Data and Methodology:

Location Affordability Index
and
My Transportation Cost Calculator

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The Location Affordability Index

The Location Affordability Index (LAI) is constructed to estimate three dependent variables of transportation behavior (auto ownership, auto use, and transit use) as functions of 14 independent variables (median income, per capita income, average household size, average commuters per household, residential density, gross density, block density, intersection density, transit connectivity, transit frequency of service, transit access shed, employment access, job diversity, and average commute distance). To hone in on the built environment's influence on transportation costs, the independent household variables (income, household size, and commuters per household) are set at fixed values to control for any variation they might cause.

The LAI is also constructed to estimate two dependent variables of housing costs (Selected Monthly Owner Costs and Gross Rent) as functions of 16 independent variables: regional median selected monthly owner costs and regional median gross rent in addition to the 14 variables used in the transportation model.

By establishing and running the model for a "typical household," any variation observed in housing and transportation costs is due to place and location, not household characteristics.

I. Geographic Level and Data Availability

The LAI is constructed at the Census block group level using the 2010 American Community Survey (ACS) 5-year estimates as the primary dataset for input parameters and measured data for the dependent variables. The LAI is constructed to cover all metropolitan and micropolitan areas in the United States, or Core Based Statistical Areas (CBSAs), as defined by the Office of Management and Budget (OMB). Because the 2010 ACS 5-year estimates serve as the primary dataset, this dictates using the 942 CBSAs as defined in 2009 (excluding the 13 regions in Puerto Rico due to data limitations).

II. Basic Index Structure

The LAI's household transportation and housing cost models are based on multidimensional regression analyses in which formulae describe the relationships between five dependent variables (auto ownership, auto use, transit use, selected monthly owner costs, and gross rent) and independent household and local environment variables. Neighborhood level data on household income (both median and per capita), household size, commuters per household, household density (both residential and gross), street connectivity (as measured using block density and intersection density), transit access (using indices for connectivity, frequency of service and area of access), employment access (including a gravity measure, diversity of type, and average commute distance) and regional housing costs (regional median selected monthly owner costs, and regional median gross rent) have been utilized as independent or predictor variables.

To construct the regression equations, each predictor variable was tested separately: first to determine the distribution of the sample and second to test the strength of the relationship to the criterion variables. For this research, the regression analysis was conducted in a comprehensive way, ignoring the distinction between the local environment variables and the household variables, to obtain the best fit possible from all of the independent variables.

The predicted results from each of the transportation component cost models were then multiplied by the appropriate price for each unit—autos, miles, and transit trips—to obtain the cost of that aspect of transportation. Total transportation costs were then calculated as the sum of the three cost components as follows:

$$\text{Household Transportation Costs} = [C_{AO} * F_{AO}(X)] + [C_{AU} * F_{AU}(X)] + [C_{TU} * F_{TU}(X)]$$

Where
- C = cost factor (i.e. dollars per mile)
- F = function of the independent variables (F_{AO} is auto ownership, F_{AU} is auto use, and F_{TU} is transit use)

The estimate of housing cost is modeled directly in the two housing cost models. The rent and ownership costs are then averaged for each block group according to fraction of owners and renters in the following way:

$$\text{Household Housing Costs} = (SMOC * N_O + GR * N_R)/(N_O + N_R)$$

Where
- SMOC = Modeled average selected monthly ownership costs
- GR = Modeled average gross rent
- N_O = Number of owner occupied housing units
- N_R = Number of renter occupied housing units

III. Data Sources

The Index is produced from data drawn from a combination of Federal sources and transit data compiled by the Center for Neighborhood Technology.

- U.S. Census American Community Survey (ACS) – an ongoing survey that generates data on community demographics, income, employment, transportation use, and housing characteristics. 2005-2010 survey data is used in the LAI.
- U.S. Census TIGER/Line Files – contains data on geographical features such as roads, railroads, and rivers, as well as legal and statistical geographic areas.
- U.S. Census Longitudinal Employment-Household Dynamics (LEHD) Origin-Destination Employment Statistics (LODES) – detailed spatial distributions of workers' employment and residential locations and the relation between the two at the Census Block level and characteristic detail on age, earnings, industry distributions, and local workforce indicators (see overview here). LODES and OnTheMap Version 6, which are built on 2010 Census data, are used here.
- AllTransit database – developed by the Center for Neighborhood Technology, this is a compilation of General Transit Feed Specification (GTFS) station and stop data for bus, rail, and ferry service for more than 75 percent of all metropolitan and micropolitan areas in the country with populations larger than 250,000 and 41 percent of those with populations of less than 250,000 (see Appendix A for coverage area)

These data describe relevant characteristics of every census block group in the LAI's coverage area. Census block groups contain between 600 and 3,000 people and vary in size depending on an area's population density, ranging from only a few city blocks to the entirety of some rural counties. Block groups are the smallest geographical unit for which reliable data is available; they can generally be thought of as representing neighborhoods.

IV. Independent Variables

Starting with a pool of potential independent variables representing all of the possible influences on housing and transportation costs for which data was available, independent variables for the model were chosen according to the strength of their correlation with the dependent variables and their statistical significance. This approach resulted in the inclusion of some variables that measure similar phenomenon, such as two measures of household density, or two measures of street connectivity. This duality, however it is manifested, is only useful if the combination of these variables results in a more robust model (as measured by a higher R^2).

Table 1: Overview of Variables

Input	Description	Data Source	Linear Transformation Used
Gross Density	# of households (HH) / total acres	Census ACS, TIGER/Line files	Natural Log
Residential Density	# of households in residential blocks / total acres in residential blocks	Census ACS, TIGER/Line files	Natural Log[1]
Block Density	# of blocks / total land area	Census TIGER/Line files	Square Root
Intersection Density	# of intersections / total land area	Census TIGER/Line files	Square Root
Transit Connectivity Index	Transit access as a function of transit service frequency and proximity to transit nodes, weighted by observed journey to work data	AllTransit database	None
Transit Access Shed	Optimal accessible area by public transportation within 30 minutes and one transfer	AllTransit database	Square Root
Transit Frequency of Service	Service frequency within a Transit Access Shed	AllTransit database	Square Root
Employment Access Index	Number of jobs in area block groups / squared distance of block groups	Census LEHD-LODES	Natural Log
Job Diversity Index	Function of the correlation between employment in 20 different industry sectors and autos per household	Census LEHD-LODES	Natural Log
Average Median Commute Distance	Calculated from data on spatial distributions of workers' employment and residential locations and the relation between the two at the Census Block level	Census LEHD-LODES	Natural Log
Median Household Income		Census ACS	Natural Log

[1] Since the value of Residential Density can legitimately be, and often is, zero (0), the number one (1) was added before taking the natural log.

Input	Description	Data Source	Linear Transformation Used
Average Household Size	Calculated from data on Tenure and Total Population in Occupied Housing Units by Tenure	Census ACS	Square Root
Per-Capita Household Income	Median household income / average household size	Census ACS	Natural Log
Average Commuters per Household	Calculated using the total number of workers 16 years and over who do not work at home	Census ACS	None
Median Selected Monthly Owner Costs[2]	Includes mortgage payments, utilities, fuel, and condominium and mobile home fees where appropriate	Census ACS	Natural Log
Median Gross Rent[2]	Includes contract rent as well as utilities and fuel if paid by the renter	Census ACS	Natural Log

The following detailed descriptions of variables used for the LAI are organized by the five biggest factors that influence transportation costs: density; connectivity and walkability; transit access; employment access and diversity; and individual household characteristics.

A. Household Density

Household density has been found to be one of the largest factors in explaining the variation in all three transportation dependent variables. Various definitions of density have been constructed and tested, and the following two have been utilized in modeling both housing and transportation costs.

Household density is a good example of a measure where using two overlapping variables is better than using one. In this case the measure of residential density is limited in that, for very low-density places, the measure will have the value of zero. However using gross density in conjunction with household density provides the model with more variation in low-density areas; for high-density places, residential density gives a more nuanced estimate. Using both of these two variables results in models that describe more of the variation in the dependent variables and have higher predictive power.

i. Residential Density

Residential Density represents household density of residential areas, in contrast to population density of land area. Total households are obtained at the block level from the 2010 US Census, and TIGER/Line files are used to define blocks. Blocks selected meet the criterion that gross density (households per land acre) must be greater than one. From these selected blocks, land acres and the count of households are aggregated to calculate the total acres of residential blocks and the households within them at the Census block group level.

ii. Gross Density

Gross Density is calculated as total households (from the ACS) divided by total land acres (as calculated using TIGER/Line files).

[2] The Regional Median Selected Monthly Owner Costs and the Regional Median Gross Rent are only used in the housing cost models.

B. Street Connectivity and Walkability

Measures of street connectivity have been found to be good proxies for pedestrian friendliness and walkability. Greater connectivity created by numerous streets and intersections creates smaller blocks and tends to lead to less dependence on automobiles as well as shorter average auto trips, and more use of transit. While other factors clearly have an impact on the pedestrian environment (e.g., crime), the following two measures of street connectivity: block density and intersection density, have been found to be important drivers of auto ownership, auto use, and transit use.

The two variables measure slightly different aspects of walkability. Block density only measures the size of the block, but if the blocks are not well connected, ease of walking is diminished. Intersection density measures how well the streets are connected. Thus, the two measures, together, provide a good proxy for walkability. Both of these two variables are included in all the models as the inclusion of both results in a better description of the variation in the data than either one independently.

i. Block Density

Census TIGER/Line files are used to calculate average block density (in acres) using the number of blocks within the block group divided by the total block group land area.

ii. Intersection Density

To determine intersection density, Census TIGER/Line files are used to identify every street intersection. All thoroughfares in the TIGER/Line files are included (e.g., alleys, interstates, etc.). For each block group, the sum of all intersections (including those on the borders) is calculated and divided by the total land area of the block group.

C. Transit Access

Transit access is measured through *General Transit Feed Specification* (GTFS) data collected and synthesized by CNT. In addition to the publicly available GTFS data provided by a small number of transit agencies, CNT has created GTFS structured datasets utilizing online transit maps and schedules. In many cases, CNT has directly contacted transit agencies to obtain more specific information on stop locations and schedules.[3] All GTFS data is merged into a proprietary dataset known as AllTransit™. AllTransit is an online tool that facilitates the collection, normalization, aggregation, and analysis of GTFS data to determine fixed-route transit service.

To date, CNT has compiled station, stop, and frequency data for bus, rail, and ferry service for all major agencies in all regions with populations greater than 250,000 (with the exception of Dayton, OH; Roanoke, VA; and York-Hanover, PA). Attachment A lists all agencies for which transit data has been compiled. In the regions where these data are not available, CNT has found that a less robust (but still very good) household transportation behavior model can be constructed. Developing a set of models in all regions that does not use the use transit access indicators provides for full coverage in the areas

[3] Sources of publicly available GTFS data include transit agency websites, Google (http://code.google.com/p/googletransitdatafeed/wiki/PublicFeeds), and GTFS Data Exchange (http://www.gtfs-data-exchange.com/). A description of the GTFS data structure and information on how to create your own GTFS feed is available on Google's website (https://developers.google.com/transit/gtfs/).

where these transit access inputs have not yet been measured. These models, that do not use the transit inputs, are then applied to locations where good transit access data is not available.[4]

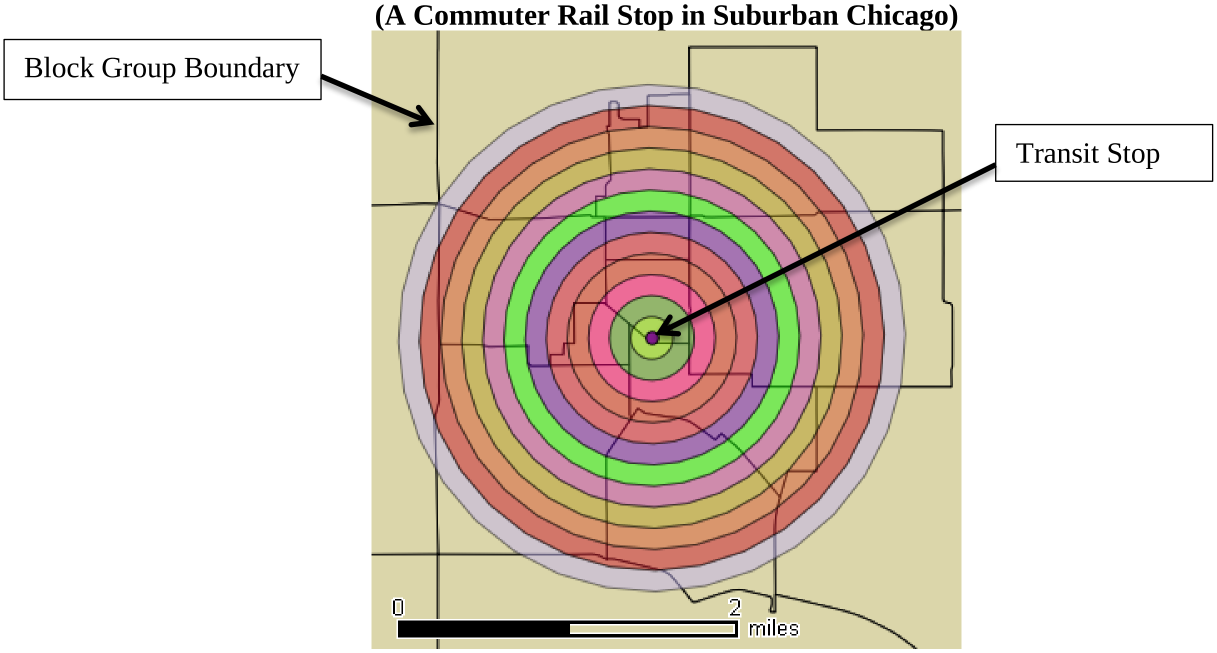
For transit access three different, unique measures—Transit Connectivity Index, Transit Access Shed, and Transit Access Shed Frequency of Service—are combined to contribute to a better model. The Transit Connectivity Index is an estimate of how many transit opportunities are within walking distance. Transit Access Shed is a proxy for how far one can travel on transit in 30 minutes. Finally the Transit Access Shed Frequency of Service relates to overall frequency of service within the block group. While Transit Access Shed Frequency of Service is similar to the Transit Connectivity Index, using it, in conjunction with the other two, results in a better explanation of the variation in household transportation behavior, since it explicitly breaks out frequency of service. Using all three measures together results in a better explanation of the variation in household transportation behavior.

i. Transit Connectivity Index

The Transit Connectivity Index (TCI) is a measure of transit access that CNT developed specifically for use in the household transportation cost model.

To calculate this measure, 12 concentric rings one-eighth of a mile in width were plotted around each transit access point (see Figure 1).

Figure 1: Illustration of 1/8th mile Rings around Transit Stop (A Commuter Rail Stop in Suburban Chicago)



[4] It should be noted that the ongoing sustainability of maintaining transit access data is still under development. Ideally, the LAI will maintain its predictive power as data inputs are continually updated. If an alternative GTFS dataset is identified or developed at a later date, it can be substituted for the AllTransit dataset. There is also the possibility that alternate sources of transit data (other than AllTransit) may provide a more sustainable solution at the price of reducing the predictive power of the model, however no suitable alternative dataset has been identified at this time.

Using these access zones, the following are defined for each block group:

Table 2: Transit Connectivity Variables

Variable	Description
LC	Land area of the block group covered by access zone
SFV	Service frequency value
BLA	Total block group land area

At each block group, twelve transit access values were calculated using the following formula:

$$TCI_{d,bg} = \frac{LC_{d,bg} SFV_{d,bg}}{BLA_{bg}}$$

Where *d* indexes across the twelve concentric circular access zones, and *bg* indexes block group. These values are calculated for every block group that a given zone intersects; meaning that in well-served block groups there may be values for zones corresponding to multiple transit stops.

Figure 2: Central Two Blockgroups (From Figure 1) Showing Access Zone Intersection Areas ($LC_{Ring, Blockgroup}$)

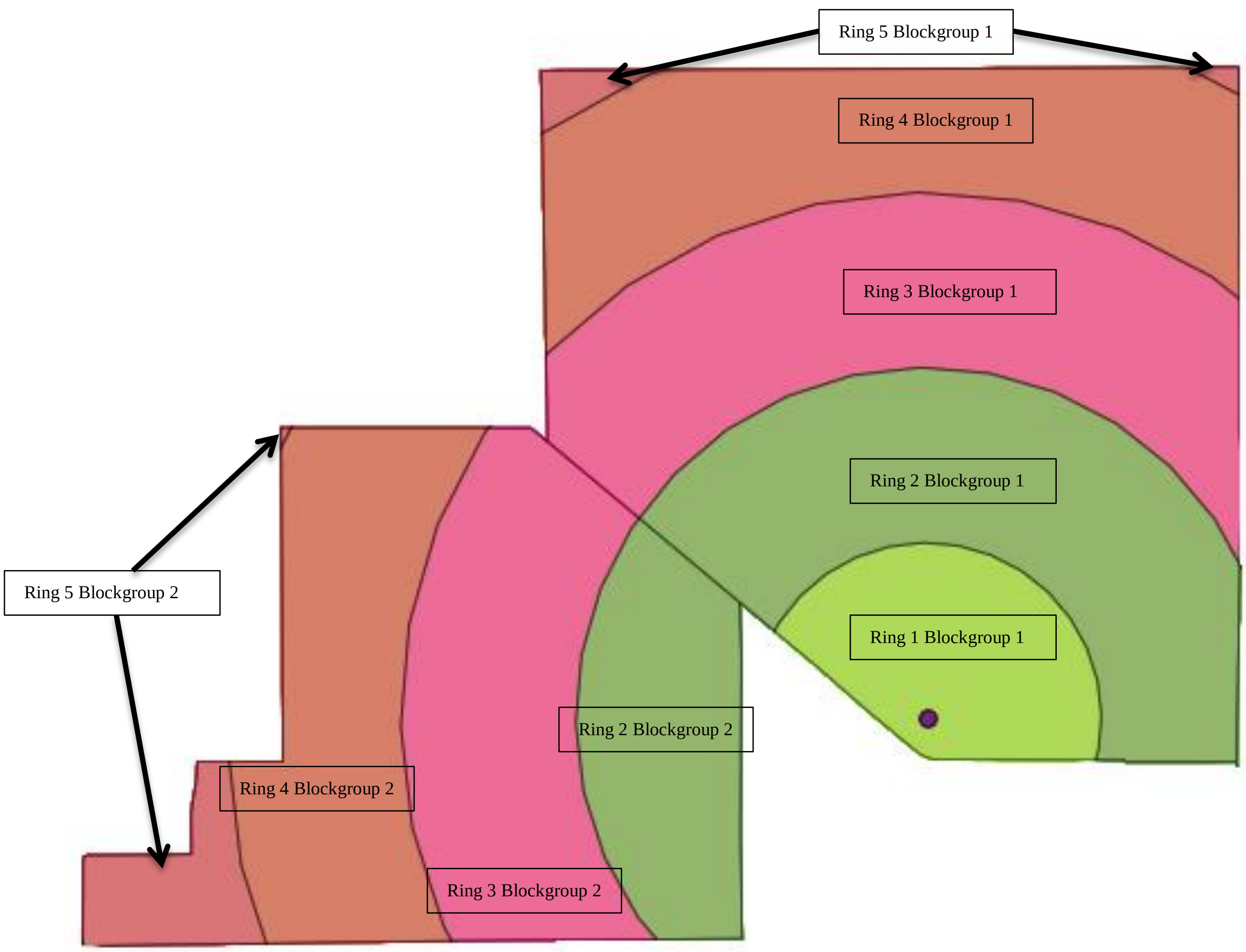
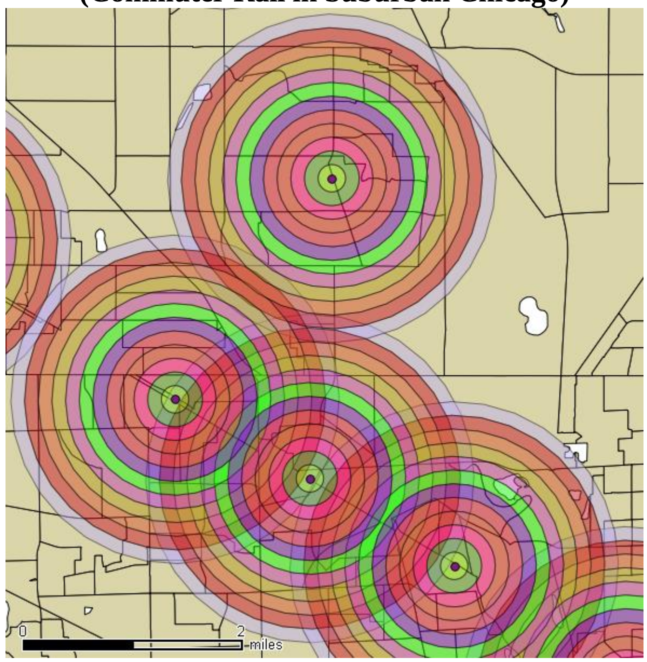


Figure 3: Multiple Transit Zones Showing More Typical Overlapping Rings (Commuter Rail in Suburban Chicago)



The farther an access zone is from its transit node, the less of a contribution it should make to the level of access in any block group it intersects. In order to account for the decreasing access benefits at greater distances from transit nodes, a two stage regression approach is used. Bus service is not the only transit option for many households, and transit use is, to some degree, driven by what type of transit is available. Two sets of access values were calculated, those for buses and those for all other modes (mostly various types of rail: commuter rail, subway, metro, tram, streetcar, light rail, but it also includes ferry service, gondola, funicular and cable cars)[5] and these two measures of transit access are used in developing the TCI. Measured values of percent journey to work by transit were regressed against the 24 access values (as defined above) using the second order flexible form to capture the interaction between the various measures of access to obtain the optimal coefficients. The final value for this index is a number from 0-100 representing the first stage of a fit for the use of transit for commuter's journey to work.

ii. Transit Access Shed:

The Transit Access Shed is defined as the accessible area from any block group within 30 minutes by public transportation. This measure was derived from the GTFS schedules discussed above. For each transit stop, all stops that can be reached within 30 minutes were identified. One transfer within 600 meters of a stop was allowed, and all transfers were padded with 10 minutes of walking and/or waiting. The stops reachable within 30 minutes were all based on the minimum travel time between the two stops, allowing the inclusion of more distant stops that are reachable within 30 minutes via express service. For each origination stop, a quarter-mile buffer was created around the destination stops. Based on the location of the originating stop, the access shed was then aggregated for each stop to the block group by including stops that were within the block group or within a quarter of a mile of its boundary. Finally, the accessible area or Transit Access Shed is calculated by summing the areas

[5] For most regions where only buses are available the value for the non-bus access is zero.

of the quarter-mile buffers around every stop that is within 30 minutes as defined above. In order to assign a value to a Census block group, the Transit Access Shed for all stops within walking distance[6] of the block group are merged into one grand shed. This area is then assigned as the block group's Transit Access Shed.

iii. Transit Access Shed Frequency of Service

The total number of available rides per week for each transit stop used in the Transit Access Shed[6] is averaged to determine the Transit Access Shed Frequency of Service for the given Census block group.

D. Employment Access and Diversity

Employment numbers are calculated using OnTheMap Version 6 which provides Longitudinal Employer-Household Dynamics (LEHD) Origin Destination Employment Statistics (LODES) at the Census block group level. These data are currently unavailable in Massachusetts. CNT created an alternative dataset for this area using 2000 Census block group level data from the Census Transportation Planning Package (CTPP), scaled to 2010 using county level employment estimates from the Bureau of Labor Statistics (BLS). Utilizing a constant share method, the block group level variation from the 2000 CTPP data was preserved, while the 2010 county level BLS data enabled updating to the appropriate time period. The estimates for Massachusetts were then combined with the more comprehensive LODES data available for all other states.

The most recent release of LODES includes, for the first time, data for the District of Columbia as well as data on the count of federal jobs. These data, however, are only available for 2010. Because the ACS data informing much of this work represents the 2006-2010 time period, employment data for 2008 were tested. The same constant share method described above was used to back cast the 2010 LODES data to 2008. The appropriateness of using the 2008 versus the 2010 data was tested in a regression analysis of autos per household. The 2010 data provided a better fit and were therefore used in the final transportation model.

These three measures of employment access provide not only an examination of access to work, but are good surrogates for access to economic activity. While they overlap in what they measure, each have a unique aspect that make them more predictive when used in concert, than when used individually. The Average Median Commute Distance looks only at the access to work, while the Employment Access Index looks at where jobs exist, and thus economic activity (this variable is the most predictive of the three for transportation costs), and finally, the Job Diversity Index is a proxy for the mix of economic activity. These three are used separately in the regressions to obtain the most statistically significant relationships.

i. Employment Access Index

The Employment Access Index is determined using a gravity model which considers both the quantity of and distance to all employment destinations, relative to any given block group. Using an inverse-square law, an employment index is calculated by summing the total number of jobs divided by the square of the distance to those jobs. This quantity allows us to examine both the existence of jobs and the accessibility of these jobs for a given Census block group. Because a gravity model enables consideration of jobs both directly and not directly in a given block group, the employment

[6] Stops within the block group as well as those within a quarter of a mile of the boundary.

access index gives a better measure of job opportunity, and thus a better understanding of job access than a simple employment density measure. This index also serves as a surrogate for access to economic activity.

The Employment Access Index is calculated as:

$$E \equiv \sum_{i=1}^{n} \frac{p_i}{r_i^2}$$

Where

E = Employment Access for a given Census block group

n = total number of Census block groups

p_i = number of jobs in the i^{th} Census block group

r_i = distance (in miles) from the center of the given Census block group to the center of the i^{th} Census block group

As jobs get farther away from the Census block group their contribution to the Employment Access Index is reduced; for example, one job a mile away adds one, but a job 10 miles away adds 0.1. All jobs in all US Census block groups are included in this measure.

ii. Job Diversity Index

Using the job type classifications in the LODES data, a Herfindahl-Hirschman (HH) Index[7] was calculated as a measure of job diversity. Gravity measures of each of the 20 job types were constructed and each of these was tested independently in a regression analysis of autos per household (obtained from the ACS and joined by Census block group). Using the statistical significance as well as the linear coefficients for each job allows the job types to be classified into similar and distinct groups. For example, those that had low correlations with autos per household formed one group; those that were significantly correlated with high positive coefficients were grouped together. Seven distinct groups were found and created. These seven groups were then used to construct a gravity HH Index.

Table 3: Table of Job Categories for Job Diversity Index

Industry Code from LODES	NAIC Two Digit Sectors and Descriptions[8]
12	54 (Professional, Scientific, and Technical Services)
13, 19	55 (Management of Companies and Enterprises) 53 (Real Estate and Rental and Leasing) 81 (Other Services [except Public Administration])
9, 20	51 (Information) 92 (Public Administration)

[7] See http://planningandactivity.unc.edu/Mixed%20land%20uses%20White%20Paper.pdf for more information. This is also referred to in other literature as the Simpson Diversity Index.

[8] See http://lehd.did.census.gov/onthemap/LODES6/LODESTechDoc6.1.pdf, page 6.

Industry Code from LODES	NAIC Two Digit Sectors and Descriptions[8]
1, 2, 3, 11, 15, 16, 17, 18	11 (Agriculture, Forestry, Fishing and Hunting) 21 (Mining, Quarrying, and Oil and Gas Extraction) 22 (Utilities) 53 (Real Estate and Rental and Leasing) 61 (Educational Services) 62 (Health Care and Social Assistance) 71 (Arts, Entertainment, and Recreation) 72 (Accommodation and Food Services)
5, 8, 10	31-33 (Manufacturing) 48-49 (Transportation and Warehousing) 52 (Finance and Insurance)
7	44-45 (Retail Trade)
4, 6, 14	23 (Construction) 42 (Wholesale Trade) 56 (Administrative and Support and Waste Management and Remediation Services)

Because LODES data were not available in Massachusetts, the job type categories available in the CTPP were used and grouped as best as possible into the seven groups of job types found using the LODES data.

iii. Average Median Commute Distance

Average median commute distance was calculated using LODES data. Median distances were calculated for each Census block using Euclidean (as the crow flies) distances between the origin and destination Census blocks. These median Census block values were then averaged to the Census block group to estimate the typical straight line distance from home to work for workers in the Census block group.[9,10] Because LODES data for the state of Massachusetts were not available, in Massachusetts a regression with all of the independent variables was used on the rest of the country to develop a model so as to synthesize a surrogate value for this variable for all block groups within Massachusetts.

E. Household Characteristics

The 2010 American Community Survey (ACS) 5-year estimates serve as the primary data source for the independent variables pertaining to household characteristics.

i. Median Income

Median household income was obtained directly from the ACS.

[9] The time for the journey to work is not available for all Census block groups due to data suppression (which ensures the anonymity of ACS respondents), so it is not included as an independent variable.
[10] LODES data are not available for Massachusetts, so the average commute distance was modeled nationally to create a synthesized estimate to apply to block groups in that state.

ii. Per Capita Income

Per capita income was calculated as median household income divided by average household size.

iii. Average Household Size

Average household size was calculated using Tenure and Total Population in Occupied Housing Units by Tenure to define the universe of Occupied Housing Units.

iv. Average Commuters per Household

Average commuters per household was calculated using the total number of workers 16 years and older who do not work at home from Means of Transportation to Work and Tenure to define Occupied Housing Units. Because Means of Transportation to Work includes workers not living in occupied housing units (i.e., those living in group quarters), the ratio of Total Population in Occupied Housing Units to Total Population was used to scale the count of commuters to better represent those living in households.

V. Dependent Variables

A. Auto Ownership

For the dependent variable of auto ownership, the regression analysis was fit using measured data on auto ownership obtained from the ACS. Aggregate Number of Vehicles Available by Tenure defined the total number of vehicles and Tenure defined the universe of Occupied Housing Units. Average vehicles per occupied housing unit were calculated.

B. Auto Use

For the dependent variable of auto use, the regression analysis was fit using measured data representing the total amount households drive their autos, or vehicle miles traveled (VMT) per automobile. Odometer readings were used to determine the amount that households drive their autos. Odometer readings for 2007 through 2009 were obtained in Illinois for the Chicago and St. Louis metro areas. In this dataset, over 660,000 matched records (two records for one vehicle identification number (VIN)) were used to calculate the change in odometer readings to provide VMT estimates. The geographic area that the data covers includes a variety of place types from rural to large city, which provides a very good data set to calibrate a model. The validity of this data set for the entire country is ensured by examining national driving records from the National Household Travel Survey. Data were obtained geographically identified with ZIP+4™ and then assigned to Census block groups. Automobiles were matched using the vehicle VIN, and the total distance driven was determined over the time period between inspections.

The final value of VMT includes an additional factor of eight percent. This factor compensates for the fact that the vehicles in this sample were all five years old or older. To reduce any bias in the model, this factor is estimated by comparing the 2009 National Household Travel Survey (NHTS) to the modeled value of the NHTS field ANNMILES, which is the self-reported miles driven for each auto. The full eight percent compensates for the age of the vehicles, as well as any other bias that may occur from the limited data sample from Illinois used to calibrate the model.

C. Transit Use

Because no direct measure of transit use is available at the block group level, a proxy was utilized for the measured data to represent the dependent variable of transit use. From the ACS, Means of Transportation to Work was used to calculate a percent of commuters utilizing public transit.

D. Housing Costs

Median Selected Monthly Owner Costs (SMOC) for households with a mortgage and Median Gross Rent (GR), both at the block group level from the ACS 5-year estimates, serve as the dependent variables in these regression analyses. The same set of independent variables as used in the transportation model are used in the housing model, with the addition of regional median SMOC and regional median GR.

VI. Regression Analysis

In the LAI, the transportation and housing models are constructed using Ordinary Least Squares (OLS) regression analysis with a second order flexible functional form. This flexible form takes into consideration all the independent variables as well as the interaction between them, i.e., residential density and block size are separate inputs; the combination of the two are also used as inputs. Both the independent and dependent[11] variables were transformed and linearized[12] in this regression analysis. The choice of transformation was made to optimize the distribution of the variables such that the distribution of the transformed variable was the most Gaussian or Normal. The same transformation is used on the independent variable for all models (see Table 1 for the transformations used). All Census block groups in the CBSAs in which data suppression was not present were used to regress auto ownership, transit use, selected monthly ownership costs, and gross rent. All Census block groups covered by the Illinois odometer data (see previous section) were used for the auto use regression.

As previously indicated, GTFS data used to calculate the independent variables of transit access are not available in all regions. Consequently, two regressions are fit and two models constructed for each dependent variable: one for regions with transit data (***w/Transit model***) that includes the transit measures as independent variables, and one for all regions (***Full model***) that does not use the transit measures as independent variables (since they are unavailable in a small subset of regions). When applying the models, the ***w/Transit model*** is used, but for the small subset of regions where transit data has not yet been collected the ***Full model*** is used.

Additionally, because there is an inherent spatial autocorrelation for the dependent variables, a robust variance calculation is employed to estimate the statistical significance of the regression coefficients. The method for estimating the error on the coefficients uses geographical clustering. Three natural geographical clustering definitions were tested: state, county and CBSA. The testing showed that the errors estimate increased (as expected) when using this robust approach, and that the state clustering increased the error estimate the least, with the county and CBSA clustering having similar estimates; therefore the CBSA clustering was employed. This method results in a better estimate of the probability that a coefficient is insignificant (often referred to as the p-value). The criteria used to include a

[11] Only the housing cost dependent variables using a linear transformation (natural log).
[12] The linearization transformations were limited to either the square root or the natural log of the variable.

coefficient in the final model is that the p-value is less than 0.05 or 5 percent; this is a very commonly used criteria in regression analysis.

There is a high probability that the independent variables are multi-collinear. To eliminate as much of this as possible, the variance inflation factor (VIF)[13] was examined. After eliminating the coefficients with high p-value, the VIF is required to be less than 20. Although this is somewhat higher than commonly used (often the criteria is set at 10), the values for this analysis tended to be greater than 10,000 to begin with, and drop perceptibly as highly multi-collinear coefficients are excluded.

[13] For a definition of VIF see http://en.wikipedia.org/wiki/Variance_inflation_factor.

Table 4: Modeling Summary | X = Independent Variable Used in Fit | Grey Cells Mean Not Included Intentionally

	Autos per Household Full	Autos per Household w/Transit	Transit Use Full	Transit Use w/ Transit	Auto Use Full	Auto Use w/Transit	SMOC Full	SMOC w/Transit	Gross Rent Full	Gross Rent w/ Transit
Adjusted R^2	75.1%	77.7%	57.7%	71.7%	75.4%	77.2%	65.2%	65.0%	51.9%	51.8%
Independent Variable										
Gross Density	X	X	X	X	X	X		X	X	X
Residential Density	X	X	X	X	X	X		X	X	X
Block Density		X				X	X	X	X	X
Intersection Density		X			X	X		X		
Transit Connectivity Index		X		X		X				X
Transit Access Shed		X		X		X				X
Transit Frequency of Service		X		X		X				X
Employment Access Index	X	X	X	X	X	X	X	X	X	X
Job Diversity Index	X				X	X	X	X	X	X
Average Median Commute Distance		X		X	X	X	X	X	X	X
Median Household Income	X			X	X		X	X		X
Average Household Size	X	X	X	X	X	X	X	X	X	X
Per-capita Household Income		X	X		X	X	X	X	X	X
Average Commuters per Household	X	X	X	X	X	X	X	X	X	X
Median Selected Monthly Owner Costs							X	X	X	X
Median Gross Rent							X	X	X	X

Table 4 summarizes the results of all of the regression analyses. An "X" indicates a statistically significant and non-collinear coefficient has been determined for either the term itself, the square of the term, and/or an interaction term with another independent variable. The entire set of cross terms used in the models with their coefficients and values can be found in Appendix B: Regression Coefficients .

For the housing cost models, the final results are scaled to include the residuals from the fit. This additional step is included in the process to approximate housing cost changes that are not captured by the modeling process. For example, housing costs in a given neighborhood may be low because they are in the flight path of an airport. Alternatively, another neighborhood that overlooks a beautiful mountain view may have enhanced values. Introducing the fit residuals into the estimate should compensate for these local affects to some extent.

VII. Transportation Cost Calculation

As discussed, the transportation model in the LAI estimates three components of travel behavior: auto ownership, auto use, and transit use. To calculate total transportation costs, each of these modeled outputs was multiplied by a cost per unit (e.g., cost per mile) and then summed to provide average values for each block group.

A. Auto Ownership and Auto Use Costs

The Consumer Expenditure Survey (CES) from US Bureau of Labor Statistics is the basis for the auto ownership and auto use cost components of the LAI. New research conducted by Diane Schanzenbach, PhD and Leslie McGranahan PhD examined expenditures based on the 2005-2010 waves of the CES, which include a range of new and used autos. This research advanced the effort to overcome limitations of other measures that focused primarily on autos less than five years old. Based on the research, expenditures are represented in inflation-adjusted 2010 dollars using the Consumer Price Index for all Urban Consumers (CPI-U). Expenses are then segmented by five ranges of household income ($0-$20,000; $20,000-$40,000; $40,000-$60,000; $60,000-$100,000; and, $100,000 and above) and applied to the modeled autos per household and annual VMT for the appropriate income range.

Expenditures related to the purchase and operation of cars and trucks are divided into five categories:

- Average annual service flow value[14] from the time the vehicle was purchased to the time the consumer responded to the CES;
- Average annual finance charge paid;
- Ownership Costs: cost of continuing to own a purchased vehicle even if it is not driven;
- Drivability Costs: cost of keeping the vehicle in drivable shape, e.g. maintenance and repairs; and
- Driving Costs: cost of the fuel used to drive the vehicle.

Table 5: Per-Vehicle Costs by Income Group Among Households with at Least One Vehicle

Income group number and range	Average Annual Service Flow (1)	Finance Charges (2)	Per vehicle (fixed) ownership costs (3)	Per vehicle (variable) drivability costs (4)	Per vehicle fuel costs (5)	Number of vehicles (6)	Average Ratio drivability to fuel costs (7)
1 ($0-$20,000)	$2,396	$73	$657.3	$400.8	$1,182.0	1.4	0.34
2 ($20,000-$40,000)	$2,478	$133	$732.0	$421.1	$1,369.5	1.6	0.31
3 ($40,000-$60,000)	$2,586	$182	$755.6	$458.8	$1,494.2	1.9	0.31
4 ($60,000-$100,000)	$2,727	$211	$758.6	$477.6	$1,552.8	2.2	0.31
5 ($100,000 & above)	$3,139	$201	$836.6	$593.1	$1,635.6	2.5	0.36
Overall average	$2,717	$165	$752.5	$474.5	$1,460.9	1.9	0.32

[14] Service flow is the average annual dollar amount of depreciation the vehicle has lost over the time of ownership.

The calculation of auto cost:

$$Cost = A * (V_{sf} + V_{fc} + V_{fixed}) + \left(\frac{VMT}{MPG}\right) * G * (1 + R)$$

Where

A = Modeled autos per household
V_{sf} = Per vehicle service flow cost from **Table 5** (1) – for the appropriate income group
V_{fc} = Per vehicle finance charge from **Table 5** (2) – for the appropriate income group
V_{fixed} = Per vehicle (fixed) ownership cost from **Table 5** (3) – for the appropriate income group
VMT = the modeled annual household VMT
MPG = the national average fuel efficiency (20.7 mpg for 2008)
G = the cost of gas per gallon (average annual regional cost for 2008 - DOE[15])
R = the Average Ratio drivability to fuel cost from **Table 5** (7) – for the appropriate income group

B. Transit Use Costs

The 2008 National Transit Database (NTD) served as the source for transit cost data. Specifically, directly operated and purchased transportation revenue were used.[16] The transit revenue, as reported by each of the transit agencies in the NTD, was assigned to agencies and related geographies where GTFS data were collected. This transit revenue was then allocated to the metropolitan areas served based on the percentage of each transit agency's bus and rail stations within the primary versus surrounding metropolitan areas. For example, if a transit agency had a total of 500 bus stops and 425 of those stops were located in the primary metropolitan area and 75 stops extend into a neighboring metropolitan area, the primary metropolitan area received 85 percent of the transit revenue and the neighboring metropolitan area received 15 percent.

To estimate average household transit costs, each metropolitan area's estimated transit revenue was then allocated to block groups based on the modeled value of the percentage of transit commuters and the total households within each block group. This was done by calculating the number of transit commuters for each block group, summing across block groups to estimate the total number of transit commuters in the metropolitan area, and then allocating the metro-wide transit revenue to block groups according to the proportion of the region's commuters living in each. The average household transit cost for each block group was then derived by dividing that block group's allocation of transit revenue by number of households.

This same method of allocating regional transit revenues to block groups was also used for allocating transit trips. Using the overall unlinked trip numbers also reported to the NTD, the average number of household transit trips for each block group was estimated by finding the total number of annual trips in each metropolitan area and allocating them proportionally to block groups based on number of households and the percent of journey to work trips.[17]

There are a number of metropolitan areas for which GTFS data are not available and/or there was no revenue listed in the NTD. In these cases, the national transit cost average from the allocation calculation described in the previous paragraph was used for these metropolitan areas. The average

[15] http://www.eia.gov/petroleum/gasdiesel/
[16] Demand response revenue is not factored into this analysis.
[17] This normalization method carries the implicit assumption that the transit use for the journey to work is a good surrogate for overall transit use.

transit costs were then allocated to the block group level based on the percentage of transit commutes and household commuter counts. The end result was an average household transit cost at the block group level.

VIII. Housing Cost Calculation

Using the modeled SMOC and GR, the weighted average was calculated for each block group using the ratio of owners to renters in that block group. Because median costs are not necessarily representative of the costs for varying household types, constructing these models using household characteristics as inputs enabled costs to be estimated for households of varying size, income, and number of commuters. The ranges of SMOC and GR in a given block group were used to top-code (or bottom-code) the resulting estimates. That is, the supply of housing in a given block group (as captured through SMOC and GR) was used to evaluate whether the estimated costs were more or less than those that exist in that area; in these cases, the estimate was adjusted accordingly. The limits are set using the 10^{th}-pecentile for the minimum value and the 90^{th}-percentile for the maximum, i.e. if the modeled value for these costs is outside that range, the value is adjusted to these limits. For each block group, estimated SMOC and GR averaged by the ratio of owner- to renter-occupied housing units were used.

IX. Constructing the Location Affordability Index

Because the LAI is constructed to estimate three dependent variables of transportation behavior (auto ownership, auto use, and transit use) and two housing costs variables, all as functions of independent variables, any set of independent variables can be altered to determine how the outputs are affected. As a way to focus on the built environment, the independent household variables (income, household size, and commuters per household) are set at fixed values. This controls for any variation in the dependent variables that is a function of household characteristics, leaving the remaining variation a sole function of the built environment. In other words, by establishing and running the model for a “typical household,” any variation observed in transportation costs is due to place and location, not household characteristics.

As shown on the Location Affordability Portal, the LAI has been constructed for various household types. These household types are defined by household income, household size, and number of commuters per household and were developed through consultation with HUD and various stakeholders.

My Transportation Cost Calculator Methodology

My Transportation Cost Calculator (MTCC) allows users to customize data from the Location Affordability Index (LAI) to estimate their combined housing and transportation costs for specific locations and compare these estimates across multiple potential locations. Like the LAI, the MTCC covers 942 U.S. Metropolitan and Micropolitan areas.

I. Functionality and Use

Based on user-provided personal household information and the urban form, the MTCC estimates a household's combined housing and transportation costs for a selected location. These costs are calculated for both the user's household and a comparison household with a similar household profile (household size, income, and number of commuters) (see section D below). The user may select as many locations as desired for comparison. The tool provides users an understanding of the combined costs of housing and transportation, how they vary from place to place, and how individual choices affect these costs.

II. User Interface and Inputs

MTCC users begin by entering a residential address. This address may be a current address or another location under consideration. After entering the address, a marker shows the location on the map.

Five tabs on the Calculator correspond to the five components used to estimate household cost for a location: (1) household, (2) housing costs, (3) vehicle ownership, (4) vehicle use, and (5) transit use. After selecting a location, users then enter information about their specific household characteristics. Each of the subsequent component tabs give the user the option of entering their specific household information or using the provided modeled value for a similar household. Tools are also provided in each of the components to help the user determine their specific costs rather than using the modeled value.

Table 6: User Inputs and Modeled Data

Tab	User Data	Modeled Data for Similar Household	Additional Functions
Household	Household size, gross annual household income, number of workers who commute, and whether the user owns or rents		
Housing	Total monthly housing cost	Monthly housing costs	Calculation tool breaks out cost components for monthly housing. For owners, costs include mortgage, taxes, insurance, association fees and utilities. For renters, costs include rent and utilities.

Tab	User Data	Modeled Data for Similar Household	Additional Functions
Vehicles	Cost per gallon of gas, number of vehicles owned, estimated miles per gallon and monthly vehicle cost for each vehicle	Monthly vehicle costs	Calculation tool breaks out cost components for monthly vehicle cost. For monthly vehicle cost, expenses for depreciation, car payment, insurance, license, registration and taxes, repairs and maintenance, parking and tolls, and other are included. Also provided is the option to calculate depreciation cost based on vehicle age and purchase price.
Driving	Monthly miles driven	Monthly miles driven	Calculation tool that allows user to enter workplace addresses and non-commuting miles driven, which make the monthly mileage estimate more accurate.[18]
Transit Use	Monthly transit costs	Monthly transit costs	Calculation tool using trips and fare information.

III. Calculated Outputs for Your Household

Based on the household and transportation information entered, the MTCC determines estimated annual housing and transportation costs for the location entered, which is displayed under the Results tab. Transportation costs are comprised of vehicle ownership and usage cost, and transit cost. Housing cost is calculated from the monthly housing costs entered. The user can edit any of their inputs for an updated cost estimate. For instance, the user may add or subtract a vehicle, or increase or decrease VMT and transit use, to see the effect on total costs.

IV. Modeled Output Variables for a Similar Household

In addition to a household's cost results, the MTCC determines values for a "Similar Household." A "Similar Household" is defined as a household with the same household profile: the same size, gross annual income, number of workers who commute, and housing ownership type. The costs shown for the "Similar Household" are modeled costs retrieved from the LAI. These modeled values include monthly housing cost, average number of vehicles owned, monthly miles driven, and monthly transit cost. As the user fills in their household information, the modeled information for the "Similar Household" is shown, and the user may elect to use these modeled results for their household costs. Using the modeled information, the Results page displays calculated annual cost of vehicle ownership, vehicle usage, transit cost and housing cost.

The combined annual housing and transportation costs for the user's household and the "Similar Household" combined costs are calculated and shown both as a table and graphically. The user also has the option to see these results as monthly figures.

[18] The percentages assigned to different trip types are based on the 2009 National Household Travel Survey, which indicates, on average, a household's workplace commute is 28 percent of their total VMT.

Appendix A: All Transit Agency Coverage

Agency	Metro
Kent State University Campus Bus Service	Akron, OH
METRO	Akron, OH
Portage Area Regional Transportation Authority (PARTA)	Akron, OH
Albany Transit System	Albany-Lebanon, OR
Capital District Transportation Authority	Albany-Schenectady-Troy, NY
ABQ Ride	Albuquerque, NM
New Mexico Rail Runner Express	Albuquerque, NM
Lehigh and Northampton Transportation Authority	Allentown-Bethlehem-Easton, PA-NJ
Amarillo City Transit	Amarillo, TX
Ames Transit Agency (Cyride)	Ames, IA
People Mover	Anchorage, AK
Ann Arbor Transit Authority	Ann Arbor, MI
Areawide Community Transportation System (ACTS)	Anniston-Oxford, AL
Valley Transit System	Appleton, WI
Asheville Transit	Asheville, NC
Sunset Empire Transportation District	Astoria, OR
Athens Transit	Athens-Clarke County, GA
Buckhead Uptown Connection	Atlanta-Sandy Springs-Marietta, GA
Cherokee Area Transit System	Atlanta-Sandy Springs-Marietta, GA
GCT (Gwinnett County Transit)	Atlanta-Sandy Springs-Marietta, GA
GRTA	Atlanta-Sandy Springs-Marietta, GA
MARTA (Metro Atlanta)	Atlanta-Sandy Springs-Marietta, GA
NJ Transit	Atlantic City-Hammonton, NJ
Phenix City Express	Auburn-Opelika, AL
Augusta Public Transit	Augusta-Richmond County, GA-SC
Capital Metropolitan Transportation Authority	Austin-Round Rock-San Marcos, TX
Golden Empire Transit District	Bakersfield-Delano, CA
Kern Regional Transit	Bakersfield-Delano, CA
Annapolis Transit (City DOT)	Baltimore-Towson, MD
Central Maryland Regional Transit	Baltimore-Towson, MD
Charm City Circulator	Baltimore-Towson, MD
Harford County Transportation Services (HCTS)	Baltimore-Towson, MD
Howard Transit (Howard County)	Baltimore-Towson, MD
MTA (Maryland Transit Authority)	Baltimore-Towson, MD
Prince George's County (The Bus)	Baltimore-Towson, MD
The BAT	Bangor, ME
Cape Cod Regional Transit Authority	Barnstable Town, MA
Capital Area Transit System	Baton Rouge, LA
Battle Creek Transit	Battle Creek, MI
Bay Metro	Bay City, MI
Port Arthur Transit	Beaumont-Port Arthur, TX
Cascades East Transit	Bend, OR
Billings MET Transit	Billings, MT
Birmingham Jefferson County Transit Authority	Birmingham-Hoover, AL

Bis-Man Transit	Bismarck, ND
Blacksburg Transit	Blacksburg-Christiansburg-Radford, VA
Bloomington Transit	Bloomington, IN
Bloomington-Normal Public Transit System	Bloomington-Normal, IL
Valley Ride	Boise City-Nampa, ID
Brockton Regional Transit Authority	Boston-Cambridge-Quincy, MA-NH
Burlington	Boston-Cambridge-Quincy, MA-NH
CATA (Cape Ann Transportation Authority)	Boston-Cambridge-Quincy, MA-NH
GATRA (Greater Attleboro-Taunton Regional Transit Authority)	Boston-Cambridge-Quincy, MA-NH
LexExpress (Town of Lexington)	Boston-Cambridge-Quincy, MA-NH
Lowell Regional Transit Authority	Boston-Cambridge-Quincy, MA-NH
MBTA (Mass Bay Transit Authority)	Boston-Cambridge-Quincy, MA-NH
MetroWest RTA	Boston-Cambridge-Quincy, MA-NH
MVRTA (Merrimack Valley Regional Transit Authority	Boston-Cambridge-Quincy, MA-NH
Regional Transit District (RTD)	Boulder, CO
Kitsap Transit (KT)	Bremerton-Silverdale, WA
CT Transit Stamford	Bridgeport-Stamford-Norwalk, CT
Greater Bridgeport Transit Authority	Bridgeport-Stamford-Norwalk, CT
Housatonic Area Regional Transit (HART)	Bridgeport-Stamford-Norwalk, CT
Norwalk Transit District	Bridgeport-Stamford-Norwalk, CT
UTA (Utah Transit Authority)	Brigham City, UT
Curry Public Transit	Brookings, OR
Brownsville Urban System	Brownsville-Harlingen, TX
Niagara Frontier Transportation Authority	Buffalo-Niagara Falls, NY
Chittenden County Transportation Authority	Burlington-South Burlington, VT
Stark Area Regional Transit Authority (SARTA)	Canton-Massillon, OH
LeeTran	Cape Coral-Fort Myers, FL
Casper Area Transportation Coalition	Casper, WY
Cedar Rapids Transit	Cedar Rapids, IA
CUMTD (Champaign-Urbana Mass Transit District)	Champaign-Urbana, IL
Kanawha Valley Regional Transportation Authority	Charleston, WV
Charleston Area Regional Transportation Authority	Charleston-North Charleston-Summerville, SC
Charlotte Area Transit System (CATS)	Charlotte-Gastonia-Rock Hill, NC-SC
Gastonia Transit	Charlotte-Gastonia-Rock Hill, NC-SC
Rider (Concord)	Charlotte-Gastonia-Rock Hill, NC-SC
STS (City of Salisbury Transit System)	Charlotte-Gastonia-Rock Hill, NC-SC
Charlottesville Transit Service	Charlottesville, VA
Chattanooga Area Regional Transportation Authority	Chattanooga, TN-GA
Cheyenne Transit Program	Cheyenne, WY
Chicago Transit Authority	Chicago-Joliet-Naperville, IL-IN-WI
ECT (East Chicago Transit)	Chicago-Joliet-Naperville, IL-IN-WI
GPTC (Gary Public Transportation Corporation)	Chicago-Joliet-Naperville, IL-IN-WI
Huskie Bus Line	Chicago-Joliet-Naperville, IL-IN-WI
Kenosha Area Transit	Chicago-Joliet-Naperville, IL-IN-WI
Metra	Chicago-Joliet-Naperville, IL-IN-WI
Northern Indiana Commuter Transportation District	Chicago-Joliet-Naperville, IL-IN-WI
PACE	Chicago-Joliet-Naperville, IL-IN-WI

Regional Bus Authority (Hammond Transit System)	Chicago-Joliet-Naperville, IL-IN-WI
TransVAC	Chicago-Joliet-Naperville, IL-IN-WI
V-Line	Chicago-Joliet-Naperville, IL-IN-WI
Butte Regional Transit (B-Line)	Chico, CA
Southwest Ohio Regional Transit Authority (SORTA)	Cincinnati-Middletown, OH-KY-IN
TANK (Transit Authority of Northern Kentucky)	Cincinnati-Middletown, OH-KY-IN
Clarksville Transit System	Clarksville, TN-KY
GCRTA (Greater Cleveland Regional Transit Agency)	Cleveland-Elyria-Mentor, OH
Laketran	Cleveland-Elyria-Mentor, OH
Lorain County Transit	Cleveland-Elyria-Mentor, OH
The District	College Station-Bryan, TX
Mountain Metropolitan Transit (Springs Transit)	Colorado Springs, CO
Columbia Transit	Columbia, MO
Central Midlands RTA	Columbia, SC
Metra	Columbus, GA-AL
COTA (Central Ohio Transit Authority)	Columbus, OH
DATA (Delaware Area Transit Authority)	Columbus, OH
Coos County Area Transit	Coos Bay, OR
The B	Corpus Christi, TX
Corvallis Transit System	Corvallis, OR
Oskaloosa County Transit	Crestview-Fort Walton Beach-Destin, FL
DART (Dallas Area Rapid Transit Authority)	Dallas-Fort Worth-Arlington, TX
Denton County Transit Authority	Dallas-Fort Worth-Arlington, TX
Fort Worth Transportation Authority(The T)	Dallas-Fort Worth-Arlington, TX
Danville Mass Transit	Danville, IL
Bettendorf Transit	Davenport-Moline-Rock Island, IA-IL
Davenport Citibus	Davenport-Moline-Rock Island, IA-IL
Quad Cities MetroLINK	Davenport-Moline-Rock Island, IA-IL
Decatur Public Transit System	Decatur, IL
Votran	Deltona-Daytona Beach-Ormond Beach, FL
Regional Transit District (RTD)	Denver-Aurora-Broomfield, CO
Des Moines Area Regional Transit Authority	Des Moines-West Des Moines, IA
Detroit Department of Transportation	Detroit-Warren-Livonia, MI
Detroit People Mover	Detroit-Warren-Livonia, MI
SMART (Suburban Mobility Authority for Regional Transit)	Detroit-Warren-Livonia, MI
Delaware Transit Corporation	Dover, DE
Keyline Transit	Dubuque, IA
Duluth Transit Authority	Duluth, MN-WI
Chapel Hill Transit	Durham-Chapel Hill, NC
Durham Area Transit Authority	Durham-Chapel Hill, NC
Triangle Transit Authority	Durham-Chapel Hill, NC
Monroe County Transit Authority	East Stroudsburg, PA
Eau Claire Transit	Eau Claire, WI
Eagle County Transit	Edwards, CO
Vail Transit	Edwards, CO
Sun Metro	El Paso, TX
Interurban Trolley	Elkhart-Goshen, IN

Erie Metropolitan Transit Authority	Erie, PA
Lane Transit District	Eugene-Springfield, OR
Arcata & Mad River Transit	Eureka-Arcata-Fortuna, CA
Eureka Transit Service	Eureka-Arcata-Fortuna, CA
Redwood Transit System	Eureka-Arcata-Fortuna, CA
Trinity Transit	Eureka-Arcata-Fortuna, CA
Evansville Transit System	Evansville, IN-KY
Henderson Area Rapid Transit	Evansville, IN-KY
Metropolitan Commuter System	Fairbanks, AK
Fairmont Marion County Transit Authority	Fairmont, WV
Metro Area Transit	Fargo, ND-MN
Fayetteville Area Transit System	Fayetteville, NC
Ozark Regional Transit	Fayetteville-Springdale-Rogers, AR-MO
Razorback	Fayetteville-Springdale-Rogers, AR-MO
Mountain Line Transit	Flagstaff, AZ
Mass TA	Flint, MI
Pee Dee Regional Transit Authority	Florence, SC
Fond du Lac Area Transit	Fond du Lac, WI
COLT (Loveland)	Fort Collins-Loveland, CO
Transfort (Fort Collins)	Fort Collins-Loveland, CO
Fort Smith Transit	Fort Smith, AR-OK
Citilink	Fort Wayne, IN
Fresno Area Express	Fresno, CA
Gadsden Transportation Services	Gadsden, AL
Regional Transit System	Gainesville, FL
Greater Glens Falls Transit	Glens Falls, NY
GATEWAY (Goldsboro-Wayne Transit Authority)	Goldsboro, NC
Grand Forks Transit	Grand Forks, ND-MN
Grand Valley Transit	Grand Junction, CO
The Rapid	Grand Rapids-Wyoming, MI
The Bus	Greeley, CO
Green Bay Metro	Green Bay, WI
Greensboro Transit Authority	Greensboro-High Point, NC
HI-TRAN	Greensboro-High Point, NC
Greenville Area Transit	Greenville, NC
Clemson Area Transit	Greenville-Mauldin-Easley, SC
Greenlink	Greenville-Mauldin-Easley, SC
Coast Transit Authority	Gulfport-Biloxi, MS
Washington County Transit (County Commuter)	Hagerstown-Martinsburg, MD-WV
Harrisburg Capital Area Transit (CAT)	Harrisburg-Carlisle, PA
Harrisonburg Public Transit	Harrisonburg, VA
CT Transit Bristol	Hartford-West Hartford-East Hartford, CT
CT Transit Hartford	Hartford-West Hartford-East Hartford, CT
CT Transit New Britain	Hartford-West Hartford-East Hartford, CT
Middletown Transit District	Hartford-West Hartford-East Hartford, CT
Western Piedmont Regional Transit Authority	Hickory-Lenoir-Morganton, NC
MAX - Macatawa Area Express	Holland-Grand Haven, MI
The Bus	Honolulu, HI

Columbia Area Transit	Hood River, OR
Island Transit	Houston-Sugar Land-Baytown, TX
Metro	Houston-Sugar Land-Baytown, TX
Uptown Shuttle	Houston-Sugar Land-Baytown, TX
Tri-State Transit Authority	Huntington-Ashland, WV-KY-OH
City of Huntsville Public Transportation	Huntsville, AL
IndyGO	Indianapolis-Carmel, IN
Coralville Transit	Iowa City, IA
Iowa City Transit	Iowa City, IA
University of Iowa Cambus	Iowa City, IA
Tompkins Consolidated Area Transit (TCAT)	Ithaca, NY
JATRAN	Jackson, MS
Jacksonville Transportation Authority	Jacksonville, FL
Johnson City Transit System	Johnson City, TN
CamTRAN	Johnstown, PA
Capital Transit	Juneau, AK
Kalamazoo Metro Transit	Kalamazoo-Portage, MI
RVMMTD (River Valley Metro Mass Transit District)	Kankakee-Bradley, IL
Kansas City Area Transit Authority (KCATA)	Kansas City, MO-KS
The Jo	Kansas City, MO-KS
Ketchikan Gateway Borough Transit System	Ketchikan, AK
Central Texas HOP	Killeen-Temple-Fort Hood, TX
Bristol TN Transit System	Kingsport-Bristol-Bristol, TN-VA
Kingsport Area Transit System	Kingsport-Bristol-Bristol, TN-VA
Basin Transit	Klamath Falls, OR
Knoxville Area Transit	Knoxville, TN
La Crosse MTU	La Crosse, WI-MN
City Bus of Greater Lafayette	Lafayette, IN
Lafayette Transit System	Lafayette, LA
Lake Charles Transit	Lake Charles, LA
Citrus Connection	Lakeland-Winter Haven, FL
Red Rose Transit Authority	Lancaster, PA
Capital Area Transportation Authority	Lansing-East Lansing, MI
RoadRunner Transit	Las Cruces, NM
Las Vegas Monorail Company	Las Vegas-Paradise, NV
Regional Transportation Commission of Southern Nevada (RTC)	Las Vegas-Paradise, NV
KU Transit	Lawrence, KS
Lawrence Transit System	Lawrence, KS
LexTran	Lexington-Fayette, KY
Allen County Regional Transit Authority	Lima, OH
StarTrans	Lincoln, NE
Central Arkansas Transit	Little Rock-North Little Rock-Conway, AR
Longview Transit	Longview, TX
Alhambra Community Transit	Los Angeles-Long Beach-Santa Ana, CA
Beach Cities Transit - City of Redondo Beach (BCT)	Los Angeles-Long Beach-Santa Ana, CA
Beeline	Los Angeles-Long Beach-Santa Ana, CA
Bellflower Bus	Los Angeles-Long Beach-Santa Ana, CA

Big Blue Bus	Los Angeles-Long Beach-Santa Ana, CA
Burbank Bus	Los Angeles-Long Beach-Santa Ana, CA
Cerritos on Wheels	Los Angeles-Long Beach-Santa Ana, CA
City of Baldwin Park Transit	Los Angeles-Long Beach-Santa Ana, CA
City of Commerce Municipal Buslines (CBL)	Los Angeles-Long Beach-Santa Ana, CA
City of Los Angeles Department of Transportation	Los Angeles-Long Beach-Santa Ana, CA
CityLine (West Hollywood)	Los Angeles-Long Beach-Santa Ana, CA
DowneyLINK	Los Angeles-Long Beach-Santa Ana, CA
El Sol Shuttle	Los Angeles-Long Beach-Santa Ana, CA
Foothill Transit	Los Angeles-Long Beach-Santa Ana, CA
Go West	Los Angeles-Long Beach-Santa Ana, CA
Irvine Shuttle	Los Angeles-Long Beach-Santa Ana, CA
La Puente Link	Los Angeles-Long Beach-Santa Ana, CA
Laguna Beach Municipal Transit (LBMT)	Los Angeles-Long Beach-Santa Ana, CA
Lawndale Beat	Los Angeles-Long Beach-Santa Ana, CA
Los Angeles County Metropolitan Transportation Authority (Metro)	Los Angeles-Long Beach-Santa Ana, CA
MetroLink (Southern California Regional Rail Authority)	Los Angeles-Long Beach-Santa Ana, CA
Municipal Area Express	Los Angeles-Long Beach-Santa Ana, CA
Norwalk Transit System	Los Angeles-Long Beach-Santa Ana, CA
Orange County Transportation Authority	Los Angeles-Long Beach-Santa Ana, CA
Pasadena Area Rapid Transit System (ARTS)	Los Angeles-Long Beach-Santa Ana, CA
Torrance Transit System (TTS)	Los Angeles-Long Beach-Santa Ana, CA
Transit Authority of River City	Louisville/Jefferson County, KY-IN
CitiBus	Lubbock, TX
Greater Lynchburg Transit Company	Lynchburg, VA
Macon Transit Authority	Macon, GA
Madison Metro	Madison, WI
Manchester Transit Authority	Manchester-Nashua, NH
Nashua Transit System	Manchester-Nashua, NH
Richland County Transit	Mansfield, OH
Rio Transit	McAllen-Edinburg-Mission, TX
Rogue Valley Transportation District	Medford, OR
Memphis Area Transit Authority	Memphis, TN-MS-AR
Merced County Transit - The Bus	Merced, CA
Broward County Transit	Miami-Fort Lauderdale-Pompano Beach, FL
Miami-Dade Transit Authority	Miami-Fort Lauderdale-Pompano Beach, FL
NOMI Express (City of North Miami)	Miami-Fort Lauderdale-Pompano Beach, FL
Palm Tran	Miami-Fort Lauderdale-Pompano Beach, FL
South Florida RTA (Tri-Rail)	Miami-Fort Lauderdale-Pompano Beach, FL
Sun Trolley	Miami-Fort Lauderdale-Pompano Beach, FL
Bay Metro	Midland, MI
EZ Rider	Midland, TX
Milwaukee County Transit System (MCTS)	Milwaukee-Waukesha-West Allis, WI
OCTS (Ozaukee County Transit)	Milwaukee-Waukesha-West Allis, WI
Waukesha Metro Transit (WMT)	Milwaukee-Waukesha-West Allis, WI
Anoka County Traveler	Minneapolis-St. Paul-Bloomington, MN-WI
City of Maple Grove Public Transit	Minneapolis-St. Paul-Bloomington, MN-WI

City of Plymouth	Minneapolis-St. Paul-Bloomington, MN-WI
Metro Transit	Minneapolis-St. Paul-Bloomington, MN-WI
MVTA (Minnesota Valley Transit Authority)	Minneapolis-St. Paul-Bloomington, MN-WI
Northstar Commuter Coach	Minneapolis-St. Paul-Bloomington, MN-WI
Southwest Transit	Minneapolis-St. Paul-Bloomington, MN-WI
Mountain Line Transit	Missoula, MT
BRATS (Baldwin Rural Area Transportation System)	Mobile, AL
The Wave Transit System	Mobile, AL
Ceres Area Transit	Modesto, CA
City of Turlock Transit Services	Modesto, CA
MAX (Modesto Area Express)	Modesto, CA
StaRT (Stanislaus Regional Transit)	Modesto, CA
Montgomery Area Transit System	Montgomery, AL
Muncie Indiana Transit System (MITS)	Muncie, IN
Collier Area Transit	Naples-Marco Island, FL
Franklin Transit Agency (FTA)	Nashville-Davidson--Murfreesboro--Franklin, TN
Metropolitan Transit Authority (MTA)	Nashville-Davidson--Murfreesboro--Franklin, TN
CT Transit Meriden	New Haven-Milford, CT
CT Transit New Haven	New Haven-Milford, CT
CT Transit Wallingford	New Haven-Milford, CT
CT Transit Waterbury	New Haven-Milford, CT
Shore Line East	New Haven-Milford, CT
Jet (Jefferson Transit)	New Orleans-Metairie-Kenner, LA
New Orleans RTA (NORTA)	New Orleans-Metairie-Kenner, LA
St. Bernard Urban Rapid Transit (SBURT)	New Orleans-Metairie-Kenner, LA
BeeLine	New York-Northern New Jersey-Long Island, NY-NJ-PA
Long Beach Bus	New York-Northern New Jersey-Long Island, NY-NJ-PA
Middlesex County Area Transit	New York-Northern New Jersey-Long Island, NY-NJ-PA
MTA	New York-Northern New Jersey-Long Island, NY-NJ-PA
MTA Long Island	New York-Northern New Jersey-Long Island, NY-NJ-PA
MTA North	New York-Northern New Jersey-Long Island, NY-NJ-PA
NJ Transit	New York-Northern New Jersey-Long Island, NY-NJ-PA
Norwalk Transit District	New York-Northern New Jersey-Long Island, NY-NJ-PA
Ocean County Transportation Services	New York-Northern New Jersey-Long Island, NY-NJ-PA
Port Authority of New York and New Jersey	New York-Northern New Jersey-Long Island, NY-NJ-PA
Rockland County Public Transportation	New York-Northern New Jersey-Long Island, NY-NJ-PA
Sarasota County Area Transit	North Port-Bradenton-Sarasota, FL
9 Town Transit	Norwich-New London, CT
Shore Line East	Norwich-New London, CT
Southeast Area Transit (SEAT)	Norwich-New London, CT
Island Transit	Oak Harbor, WA
SunTran	Ocala, FL
NJ Transit	Ocean City, NJ
EZ Rider	Odessa, TX
UTA (Utah Transit Authority)	Ogden-Clearfield, UT
Metro Transit	Oklahoma City, OK
Intercity Transit	Olympia, WA
Metro Area Transit (MAT)	Omaha-Council Bluffs, NE-IA

Lake Express	Orlando-Kissimmee-Sanford, FL
Lynx	Orlando-Kissimmee-Sanford, FL
Oshkosh Transit System	Oshkosh-Neenah
Owensboro Transit System	Oshkosh-Neenah, WI
Camarillo Area Transit	Oxnard-Thousand Oaks-Ventura, CA
Gold Coast Transit	Oxnard-Thousand Oaks-Ventura, CA
Moorpark CityBus	Oxnard-Thousand Oaks-Ventura, CA
Simi Valley Transit (SVT)	Oxnard-Thousand Oaks-Ventura, CA
Thousand Oaks Transit (TOT)	Oxnard-Thousand Oaks-Ventura, CA
Ventura Intercity Service Transit Authority	Oxnard-Thousand Oaks-Ventura, CA
Space Coast Area Transit	Palm Bay-Melbourne-Titusville, FL
Bay Town Trolley	Panama City-Lynn Haven-Panama City Beach, FL
Mid-Ohio Valley Transit Authority	Parkersburg-Marietta-Vienna, WV-OH
City of Milton-Freewater Transit	Pendleton-Hermiston, OR
Escambia County Area Transit	Pensacola-Ferry Pass-Brent, FL
CityLink	Peoria, IL
DART (Delaware Transit)	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD
Maryland Transit Authority	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD
NJ Transit	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD
PATCO	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD
SCOOT	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD
SEPTA	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD
City of Maricopa Express Transit	Phoenix-Mesa-Glendale, AZ
City of Scottsdale Transit Division	Phoenix-Mesa-Glendale, AZ
Tempe Orbit	Phoenix-Mesa-Glendale, AZ
Valley Metro	Phoenix-Mesa-Glendale, AZ
BCTA (Beaver County Transit Authority)	Pittsburgh, PA
FACT (Fayette Area Coordinated Transit)	Pittsburgh, PA
MMVTA (Mid-Mon Valley Transit Authority)	Pittsburgh, PA
PAAC (Port Authority of Allegheny County)	Pittsburgh, PA
WCTA (Westmoreland County)	Pittsburgh, PA
Berkshire Regional Transit Authority	Pittsfield, MA
Pocatello Regional Transit	Pocatello, ID
Treasure Coast Connector	Port St. Lucie, FL
Metro (Greater Portland Transit District)	Portland-South Portland-Biddeford, ME
South Portland Bus Service	Portland-South Portland-Biddeford, ME
Canby Area Transit	Portland-Vancouver-Hillsboro, OR-WA
C-Tran (Vancouver)	Portland-Vancouver-Hillsboro, OR-WA
S Clackamas Transportation Dist	Portland-Vancouver-Hillsboro, OR-WA
SAM (Sandy Area Metro)	Portland-Vancouver-Hillsboro, OR-WA
SMART (South Metro Area Rapid Transit)	Portland-Vancouver-Hillsboro, OR-WA
Tri-Met	Portland-Vancouver-Hillsboro, OR-WA
Yamhill County Transit	Portland-Vancouver-Hillsboro, OR-WA
City of Poughkeepsie Transit	Poughkeepsie-Newburgh-Middletown, NY
Dutchess County Loop Bus	Poughkeepsie-Newburgh-Middletown, NY
Cottonwood Area Transit	Prescott, AZ
Sedona RoadRunner	Prescott, AZ
Rhode Island Public Transit Authority (RIPTA)	Providence-New Bedford-Fall River, RI-MA

UTA (Utah Transit Authority)	Provo-Orem, UT
Pueblo Transit	Pueblo, CO
Capital Area Transit (CAT)	Raleigh-Cary, NC
Cary Transit	Raleigh-Cary, NC
Triangle Transit Authority	Raleigh-Cary, NC
Berks Area Regional Transportation Authority	Reading, PA
Tehama Rural Area Express (TRAX)	Red Bluff, CA
Redding Area Bus Authority	Redding, CA
RTC Ride	Reno-Sparks, NV
Greater Richmond Transit Company	Richmond, VA
Petersburg Transit	Richmond, VA
City of Corona Transit Services (CCTS)	Riverside-San Bernardino-Ontario, CA
Omnitrans	Riverside-San Bernardino-Ontario, CA
Riverside Transit Agency	Riverside-San Bernardino-Ontario, CA
SunLine Transit Agency (SunLine)	Riverside-San Bernardino-Ontario, CA
Victor Valley Transit Authority (VVTA)	Riverside-San Bernardino-Ontario, CA
Rochester Bus	Rochester, MN
Rochester-Genessee Regional Transportation Authority	Rochester, NY
Rockford Mass Transit District	Rockford, IL
U-Trans	Roseburg, OR
BlueGo	Sacramento--Arden-Arcade--Roseville, CA
COLT (City of Lincoln Transit)	Sacramento--Arden-Arcade--Roseville, CA
El Dorado County Transit Authority	Sacramento--Arden-Arcade--Roseville, CA
e-Tran (city of Elk Grove)	Sacramento--Arden-Arcade--Roseville, CA
Placer County Transit	Sacramento--Arden-Arcade--Roseville, CA
Roseville Transit	Sacramento--Arden-Arcade--Roseville, CA
Sacramento Regional Transportation District	Sacramento--Arden-Arcade--Roseville, CA
Tahoe Area Regional Transit	Sacramento--Arden-Arcade--Roseville, CA
TPT (Town of Truckee Public Transit)	Sacramento--Arden-Arcade--Roseville, CA
Unitrans(City of Davis & UC Davis)	Sacramento--Arden-Arcade--Roseville, CA
YCRD (Yolo County Transportation District - Yolobus)	Sacramento--Arden-Arcade--Roseville, CA
Saginaw STARS	Saginaw-Saginaw Township North, MI
Salem-Keizer Transit (Cherriots)	Salem, OR
Woodburn Public Works Department Transit Division	Salem, OR
CityGo	Salina, KS
Monterey-Salinas Transit (MST)	Salinas, CA
UTA (Utah Transit Authority)	Salt Lake City, UT
VIA Metropolitan Transit	San Antonio-New Braunfels, TX
Chula Vista Transit (CVT)	San Diego-Carlsbad-San Marcos, CA
North County Transit District (NCTD)	San Diego-Carlsbad-San Marcos, CA
San Diego Metropolitan Transit System	San Diego-Carlsbad-San Marcos, CA
AC Transit (Alameda-Contra Costa Transit District)	San Francisco-Oakland-Fremont, CA
BART (San Francisco Bay Area Rapid Transit District)	San Francisco-Oakland-Fremont, CA
Caltrain	San Francisco-Oakland-Fremont, CA
County Connection (Central Contra Costa Transit Authority)	San Francisco-Oakland-Fremont, CA
East Bay Ferries	San Francisco-Oakland-Fremont, CA
MUNI	San Francisco-Oakland-Fremont, CA

The Stage (West Marin Stagecoach)	San Francisco-Oakland-Fremont, CA
Tri Delta Transit (Eastern Contra Costa Transit Authority)	San Francisco-Oakland-Fremont, CA
UCT (Union City Transit)	San Francisco-Oakland-Fremont, CA
Western Contra Costa Transit Authority (WESTCAT)	San Francisco-Oakland-Fremont, CA
Wheels (Livermore/Amador Valley Transit Authority)	San Francisco-Oakland-Fremont, CA
City of Menlo Park Shuttles	San Jose-Sunnyvale-Santa Clara, CA
San Benito County Express	San Jose-Sunnyvale-Santa Clara, CA
Santa Clara Valley Transportation Authority (VTA)	San Jose-Sunnyvale-Santa Clara, CA
San Luis Obispo Regional Transit Authority	San Luis Obispo-Paso Robles, CA
COLT (City of Lompac Transit)	Santa Barbara-Santa Maria-Goleta, CA
Santa Barbara Metropolitan Transit District	Santa Barbara-Santa Maria-Goleta, CA
Santa Maria Area Transit	Santa Barbara-Santa Maria-Goleta, CA
Metro (Santa Cruz Metropolitan Transit District)	Santa Cruz-Watsonville, CA
Santa Fe Trails Transit	Santa Fe, NM
City of Petaluma Transit	Santa Rosa-Petaluma, CA
SCT (Sonoma County Transit)	Santa Rosa-Petaluma, CA
SRCB (Santa Rosa City Bus)	Santa Rosa-Petaluma, CA
Chatham Area Transit	Savannah, GA
COLTS (County of Lackawanna Transit System)	Scranton--Wilkes-Barre, PA
Hazleton Public Transit	Scranton--Wilkes-Barre, PA
Luzerne County Transportation Authority	Scranton--Wilkes-Barre, PA
Delaware Transit Corporation	Seaford, DE
Community Transit (Snohomish County)	Seattle-Tacoma-Bellevue, WA
King County Metro	Seattle-Tacoma-Bellevue, WA
Pierce Transit (Pierce County)	Seattle-Tacoma-Bellevue, WA
Seattle Center Monorail	Seattle-Tacoma-Bellevue, WA
Sound Transit	Seattle-Tacoma-Bellevue, WA
Washington State Ferries	Seattle-Tacoma-Bellevue, WA
Lakeshore Metro (Sheboygan Transit System)	Sheboygan, WI
Mason County Transportation Authority	Shelton, WA
SporTran	Shreveport-Bossier City, LA
Free Ride Transit System	Silverthorne, CO
Summit Stage	Silverthorne, CO
Sioux City Transit	Sioux City, IA-NE-SD
Sioux Falls Transit	Sioux Falls, SD
Transpo	South Bend-Mishawaka, IN-MI
Spartanburg Area Regional Transit Authority	Spartanburg, SC
Spokane Transit Authority	Spokane, WA
Franklin RTA	Springfield, MA
Pioneer Valley Transit Authority	Springfield, MA
University of Massachusetts Transit Service	Springfield, MA
City Utilities Transit	Springfield, MO
St. Joseph Transit	St. Joseph, MO-KS
Madison County Transit District	St. Louis, MO-IL
Metro	St. Louis, MO-IL
Centre Area Transportation Authority	State College, PA
Altamont Commuter Express (ACE)	Stockton, CA

eTrans	Stockton, CA
San Joaquin Regional Transportation District	Stockton, CA
Centro	Syracuse, NY
Star Metro	Tallahassee, FL
HART (Hillsborough Area Regional Transit)	Tampa-St. Petersburg-Clearwater, FL
Hernando County Bus System	Tampa-St. Petersburg-Clearwater, FL
PCPT (Pasco County Public Transportation)	Tampa-St. Petersburg-Clearwater, FL
PSTA (Pinellas County Transit Provider)	Tampa-St. Petersburg-Clearwater, FL
Texarkana Urban Transit District	Texarkana, TX-Texarkana, AR
Toledo Area Regional Transit Authority	Toledo, OH
NJ Transit	Trenton-Ewing, NJ
Nevada County Gold Country Stage	Truckee-Grass Valley, CA
SunTran	Tucson, AZ
Tulsa Transit	Tulsa, OK
Tuscaloosa Transit Authority	Tuscaloosa, AL
Tyler Transit	Tyler, TX
Centro	Utica-Rome, NY
City Coach	Vallejo-Fairfield, CA
Fairfield-Suisun Transit System	Vallejo-Fairfield, CA
Rio Vista Delta Breeze	Vallejo-Fairfield, CA
SolTrans	Vallejo-Fairfield, CA
NJ Transit	Vineland-Millville-Bridgeton, NJ
Hampton Roads Transit	Virginia Beach-Norfolk-Newport News, VA-NC
City of Visalia Transit	Visalia-Porterville, CA
Dinuba Transit	Visalia-Porterville, CA
Porterville Transit	Visalia-Porterville, CA
Tulare County Area Transit	Visalia-Porterville, CA
Tulare Transit Express	Visalia-Porterville, CA
Waco Transit System	Waco, TX
Valley Transit	Walla Walla, WA
Arlington Transit	Washington-Arlington-Alexandria, DC-VA-MD-WV
Calvert County Department of Transportation	Washington-Arlington-Alexandria, DC-VA-MD-WV
CUE Bus	Washington-Arlington-Alexandria, DC-VA-MD-WV
DC Circulator	Washington-Arlington-Alexandria, DC-VA-MD-WV
Fredericksburg Regional Transit	Washington-Arlington-Alexandria, DC-VA-MD-WV
Howard Transit	Washington-Arlington-Alexandria, DC-VA-MD-WV
Loudon County Transit	Washington-Arlington-Alexandria, DC-VA-MD-WV
Maryland Transit Authority	Washington-Arlington-Alexandria, DC-VA-MD-WV
PanTran	Washington-Arlington-Alexandria, DC-VA-MD-WV
Potomac and Rappahannock Transportation Commission	Washington-Arlington-Alexandria, DC-VA-MD-WV
Prince George's The Bus	Washington-Arlington-Alexandria, DC-VA-MD-WV
RideOn	Washington-Arlington-Alexandria, DC-VA-MD-WV
TransIT	Washington-Arlington-Alexandria, DC-VA-MD-WV
Virginia Regional Transit	Washington-Arlington-Alexandria, DC-VA-MD-WV
Washington Metro Area Transit Authority (WMATA)	Washington-Arlington-Alexandria, DC-VA-MD-WV
Met Transit	Waterloo-Cedar Falls, IA
Metro Ride	Wausau, WI
Ohio Valley Regional Transit Authority	Wheeling, WV-OH

Wichita Falls Transit System	Wichita Falls, TX
Wichita Transit	Wichita, KS
Wave Transit	Wilmington, NC
Winston-Salem Transit Authority	Winston-Salem, NC
MBTA (Mass Bay Transit Authority)	Worcester, MA
Worcester Regional Transit Authority (WRTA)	Worcester, MA
Yakima Transit	Yakima, WA
Shenango Valley Shuttle Service	Youngstown-Warren-Boardman, OH-PA
Western Reserve Transit Authority (WRTA)	Youngstown-Warren-Boardman, OH-PA
Yubba Sutter Transit	Yuba City, CA
Z-Bus	Zanesville, OH

Appendix B: Regression Coefficients

The following tables show the value for the coefficients found in the regression analysis. Note that the standard error is reported to two significant digits and the value is reported at the same precision. All independent variables are transformed to make for a better linear fit. Table 7 below provides the transformations and defines the variables names for the remaining tables.

Table 7: Review of Independent Variables

Input	Linear Transformation Used	Linearized Variable Name
Gross Density	Natural Log	gross_hh_density
Residential Density	Natural Log[19]	res_density_gt05
Block Density	Square Root	block_denstiy
Intersection Density	Square Root	intersection_density
Transit Connectivity Index	None	Tci
Transit Access Shed	Square Root	tas_acres
Transit Frequency of Service	Square Root	tas_trips
Employment Access Index	Natural Log	emp_gravity
Job Diversity Index	Natural Log	hh7
Average Median Commute Distance	Natural Log	avg_d
Median Household Income	Natural Log	median_hh_income
Average Household Size	Square Root	avg_hh_size
Per-Capita Household Income	Natural Log	per_capita_income
Average Commuters per Household	None	commuters_per_hh
Median Selected Monthly Owner Costs	Natural Log	cbsa_median_smoc
Median Gross Rent	Natural Log	cbsa_median_gr

Table 8: Autos per Household Model Coefficients

Coefficient	Value	Standard Error
Intercept	-0.06	0.22
avg_hh_size*hh7	-0.2654	0.0075
avg_hh_size*median_hh_income	0.2272	0.0089
commuters_per_hh	0.519	0.038
commuters_per_hh*gross_hh_density	0.0356	0.0060
commuters_per_hh*res_density_gt05	-0.154	0.022
emp_gravity*emp_gravity	-0.00478	0.00061
gross_hh_density*gross_hh_density	0.00902	0.00093
gross_hh_density*res_density_gt05	-0.0390	0.0029
hh7*hh7	0.0210	0.0028

[19] Since the value of Residential Density can legitimately be, and often is, zero (0), the number one (1) was added before taking the natural log.

Table 9: Autos per Household Model Coefficients Using Transit Variables

Coefficient	Value	Standard Error
Intercept	0.79	0.18
avg_d*block_denstiy	-0.069	0.012
avg_d*tas_trips	0.00207	0.00034
avg_hh_size	-1.790	0.079
avg_hh_size*per_capita_income	0.2850	0.0061
avg_hh_size*res_density_gt05	-0.0690	0.0094
block_denstiy*gross_hh_density	0.043	0.017
commuters_per_hh*emp_gravity	0.0275	0.0015
commuters_per_hh*intersection_density	0.128	0.018
commuters_per_hh*tci	-0.01073	0.00057
emp_gravity*per_capita_income	-0.0088	0.0013
gross_hh_density*per_capita_income	-0.00578	0.00075
gross_hh_density*tas_acres	0.000326	0.000085
res_density_gt05*tas_trips	-0.00333	0.00057

Table 10: Transit Use Model Coefficients

Coefficient	Value	Standard Error
Intercept	-17.1	4.3
avg_hh_size*commuters_per_hh	-1.83	0.28
avg_hh_size*res_density_gt05	6.2	1.2
emp_gravity*emp_gravity	0.187	0.040
gross_hh_density	-5.35	0.69
gross_hh_density*gross_hh_density	-0.304	0.038
gross_hh_density*res_density_gt05	3.18	0.31
per_capita_income*res_density_gt05	-0.51	0.12

Table 11: Transit Use Model Coefficients Using Transit Variables

Coefficient	Value	Standard Error
Intercept	-2.9	2.9
avg_d*commuters_per_hh	1.47	0.34
avg_d*emp_gravity	-0.148	0.030
avg_d*tci	0.179	0.044
avg_hh_size*tci	0.379	0.059
block_denstiy*tas_acres	-0.028	0.010
commuters_per_hh*emp_gravity	-0.4288	0.068
emp_gravity*emp_gravity	0.108	0.038
gross_hh_density*tas_acres	-0.0119	0.0048
gross_hh_density*tas_trips	0.113	0.039
median_hh_income*res_density_gt05	-0.185	0.039
res_density_gt05*res_density_gt05	0.84	0.12

Table 12: Auto Use Model Coefficients

Coefficient	Value	Standard Error
Intercept	32260	600
avg_d*emp_gravity	-822.8	1.8
avg_d*intersection_density	164	81
avg_d*median_hh_income	913	23
avg_hh_size*gross_hh_density	-394	21
avg_hh_size*median_hh_income	342	19
commuters_per_hh	7640	250
commuters_per_hh*res_density_gt05	-1667.0	4.8
emp_gravity*per_capita_income	-22.4	6.8
gross_hh_density*gross_hh_density	96	12
hh7	-3660	270
intersection_density*intersection_density	-685	140

Table 13: Auto Use Model Coefficients Using Transit Variables

Coefficient	Value	Standard Error
Intercept	12460	2400
avg_d*avg_hh_size	560	220
avg_d*tci	-46.6	3.5
avg_hh_size*avg_hh_size	-2117	190
avg_hh_size*gross_hh_density	-814	23
avg_hh_size*per_capita_income	1469.6	5.3
avg_hh_size*tas_acres	-2.39	0.50
block_denstiy*gross_hh_density	1865.1	4.4
block_denstiy*per_capita_income	-336	36
commuters_per_hh*hh7	644.7	9.6
commuters_per_hh*intersection_density	2169	28
commuters_per_hh*res_density_gt05	-919.0142	70.62983
commuters_per_hh*tci	-74.35559	6.334358
emp_gravity*hh7	-228.9751	19.2672
intersection_density*tas_trips	-40.41736	6.306821
tas_acres*tci	0.4391124	0.07048661

Table 14: Natural Log (SMOC) Model Coefficients

Coefficient	Value	Standard Error
Intercept	2.46	0.11
avg_d*avg_d	-0.0063	0.0012
avg_hh_size*per_capita_income	0.0470	0.0026
block_denstiy*block_denstiy	0.45	0.16
block_denstiy*median_hh_income	-0.0460	0.0086
cbsa_median_gr*cbsa_median_gr	0.0241	0.0038
cbsa_median_smoc*cbsa_median_smoc	0.0242	0.0021
commuters_per_hh*emp_gravity	0.0222	0.00366
commuters_per_hh*hh7	-0.0362	0.0046
hh7*hh7	0.0071	0.0013
per_capita_income*per_capita_income	0.01561	0.00072

Table 15: Natural Log (SMOC) Model Coefficients Using Transit Variables

Coefficient	Value	Standard Error
Intercept	3.05	0.25
avg_d*cbsa_median_smoc	-0.0201	0.0022
avg_d*emp_gravity	0.0129	0.0019
avg_hh_size*cbsa_median_smoc	0.0643	0.0030
block_denstiy*median_hh_income	-0.0331	0.0098
block_denstiy*res_density_gt05	0.209	0.054
cbsa_median_gr*cbsa_median_gr	0.0272	0.0039
cbsa_median_smoc*hh7	0.0310	0.0044
commuters_per_hh*gross_hh_density	0.0077	0.0019
commuters_per_hh*hh7	-0.0088	0.0013
hh7	-0.146	0.040
intersection_density*median_hh_income	-0.0124	0.0038
per_capita_income*per_capita_income	0.02027	0.00073
per_capita_income*res_density_gt05	-0.0081	0.0020

Table 16: Natural Log (Gross Rent) Model Coefficients

Coefficient	Value	Standard Error
Intercept	-1.82	0.16
avg_d*gross_hh_density	0.0065	0.0012
avg_hh_size	0.596	0.022
avg_hh_size*res_density_gt05	-0.0597	0.0082
block_denstiy*block_denstiy	0.176	0.054
block_denstiy*commuters_per_hh	-0.239	0.034
cbsa_median_gr*hh7	0.0973	0.0046
cbsa_median_smoc*hh7	-0.0010	0.0025
commuters_per_hh*gross_hh_density	0.0204	0.0029
commuters_per_hh*res_density_gt05	0.0679	0.0088
emp_gravity*per_capita_income	0.00185	0.00029
gross_hh_density*res_density_gt05	-0.00316	0.00072
hh7*per_capita_income	-0.0564	0.0027
per_capita_income	0.741	0.023

Table 17: Natural Log (Gross Rent) Model Coefficients Using Transit Variables

Coefficient	Value	Standard Error
Intercept	0.26	0.10
avg_d*emp_gravity	0.0086	0.0016
avg_d*per_capita_income	-0.0076	0.0014
avg_d*tas_trips	0.00084	0.00027
avg_d*tci	-0.00236	0.00049
avg_hh_size*res_density_gt05	-0.0582	0.0083
block_denstiy*commuters_per_hh	-0.1867	0.018
block_denstiy*tas_acres	0.00112	0.00023
cbsa_median_gr*hh7	0.0663	0.0026
cbsa_median_gr*per_capita_income	0.0258	0.0027
cbsa_median_smoc	-0.092	0.020
commuters_per_hh*res_density_gt05	0.0882	0.0092
commuters_per_hh*tas_acres	-0.000284	0.000062
gross_hh_density*median_hh_income	0.00355	0.00025
gross_hh_density*tas_acres	-0.000140	0.000026
hh7*per_capita_income	-0.0415	0.0024
median_hh_income	0.480	0.015
tci*tci	0.0000400	0.0000083