Impact of Jobs-Housing Balance on Passenger Vehicle Use and Greenhouse Gas Emissions

Technical Background Document

Hsin-Ping Hsu, University of California, Irvine
Marlon G. Boarnet, University of Southern California
Susan Handy, University of California, Davis

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Study Selection

When the concept of jobs-housing balance originated in the 1980s, the primary goal was to relieve traffic congestion during peak hours. Hence much research focused on the relationship between jobs-housing ratios and commute time. The studies summarized in this document provide results pertaining to vehicle miles traveled (VMT) or commute distance traveled, including Miller and Ibrahim (1998), Peng (1997), Cervero and Duncan (2006), and Frank and Pivo (1994). Three other studies were added because of their insights related to trip distance. Kockelman (1997) related jobs-housing balance (measured by a gravity variable over a 30-mile distance) to VMT. Nowlan and Stewart (1991) found that promoting jobs-housing balance can reduce trip numbers. Yang (2008) adopted the "excess commuting" approach, which is related to but different from the concept of jobs-housing balance, comparing minimum commute distances if all people worked at the nearest job (matching occupations and job type) with actual commute distances. Schleith and Horner (2014) calculate excess commute measures for three income groups in the county that contains Tallahassee, Florida, which gives insights into the relationship between commute distance and housing market characteristics.

Effect Size, Methodology, and Applicability Issues

Detailed information for each study is provided below, including the data source, unit of analysis, operational definition of jobs-housing balance, geographic area, and statistical methods.

1. Miller and Ibrahim (1998)

Using 1986 travel survey data in the greater Toronto area, the authors aggregated vehicle kilometers traveled (VKT) into zones. They measured jobs-housing balance by the ratio of employment to population within a 5 km radius of each residential zone's centroid. The study area was divided into 1404 zones. Multiple linear regression models showed that the ratio of employment to population has only marginally significant influence on commute VKT per worker per zone.

2. Peng (1997)

Portland transport survey data were aggregated into traffic analysis zones. The ratio of jobs to housing units was calculated within a 5-7 mile radius of each traffic analysis zone. A spline function was used to model a nonlinear relationship between the jobs-housing ratio and total VMT, and the results showed that in areas with a roughly balanced jobs-housing ratio (1.2 to 2.8) the marginal change in VMT from changes in

the jobs-housing ratio is small. When the ratio is less than 1.2, VMT decreases noticeably as the ratio increases; when the ratio is larger than 2.8, VMT increases dramatically as the ratio increases.

3. Cervero and Duncan (2006)
Using 2000 Bay Area travel survey data which contained a detailed two-day travel diary for over 16,000 randomly sampled households, the authors measured two types of job accessibility. The first is all jobs within a 4-mile radius of each survey respondent's residence, and the second counts only jobs in the same occupational category (executive/professional, support/service, or blue collar) as that held by the survey respondent. Regression models show that both types of job accessibility have statistically significant effects on commute VMT. The 4-mile radius catchment area was the result of testing jobs-housing balance measures calculated for one-mile rings from one to nine miles around each household. The 4-mile radius area gave the best statistical explanatory power, as indicated by the R-squared for a regression of household VMT on jobs-housing balance and several measures of household characteristics, the latter included as control variables.

4. Kockelman (1997)
Using 1990 San Francisco Bay Area travel survey data which contains a one-day travel diary for more than 9,000 households, the author measured job accessibility as all jobs within a 30-minute radius by car from the survey respondent's residence. Regression models show that job accessibility has a significant effect on both total and non-work VKT per household.

5. Frank and Pivo (1994)
The authors analyzed the 1989 Puget Sound Transportation Panel survey data, containing approximately 30,000 individual trips made by 1,500 households over a two-day period. The ratio of jobs to households was measured at the census tract level. The average distance of trips ending in balanced census tracts (according to the authors, those with a jobs-to-households ratio of 0.8 to 1.2) was shorter than the average distance of trips ending in unbalanced tracts. This result is a comparison of averages, without controlling for other factors.

6. Yang (2008)
The author used the 1980, 1990, and 2000 Census Transport Planning Package (CTPP) database for Atlanta and Boston census tracts and adopted the "excess commuting" approach to show that the spatial mismatch of different types of jobs and workers can increase commuting distance. Yang compared the minimum required commute distance (MRC) to actual commute distance (AC). The MRC distance was computed by hypothetically assigning persons to jobs to minimize total commuting in the metropolitan area, while the AC distance was the average commuting distance for census tracts in the two study cities. The difference between MRC and AC is "excess commuting" – the amount that people within a city or metropolitan area, on average, commute beyond the minimum required. Excess commuting is often interpreted as either a measure of the extent to which available jobs are not near workers or the extent

to which people willingly choose to live far from work. With excess commuting calculated, Yang defined a "skill mismatch" measure as follows:

a) All job opportunities and employed residents were divided into two categories: high-skilled and low-skilled. The MRC ("old MRC") was computed as described above and then computed again for each census tract, enforcing the constraint that high-skilled workers work in high-skill jobs and similarly matching low-skilled workers and jobs. This is the "new MRC."

b) The difference between the new and old MRCs represents a commuting penalty stemming from the spatial mismatch of different skill categories of jobs and workers. The difference between new and old MRC is the skill mismatch variable. (Note that the new and old MRC, and the difference between the two, is in units of kilometers, km, as all MRCs, AC, and excess commute are distances.)

With the skill mismatch variable calculated, Yang then regressed excess commuting on the skill mismatch variable, other measures of job and resident spatial distribution, and census tract aggregates of population demographic characteristics. Yang found that, in Atlanta, a 1 km increase in "skill mismatch" is associated with a 0.67 km increase in actual commuting distance. He interpreted that as evidence that spatial separation of jobs and housing, adjusting for skills, contributed to longer commute distances in Atlanta.

7. Schleith and Horner (2014)

The authors use data from the Census Longitudinal Employer-Household Dynamics (LEHD) for 2006-2011 for Leon County, Florida, which contains the state capitol, Tallahassee. They identify four employment centers in Leon County, and they calculate excess commute measures for workers in each employment center, dividing workers into three income groups: annual income less than or equal to $15,000, annual income between $15,000 and $40,000, annual income greater than $40,000. Excess commute measures the difference between the observed commutes and the minimum possible commute. The minimum possible commute was calculated for each income group using a linear programming model that calculates the minimum commute distance if each worker lived in the house nearest their job, using the existing spatial distribution of jobs and housing within census blocks. Observed commutes are actual distances traveled based on commute flows reported in the LEHD. Excess commute is the difference between the observed and minimum possible commute distance expressed as a fraction of the observed commute. Schleith and Horner (2014) find larger excess commute for the low income group, suggesting that the low income group either has less ability to live near their workplace or the low income group has less desire to live near their workplace, conditional on the existing spatial distribution of houses and workplaces.

8. Nowlan and Stewart (1991)

Analyzing 1975 to 1988 cordon count data in the downtown Toronto Central Area, the

authors found that since 1976, every 100 additional residents in the Central Area is associated with 70 fewer inbound trips during the morning 3-hour rush period, and every 100 additional dwelling units in the Central Area is associated with 120 fewer inbound trips in the same time period. These results are from a time series regression analysis, with inbound commuting trips regressed on measures of downtown population, dwelling units, jobs, and office space.

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