance rather than travel time to measure regional accessibility and therefore omit the impact of congestion on the ease of getting to destinations. While it is not clear whether these simplifications lead to higher or lower estimates of effect sizes, they may help to explain the range of estimates. The estimated effect sizes should thus be applied with caution and an acknowledgement of the uncertainty.

Because the cited studies focus solely on metropolitan areas, it is not clear whether the effect of regional accessibility is similar in rural areas. However, it is likely that having more jobs within a specified distance and closer to a town center would result in less VMT for rural residents as well. In very low density areas, the effect might be even greater, given the relatively sparse distribution of jobs and other destinations.

Greenhouse Gas Emissions

No studies provide direct evidence of the impact of regional accessibility on greenhouse gas (GHG) emissions. Translating VMT reductions into GHG emissions reductions depends on the nature of the VMT eliminated (e.g. speeds, acceleration, deceleration, times vehicle is started) and the types of vehicles owned by residents who decrease their driving. Apart from from those particular considerations, one would generally expect GHG reduction to be similar to VMT reduction, if vehicle fleet composition and driving patterns are unchanged. Some research has shown that vehicle choice depends in part on land use (e.g. Fang, 2007, Brownstone and Golob, 2009). While the pattern of such changes in response to regional accessibility in particular has not been documented, it is reasonable to expect that policies that reduce VMT will also lead to reductions in GHG emissions.

Co-Benefits

Many different policies can be used to increase regional accessibility, as discussed below, and the co-benefits depend on the policy. For example, policies to promote infill development help to increase regional accessibility but also to preserve open space and reduce infrastructure costs. Investments in transit improve regional accessibility for those with limited access to cars and may stimulate economic development. Many other co-benefits are possible, depending on the strategy used to increase regional accessibility.

Examples

Conceptually, there are three ways to increase regional accessibility: put more potential destinations within close proximity of existing residences, put more residents within close proximity of existing destinations, and improve the transportation connections between residences and destinations. Different strategies can be used to effect these changes, but some strategies will tend to increase VMT while others will tend to decrease VMT. Strategies that tend to reduce VMT include infill policies, redevelopment programs, and transit-oriented development that increase the proximity of residences and destinations at relatively high densities; these strategies may both reduce average driving distances and encourage use of transit and non-motorized modes. Another strategy is the implementation of a bus-rapid transit line that improves transportation connections by decreasing travel times and increases the comfort of traveling by transit. Strategies that may increase VMT include improvements to the freeway system that make it easier for residents to live farther from centers or that increase the attractiveness of driving relative to transit. Land use policies that encourage job growth in low-density suburban areas may increase job accessibility for residents in those areas but do less to increase overall regional accessibility than if the jobs were located in the center or in subcenters, where they would be in closer proximity to a greater share of residents. In general, improving regional accessibility by increasing the centralization of jobs and residents (in one or more centers) and/or by improving transit connections relative to driving connections should help to reduce rather than increase VMT.

Successfully implementing these strategies requires coordinated action on the part of many jurisdictions within a region. The San Francisco Bay Area is one example. The expansion of the BART system and other rail systems has created a more competitive transit network for the region. The Metropolitan Transportation Commission (MTC) adopted a transit-oriented development (TOD) policy in 2005 that sets standards for minimum levels of development around transit stations in new transit corridors and supports TOD planning around stations (http://www.mtc.ca.gov/planning/smart_growth/tod/TOD_policy.pdf). The City of San Francisco has encouraged high-density mixed-use development in the South of Market and Mission Bay redevelopment areas. The City of Emeryville's redevelopment efforts have created a new retail subcenter for the region. The traditional downtowns of cities around the Bay, many served by BART or commuter rail, have been revitalized as mixed-use centers. These efforts have enhanced regional accessibility in a way that has the potential to reduce VMT.

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