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Does competition matter in measures of job accessibility? Explaining employment in Los Angeles

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ABSTRACT

Planning organizations are increasingly looking to accessibility measures to understand how well the transportation system provides access to employment opportunities. However, the most common type of job accessibility measure employed in planning practice, the cumulative opportunity measure, considers job supply but overlooks competition for jobs. Therefore, the cumulative opportunity measure may not fully capture workers' access to job opportunity.

In this paper, we examine four accessibility measures, two of which account for spatial competition and the other two do not, using the Los Angeles metropolitan area as a case study. We find that measures of competitive accessibility have stronger associations with employment than non-competitive accessibility measures. We examine the relationship between residential accessibility and employment for four separate levels of educational attainment, and we find that competitive measures are especially pertinent for population segments with lower educational attainment. Therefore, we recommend competitive accessibility measures to assess the employment opportunity more accurately.

1. Introduction

Place-based job accessibility is of interest to geographers, urban planners, and urban economists for its relationship with many issues of interest. Job accessibility can help explain urban form (Ahlfeldt, 2011) alongside various aspects of travel behavior, including commute length and mode choice (Owen and Levinson, 2015). From the perspective of workers, increased job accessibility offers the potential for shorter commutes and possibly even the potential for improved employment prospects (Hu, 2014a,b). Of particular interest in recent research is the job accessibility for disadvantaged population segments (Foth et al., 2013), who may be more dependent upon transit or who may experience the costs of commuting more acutely.

Empirical results on the link between job accessibility and employment do not paint a clear picture of accessibility's impact on employment. Kain (1968) formulated the Spatial Mismatch hypothesis which has been the subject of almost continuous investigation since. Kain's hypothesis was that as jobs relocate increasingly to suburban locations, inner city residents disproportionately suffer from lowered job accessibility and therefore a worsened employment situation. Note that Kain also identified housing market discrimination against minorities as a primary cause of lower employment levels. Despite the logic of this hypothesis, the empirical evidence on this hypothesis is quite mixed. The question of whether and how much place-based job accessibility increases the odds of employment, in particular for disadvantaged populations, is still under debate.

At the same time, professional planners have increasingly turned towards cumulative opportunity accessibility measures to evaluate the job accessibility impacts of various land use and transportation plans. The benefits of cumulative opportunity accessibility measures are in their ease of interpretation – in comparison with other types of job accessibility measures, cumulative opportunity measures are easier to calculate and to understand. Cumulative opportunity measures have been implemented to understand job accessibility and equity benefits of regional planning proposals, including in leading metro areas such as Chicago, Seattle, and San Francisco (Chicago Metropolitan Agency for Planning, 2010a; Metropolitan Planning Commission, 2009; Puget Sound Regional Council, 2008). Policy think tanks such as the Brookings Institution, have relied upon cumulative opportunity measures to evaluate important accessibility concerns such as metro transit accessibility (Tomer et al., 2011). Accessibility measures are increasing used in professional planning practice and policy analysis, but by far the dominant form of such measures are cumulative opportunity measures.

Cumulative opportunity accessibility measures are appealing for

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their transparency and ease of access. And some of the literature shows that various kinds of accessibility measures tend to be highly correlated, so it may make sense to present the simplest possible measure that tells the story of job accessibility (Bunel and Tovar, 2014; Geurs and Ritsema van Eck, 2003a). However, it is unclear if reporting cumulative opportunity accessibility measures is leaving out the role that spatial job competition may play in limiting such employment opportunity.

Shen (1998) produced a seminal paper arguing that job competition must be accounted for in order to understand how accessibility impacts employment opportunity. Since this time, there have been a number of studies examining Shen-style accessibility measures and how they relate with more conventional accessibility measures (Bunel and Tovar, 2014). However, neither the original Shen paper itself nor any of the papers that have followed have examined whether Shen-style accessibility measures better explain spatial employment patterns than conventional, non-competitive accessibility measures. Although there are theoretical reasons to prefer Shen-style accessibility measures, these theoretical reasons have not been validated in the empirical literature.

This paper seeks to address this unresolved issue empirically, by examining the strength of correlation between employment status and various job accessibility measures. Two versions of non-competitive job accessibility area considered, the cumulative opportunity measure and the gravity accessibility measure. Also, two competitive versions of job accessibility measures are evaluated as well, first the Shen measure discussed above, and second the doubly-constrained gravity accessibility measure. The correlation of each of these accessibility measures with employment patterns is considered after accounting for a host of control factors.

Since the effects of job competition may vary by the level of human capital, we conduct separate analyses for four differing levels of educational attainment. By analyzing different education groups, we hope to understand if job competition plays a different role across such population segments. The goal of the paper is to determine whether widely adopted cumulative opportunity measures of accessibility provide an accurate portrait of the job opportunity available to the least advantaged populations.

2. Literature review

This first part of this section reviews research that defines and applies the four accessibility measures (cumulative opportunity, gravity, Shen, and Inverse Balancing Factor) considered in this paper. The second part examines the relationship between the four measures and employment outcomes.

2.1. Job accessibility measures

Conceptually, accessibility is decided by the spatial distribution of opportunities as well as the quantity and quality of travel to reach these opportunities (Handy and Niemeier, 1997; Wachs and Kumagai, 1973). In this research, we define job accessibility as the measure of the ease of reaching job opportunities distributed across space from one's residential location.

Based on this definition, job accessibility is a spatial indicator of potential employment opportunities. The emphasis on “potential opportunities” was suggested by Hansen (1959, p. 75) and accepted widely by subsequent literature (Ben-Akiva and Lerman, 1979; Dalvi and Martin, 1976; Geurs and Van Wee, 2004; Handy and Niemeier, 1997).

Measurements of job accessibility have advanced with an increasingly accurate understanding of the concept as well as improved data and computational power (Kwan et al., 2003). The most straightforward measurements include the cumulative opportunity measure, which sums up the number of job opportunities within a certain distance or time. The measures are widely applied in both research and practice (Åslund et al., 2010; Casas, 2007; El-Geneidy and Levinson, 2007; Hanson and Schwab, 1987; Manaugh et al., 2010; Wachs and Kumagai, 1973). Note that a few studies have modified the cumulative opportunity measures and used the ratio of the number of jobs to the number of workers within a certain area or a threshold time/distance (Ellwood, 1986; Gottlieb and Lentnek, 2001; Immergluck, 1998). Such modification apparently considers the potential for job competition within the cumulative opportunity measurement framework.

The cumulative opportunity measures have two major advantages. First, they are consistent with the conceptual definition, since they consider both the spatial locations of job opportunities and transportation impedance, although this impedance indicator is very simple. Second, compared with most other accessibility measures, cumulative opportunity measures are easier to calculate and to understand. This could be the reason that they are widely applied by Metropolitan Planning Organizations (MPOs), policy think tanks, and research institutes.

On the other hand, the simplicity of the cumulative opportunity measures could limit their capability to reflect complicated labor markets and travel behaviors. First, the measures treat jobs within arbitrary travel time or distance equally without considering the increased cost of reaching distant opportunities. Second, the travel time or distance benchmarks could be “sensitive to the travel purpose and to individual socio-demographic characteristics” (Bertolini et al., 2005, p. 219). Other job accessibility measures have been used to address these limitations.

Gravity-based job accessibility measures consider travel distance or time decay of job opportunities. The measure was first developed by Hansen (1959) and then applied widely in the literature (e.g. (Cervero et al., 2002; Foth et al., 2013; Gibb et al., 2014; Helling, 1998; Hess, 2005; Levine et al., 2012; Levinson, 1998; Muhammad et al., 2008; Osland, 2010; Parks, 2004; Raphael, 1998; Reggiani et al., 2011; Wang and Chen, 2015). The gravity-based measures have many variations. Most variations are about the functional form of the impedance function, such as exponential functions, power functions, and Gaussian functions. Reggiani et al. (2011) found that different impedance functions affect the predictive power of job accessibility on commuting flows, but their empirical research is based on very large spatial units—439 districts in the whole country of Germany.

Compared with the cumulative opportunity measures, the gravity-based measures are conceptually more appealing. The latter are more consistent with the theoretical expectation that the interaction, e.g. travel, between activities can be proportional to their size and inversely proportional to the distance between them (Wilson, 1967). The gravity-based measures are also more consistent with the observed individual behavior: job seekers or workers discount jobs that are further away; the impedance functions can be calibrated to reflect such behavioral patterns. Therefore, gravity-based measures have become a basis for trip distribution in conventional transportation demand modeling (Martin and McGuckin, 1998).

Shen (1998) incorporated the component of job competition into the gravity-based measures, and he elaborated the deficiency of the conventional gravity-based measures that do not consider such competition. Shen's model discount jobs not only by travel impedance but also by competition at workplace locations. The model has been adopted by much research (Grengs, 2010; Grengs et al., 2010; Hu, 2014b, 2015; Kawabata, 2009; Kawabata and Shen, 2006, 2007; Lens, 2014; Sanchez et al., 2004; Shen and Sanchez, 2005).

Shen's model is a meaningful advancement since, by incorporating job competition, the measure considers labor demand and labor supply, which are important factors that affect job search outcomes based upon labor economics (Mortensen, 1986). A disadvantage of Shen's model is its complexity, which might explain the model's limited application in the real-world practice.

Only a few articles in the research literature have applied inverse balancing factor accessibility (also sometimes referred to as “balancing factors”) (Cerda, 2009; De Montis et al., 2011; Geurs and Ritsema van