



The Affordability Index: A New Tool for Measuring the True Affordability of a Housing Choice

By Center for Transit Oriented Development and Center for Neighborhood Technology

This brief describes a new information tool developed by the Urban Markets Initiative to quantify, for the first time, the impact of transportation costs on the affordability of housing choices. This brief explains the background, creation, and purpose of this new tool. The first section provides a project overview and a short summary of the method used to create the Affordability Index. The next section highlights the results from testing the index in a seven-county area in and around Minneapolis-St. Paul, MN. To demonstrate the usefulness of this tool at a neighborhood level, the third section projects the effect of transportation and housing choices on three hypothetical low- and moderate-income families in each of four different neighborhoods in the Twin Cities. The brief concludes with suggested policy recommendations and applications of the new tool for various actors in the housing market, and for regulators, planners, and funders in the transportation and land use arenas at all levels of government.

The Housing and Transportation Affordability Index is a groundbreaking innovation because it prices the trade-offs that households make between housing and transportation costs and the savings that derive from living in communities that are near shopping, schools, and work, and that boast a transit-rich environment. Built using data sets that are available for every transit-served community in the nation, the tool can be applied in neighborhoods in more than 42 cities in the United States.¹ It provides consumers, policymakers, lenders, and investors with the information needed to make better decisions about which neighborhoods are truly affordable, and illuminate the implications of their policy and investment choices.

I. Housing and Transportation: Key Elements of the Cost of Living

The cost of living for an American family consists of many components. The two largest are housing and transportation. Housing affordability is most commonly understood as the extent to which a household's income can cover the purchase price of a home. However, the traditional definition of housing affordability may be too limited. The cost of transportation, while not currently factored in to the affordability equation, has become increasingly central to family budgets, given their choices to live

“...neighborhood characteristics influence how much is spent on transportation and how many vehicles are owned, given that the characteristics of place also shape transportation demand.”

farther from jobs and as today's development patterns require families to use their cars more often to run errands or take their children to school. Therefore, the affordability of housing should be considered in the context of the transportation costs associated with the neighborhood in which the home is located. It is the interaction between housing and location that provides a more meaningful measure of affordability.

Although housing is considered affordable if it accounts for roughly 30 percent or less of a household's monthly budget, location costs, and more specifically transportation costs, are often dramatically underestimated or ignored. Nationally, transportation is the second largest household expenditure after housing, ranging from less than 10 percent of the average household's expenditures in transit-rich areas to nearly 25 percent in many other areas. Based on calculations using the 2003 Consumer Expenditure Survey, we estimate that the average U.S. household spends 19 percent of its budget on transportation.

As this brief demonstrates, transportation costs also vary widely by neighborhood. Generally speaking, housing is cheaper in areas that lack new investment or that is farther from the central business district, while household transportation costs increase as one moves farther out from urban centers.

A growing body of research has shown a strong relationship between increased density, transit access, and pedestrian friendliness, on the one hand, and reduced vehicle miles and automobile ownership, on the other.² With the high and rising cost of driving, owing to rising gasoline prices and the increasing need to drive for most household trips, the transportation savings that can result from living in a dense, convenient, and transit-friendly community can be considerable.

The significant increase in recent gas prices has important impacts on affordability. At \$3.00 per gallon, double the price of just two years ago, the average household will increase its total transportation expenditures by 14 percent, or \$1,200 per year. This increase alone is 3 percent of the median income household's annual earnings.

Until now, a household's transportation demand was considered to be primarily driven by household income and size. This research shows that larger and wealthier households tend to own more vehicles, select more expensive models, and drive more miles. Our study shows, however, that transportation demand and corresponding costs are highly correlated with characteristics of the neighborhood. Even among wealthy households, neighborhood characteristics influence how much is spent on transportation and how many vehicles are owned, given that the characteristics of place also shape transportation demand. Neighborhood characteristics such as density; walkability; the availability and quality of transit service; convenient access to amenities such as grocery stores, dry cleaners, day care, and movie theaters; and the number of accessible jobs shape how residents get around, where they go, and how much they ultimately spend on transportation.³ Neighborhoods with the above characteristics are considered “location efficient,” providing convenient access to shopping, services, and jobs, and low-cost transportation alternatives to the auto.

These costs, however, are not considered in the housing affordability standards used to allocate low-income housing tax credits or vouchers for other affordable housing programs. Nor are they considered—except with the Location Efficient Mortgage®—when lenders score individual home loan applications. Reframing nationally accepted affordability measures to combine both housing and transportation costs could allow low-income households to more easily qualify for homeownership, provide a substantial incentive to the private sector to invest in transit-oriented locations, and support the public sector in making investments that lower household transportation costs.

The Affordability Index calculates the true affordability of a home based on its market value and the transportation costs incurred by its location. It does so not only at the broad metropolitan area level, but also at the neighborhood level, where hundreds of consumer,

investment, development, and infrastructure decisions are made every day. Used at a community level, the Affordability Index can help households assess which neighborhoods in a region are most affordable, and it can help policymakers determine where resources should be focused to enhance affordability.

II. Building the Affordability Index

The Affordability Index calculates the sum of average housing costs plus the average transportation costs for a neighborhood (represented by a census block group), divided by average neighborhood income. In the simplified formula, total housing costs include current housing sales prices and rents, and total transportation costs equal the sum of the costs for auto ownership, auto use, and transit. The index can be adjusted for an individual household to reflect household income, the price members intend to pay for a new home, and a particular neighborhood's transportation costs.

The Affordability Index builds on the analysis and theory of the Location Efficient Mortgage® (LEM), which was developed by a group of researchers, including members of the

$$\text{Affordability Index} = \frac{\text{Housing Costs} + \text{Transportation Costs}}{\text{Income}}$$

Center for Transit-Oriented Development team.⁴ The LEM uses actual vehicle miles traveled for millions of households in the San Francisco Bay Area, Southern California, and the Chicago region to generate models that predict auto ownership and vehicle miles traveled, based on residential density, transit availability, and neighborhood walkability. The model results in a “location efficient value” for each neighborhood within these regions. The researchers selected these characteristics on the basis of the extensive literature on transportation costs in relation to the built environment. The location efficient model was then used to create a Fannie Mae-backed mortgage product that allows the underwriter to give additional credit for the location efficiency of an area. The Affordability Index is based on the proven concepts in the location efficiency study—that transportation costs are determined by both neighborhood and socioeconomic characteristics.

In the Affordability Index, household transportation costs are estimated as three separate components: costs of auto ownership, auto use, and transit use. These three components are the dependent variables in the model and are affected by the combination of seven independent built environment variables and two independent household variables. Together, these nine variables represent the independent neighborhood and socioeconomic variables that predict household transportation costs at the census block group level, the smallest geography available to approximate neighborhoods. It is important to model these costs at a neighborhood level, given that the independent variables can vary block by block.

Modeled values for these variables are derived primarily from the U.S. Decennial Census 2000 Survey; the Census Transportation Planning Package 2000 (CTPP 2000); the National Household Travel Survey (NHTS); and the National Transit-Oriented Development (TOD) database. The TOD database was developed by the CTOD with the support of the Federal Transit Administration, Fannie Mae, and the Surdna Foundation. It contains the demographic, land use, and transportation characteristics of neighborhoods located within a half mile of 4,000 existing and planned fixed-guideway transit stations in the United States. The transportation characteristics in the database include the location of train stations and lines, train frequencies, bus routes, and actual and estimated bus route frequencies. Bus route information was collected from the Federal Transit Administration and from local transit authorities. Table 1 provides a complete list of the variables, their source, and their use in the transportation cost model.

We combined the variables in a regression model that account for changes in the loca-

tion variables that influence transportation costs, while controlling for the household characteristics that, to a lesser extent, also determine the costs. To develop the exact regression formula, we tested each of the independent variables separately against the dependent variables, and then in combination to determine their relationship. The analysis showed that the independent variables co-vary and are interdependent of one another. Thus, no one variable, such as transit accessibility or household income, by itself completely determines transportation costs. Rather, it is the combination of these variables that determines how many autos a household owns, how many miles members drive each vehicle, and how much transit they use. Because transportation is an integral part of our daily routines, it makes sense that it is the combination of how a household commutes to work, how far away the grocery store is, how children get to school or other activities, and how much a family earns that determines total household transportation costs.⁵ The Detailed Methods section offers a fuller description of the process.

III. Testing the Index: Minneapolis-St. Paul

We tested the Affordability Index in the Minneapolis-St. Paul region to refine the method and to determine the ways in which it can be used to affect regional housing and transportation decisions. During this process we worked with a group of transportation and housing experts in the Minneapolis region to refine the methodology and data sets used in the analysis.

More than one-half of households in the Twin Cities spend more than \$10,000 per year on transportation. Including the 40 percent increase in recent gas prices, transportation costs for all Twin Cities households approach a billion dollars per month. Although total transportation costs in the region are higher than the national average, average housing costs are significantly below the national benchmark of affordability. On average, Twin City households spend only about 20 percent of their monthly expenditures on housing. Taken together, households in the Twin Cities spend roughly 40 percent of their monthly pre-tax income on housing and transportation. A closer look at specific communities and neighborhoods reveals a range of costs for each item, however, which reflects proximity to transit and to the central business district. Escalating home prices have begun to make affordable housing a greater concern in the Twin Cities.

A. Using the Affordability Index to Develop a Regional Perspective on Housing and Transportation Costs

Maps 1 and 2 illustrate the difference in affordability when considering only housing costs and when considering the combined cost of housing and transportation. Both maps depict the cost for households earning 80 percent of the area median income. Map 1 shows the monthly mortgage cost as a percentage of income. The yellow areas are those that would traditionally be deemed affordable; they are in accord with the lending guideline that requires households to spend 28 percent or less of their income on housing. Except for the areas directly west and east of Minneapolis and St. Paul, the majority of the region's housing appears affordable for this income group. Both maps show the location of the new Hiawatha light rail line. However, the Affordability Index analysis does not include the impact of the line because it did not open until 2004. All data in the Affordability Index are a snapshot of 2000. It will be interesting to see the effects of this new investment using future data.

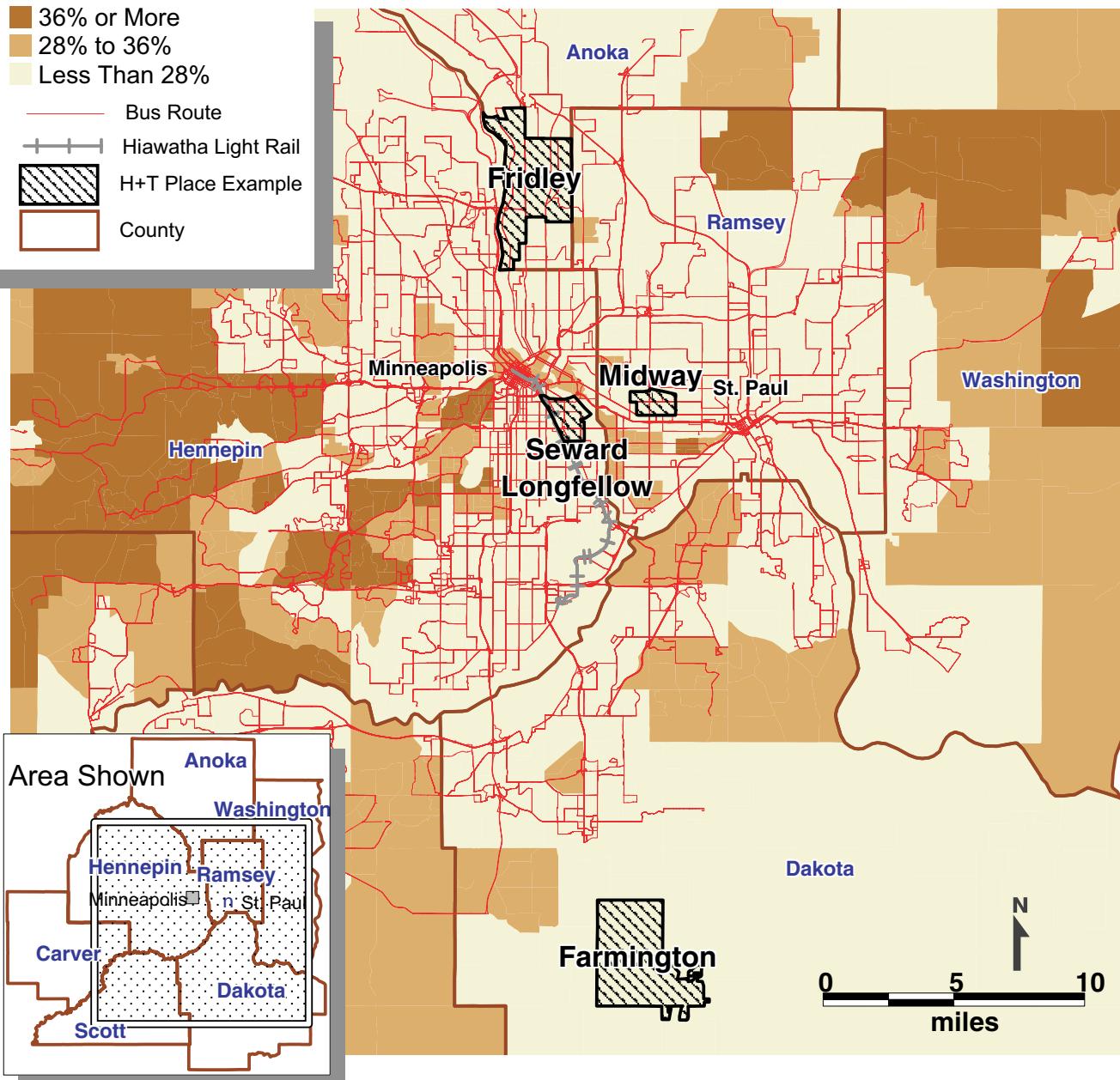
Map 2 adds transportation costs. The Affordability Index uses a range for housing and transportation costs: less than 47 percent; 47 to 74 percent, and 75 percent and above. The benchmark rate of 47 percent represents the sum of the current national average expenditure on transportation (19 percent of income) plus the mortgage underwriting standard for housing debt (28 percent or less of income). On the basis of the guideline that a household should spend no more than 47 percent of its income on housing and transpor-

Map 1. Housing as a percentage of income for a household earning 80 percent area median income (AMI)

Housing Payment as a Percent of Income

by Census Block Groups - 80% AMI - 3 Person Household

- 36% or More
- 28% to 36%
- Less Than 28%
- Bus Route
- Hiawatha Light Rail
- H+T Place Example
- County



Map 2. Affordability Index results for households earning 80 percent area median income (AMI)

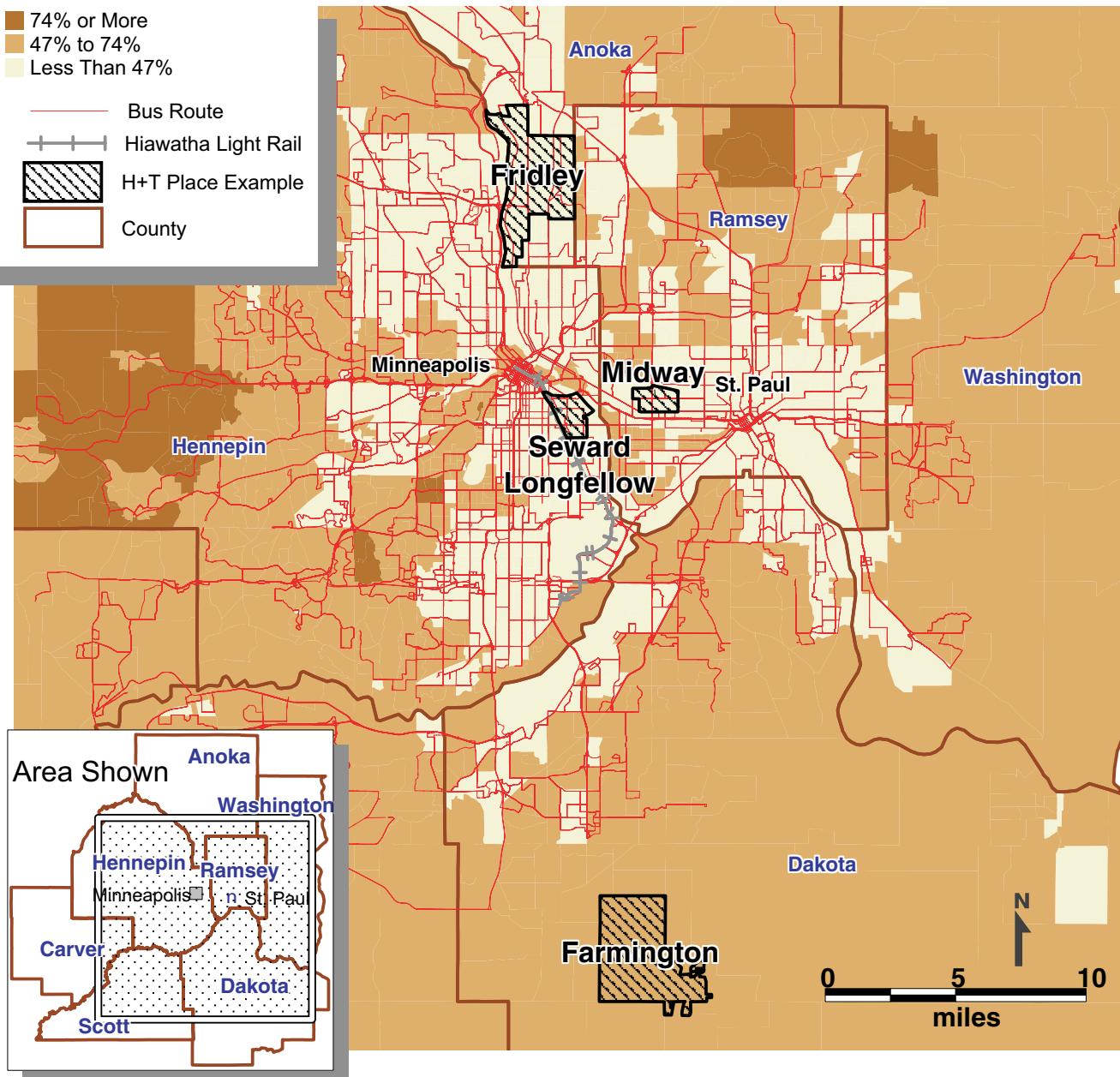
"H + T" as a Percent of Income

by Census Block Groups - 80% AMI - 3 Person Household



74% or More
47% to 74%
Less Than 47%

 Bus Route
 Hiawatha Light Rail
 H+T Place Example
 County



tion, the areas considered affordable on a \$43,443 income contract substantially from those observed in Map 1.

The presence or absence of transit helps explain the difference in affordability between these two maps. The bus system, shown on Map 2, is extensive, offers frequent service, and is well used in the core of the region. Even without fixed-rail transit (the Census 2000 preceded the opening of the region's Hiawatha light rail line), 8 percent of the workers in the Minneapolis-St. Paul region commuted by something other than an auto: by bus, bicycle, or on foot. When looking at the cities of Minneapolis and St. Paul, which have the most extensive bus system in the region, the non-auto commute rates were even higher, at 23 percent and 15.4 percent, respectively. Thus, the Affordability Index results show that the combined costs of housing and transportation are most affordable in areas well served by public transit.

The region's new Hiawatha light rail line is referenced on the map; however, it is not reflected in the transportation costs models because the line was not in operation at the time of Census 2000.

B. Using the Affordability Index to Project the Effect of Transportation Costs on Three Hypothetical Households in Minneapolis-St Paul

The Affordability Index allows one to consider the effect on a typical family's budget of a variety of housing choices. To demonstrate the effect of different housing location choices on a family's pocketbook, we constructed three hypothetical families and calculated how their spending distribution differs on the basis of where they live.⁶

The Johnson Family

- Three-person household living in Fridley
- Annual household income: \$56,690
- Annual housing costs: \$7,872
- Annual transportation costs: \$10,671
- Percentage of income spent on housing and transportation: 33 percent

Chip Johnson is an insurance underwriter who lives in Fridley but works in downtown Minneapolis, earning \$56,690 per year. His wife, Bekah, is a stay-at-home mother taking care of their young son, Chip Jr.

For housing, the family pays \$7,872, or 14 percent of their income. Although they chose to live in Fridley because they could purchase "more home for the money," the Johnsons also needed to purchase a second car to maintain their mobility. Because they rely on two cars to commute to work and travel throughout town, their transportation spending equates to \$10,671 a year, five times the amount paid for health care, and double the amount spent on savings, pensions, and insurance. The Johnson family spends 62 percent of its expenditures on housing, transportation, food, apparel and services, and health care.



Photo:Aerial view depicting proposed new commuter rail line and station in Fridley. Source: Northstar Commuter Rail Project Office

Sheila Washington

- Single college student renting apartment in St. Paul's Midway neighborhood
- Annual household income: \$16,830
- Annual housing costs: \$6,096
- Annual transportation costs: \$6,336
- Percentage of income spent on housing and transportation: 73 percent

Sheila Washington is a junior at Hamline University and works at the nearby Rosedale mall to help pay for college. After looking at surrounding neighborhoods, she chose an apartment in Midway where rents are cheaper. Nevertheless, a significant part of her monthly expenditures go to rent. She is able to walk to classes and could take the bus to her job, which pays her roughly \$17,000 annually, but instead she drives, preferring the flexibility that a car provides.



As with many college students, Sheila is acquiring debt and trying to find ways to reduce her cost of living. Together, housing and transportation are 73 percent of her expenditures, which she covers with student loans and her job at the mall. Although Sheila tried to save money by living in a more affordable area, she also lives in a more affordable transportation area but has yet to take advantage of these savings. Sheila could save \$400 per month by using the bus for work and selling her car. Average mortgages in the Midway neighborhood in 1999 were \$577, less than what Sheila spent on owning and driving a car and only slightly higher than what she now pays for rent.

Photo: Hamline University campus in St. Paul

Source: Center for Transit Oriented Development

The Dorgan Family

- Three- person household living in Farmington
- Annual household income: \$43,470
- Annual housing costs: \$9,732
- Annual transportation costs: \$13,020
- Percentage of income spent on housing and transportation: 52 percent

Jim Dorgan is a police officer in Minneapolis, but lives in Farmington with his two retired parents. He spends 94 percent of his \$43,470 annual income on all expenditures, including housing, transportation, and health care, with the largest cost being transportation, which totals over \$13,000 per year.



Jim puts up with a lengthy commute because of cheaper housing costs and a desire to help his aging parents, who rely on him. Together, housing and transportation costs compose 52 percent of his monthly expenditures. Given family responsibilities, Jim chooses to remain in Farmington to help his parents. Because it is difficult to take transit between Farmington and Minneapolis, or even within Farmington, the Dorgans are a three-car family.

Photo: Farmington neighborhood

Source: Center for Transit Oriented Development

C. Putting it All Together: The Impact of Housing Location Choice on Neighborhoods and Families in Minneapolis-St. Paul

We chose four neighborhoods in the Twin Cities to test the model's sensitivity to changes in density, housing costs, proximity to transit, and for the potential of the results to inform policy decisions on future potential transit lines. Tables 2 and 3 provide more information on each of these neighborhoods. Fridley is a northwestern suburb of Minneapolis that is being considered as a potential site for a station on the proposed new commuter rail line, the Northstar. Similarly, the Midway neighborhood in St. Paul encompasses the heart of the area being considered for a new light rail extension, and the Seward/Longfellow neighborhood currently adjoins the new Hiawatha light rail line. Farmington is a once-rural community that has seen rapid housing growth during the past decade as the metropolitan area continues to expand.

**Table 2. Background information on four Twin Cities neighborhoods:
two city neighborhoods, one inner-ring suburb, one urban fringe**

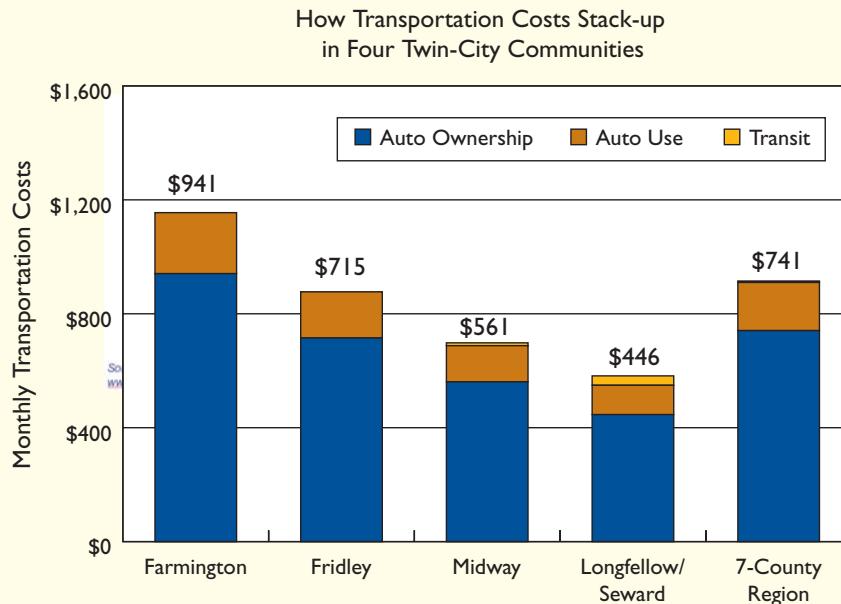
	Farmington	Fridley	Midway, St. Paul	Longfellow/ Seward, Minneapolis	Seven- County metro region
Demographics	Number of households ¹	4,686	11,328	4,861	6,006
	Avg. household size ¹	2.9	2.4	2.3	2.1
Income factors	Annual median household income ¹	\$43,443	\$59,196	\$39,601	\$32,909
	Household income range ¹	\$41,250–\$67,188	\$27,308–\$72,292	\$17,039–\$51,307	\$11,7120–\$46,923
Density measures	Walkability ¹	79.3	13.8	5.1	5.7
	Avg. households/residential acre ¹	0.6	2.7	5.9	9.7
Access to transit and jobs	Jobs /sq. mi. ²	6,209	35,004	72,748	99,060
	Percent commuting by transit, walking, or bicycling ¹	2%	5%	22%	26%
Housing and transportation cost indicators	Transit Connectivity Index ³	No Transit Access	Low	Medium	Medium
	Avg. vehicles per household ¹	2.1	1.8	1.4	1.2
	Avg. monthly mortgage payment ⁴	\$811	\$649	\$577	\$597
	Avg. monthly rental payment ¹	\$535	\$627	\$509	\$497
					\$657

¹ Census 2000. The seven-county average is a weighted average by county.

² Census Transportation Planning Package 2000 (CTPP 2000)

³ Housing payments are based on Census 2000 data and HMDA Average Mortgage Payment for 1999 for the Minneapolis metropolitan statistical area (MSA) and loan terms and rates from the FFEIC for the Minneapolis MSA in 2000.

Figure 1. Transportation cost comparisons in the four model communities



As noted in Figure 1, transportation costs vary across the four case study neighborhoods. Increased costs in auto ownership reflect the need for more cars per household the further from the central city that a suburban community is located. The costs of driving increase in corresponding relationship. The absence or lack of transit service also indicates the relative cost of using transit between the study neighborhoods. As this information is averaged across all households living within the case study neighborhoods, for individual households there may be variation from the average based on individual transit or auto use.

Table 3 and the following four neighborhood summaries demonstrate the underlying transportation infrastructure of each neighborhood. Pie charts at the base of each neighborhood map show the effect on the household budgets of choosing to live in that neighborhood by each of the three hypothetical families. The four neighborhoods are highlighted in the previous regional maps to place these communities in their regional context.

Table 3. Housing and transportation costs in the four Twin Cities areas

	Farmington	Fridley	Midway, St. Paul	Longfellow/ Seward, Minneapolis	Seven- County metro region
Median income ¹	\$43,443	\$59,196	\$39,601	\$32,909	\$54,304
Annual transportation costs ²	\$13,860	\$10,526	\$8,378	\$6,995	\$10,989
Transportation costs as a % of income ²	32%	18%	21%	21%	20%
Average housing cost as a % of income ³	22%	13%	17%	22%	20%
Housing and transportation costs for homeowners	54%	31%	39%	43%	40%
Housing and transportation costs for renters	47%	30%	37%	39%	35%

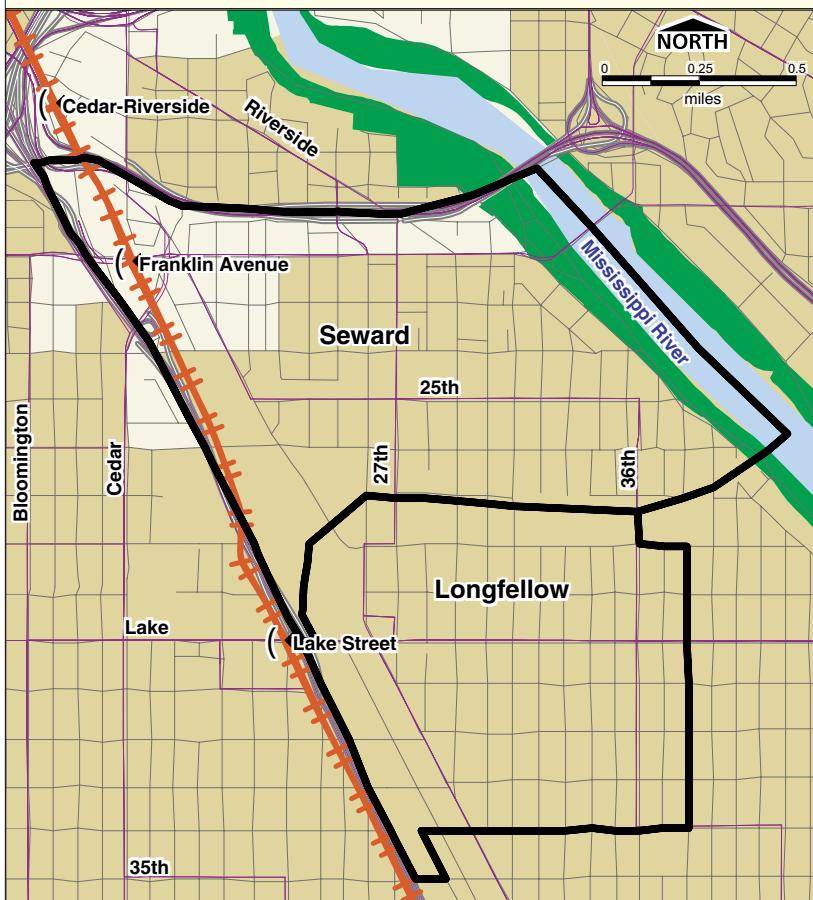
¹ Census 2000, median household income for each community by place and census tract

² Affordability Index model calculation for the median income household in each area

³ Average of rental and mortgage payments for each area using Census 2000 median rents and 1999 HMDA loans and 1999 FFEIC loan terms and rates for Minneapolis-St. Paul to calculate mortgage payments

The four neighborhoods in focus represent different tradeoffs between housing cost and transportation cost. The residents of the Seward-Longfellow neighborhood are located close to downtown Minneapolis and well connected to mass transit. The median income is also lower in this neighborhood compared to our other study areas. On average, residents in this neighborhood spend 21 percent of their income on transportation or roughly \$446 per month. In comparison, for the average household in Farmington where transit service is extremely limited and commutes are long, transportation accounts for 32 percent of income or \$941 per month. When housing costs are factored in, affordability varies dramatically. Whereas regionally, the average two-person household spend 40 percent of its income on housing and transportation, if that same household lived in the Longfellow-Seward neighborhood they would be spending only 34 percent of their income on these same costs, a savings of over \$3,000 annually.

Putting it All Together: Longfellow and Seward Neighborhoods in Minneapolis, Minnesota



Transportation Costs for Homeowners in Longfellow & Seward

\$1,100 to \$1,340
\$900 to \$1,100
\$600 to \$900
0 to \$600

- () Hiawatha Station
- Hiawatha Line
- Bus Route
- Highway/Interstate
- Park
- Neighborhood Boundary

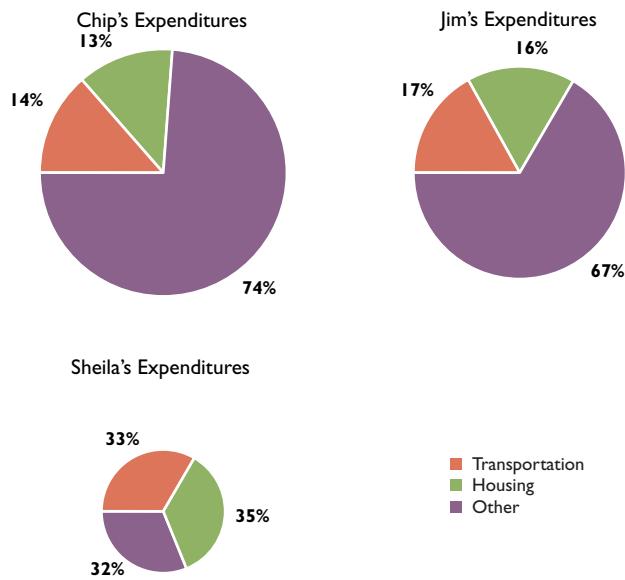
The Longfellow and Seward neighborhoods in South Minneapolis are some of the region's more densely settled, with a mix of housing, household types, and income levels. In addition to being densely populated, the neighborhoods also have a higher concentration of jobs relative to other places.

The Affordability Index is calculated using data prior to the existence of the Hiawatha mass transit line. It shows that 26 percent of households in this area were commuting by transit, walking, or biking in 2000, and overall households were saving \$4,000 a year on transportation compared with the regional average expenditures.

However, housing prices are also increasing in the corridor as a result of rising demand for living near transit and city-living in general. Average housing prices were 22 percent of median household income (\$33,209) in this area, slightly higher than the regional average but still below the industry standard of 30 percent. Combined, housing and transportation costs were 43 percent of the average household expenditures in Longfellow and Seward.

The Affordability Index does not include data to capture the neighborhood changes since 2000, but the model could be updated with current regional data on housing and transit to recalculate the affordability, such as the addition of the Hiawatha Line. The market changes resulting from the investment in fixed guideway transit have profound implications for affordable housing policies. Although the index helps to quantify the value of living near transit for households, it also illustrates neighborhood concerns over gentrification..

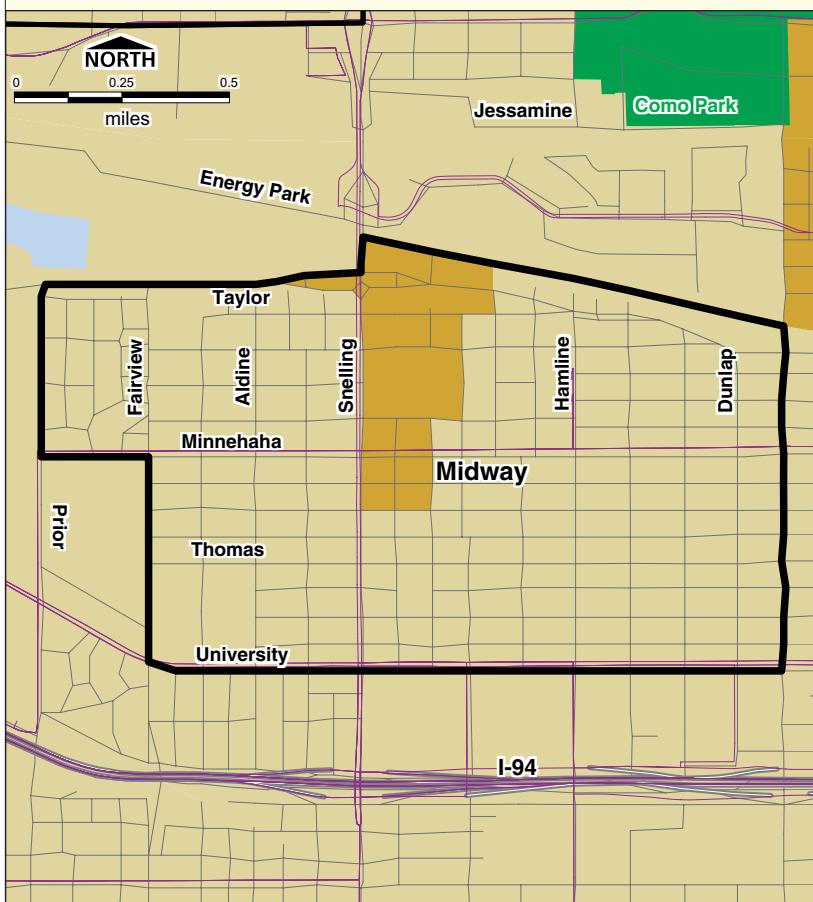
Cost of living in Longfellow/Seward to hypothetical “case” families



The Cost of Living in Longfellow/Seward: Examining the Housing—Transportation Trade-Offs

The pie charts depict the relative cost of living for our three hypothetical families. For Chip, Jim and Sheila, combined housing and transportation costs are lower in Longfellow/Seward than in the other profiled neighborhoods. Whereas Chip currently spends 33 percent of his income on these two costs to live in Fridley, were he to live in Longfellow they would account for only 26 percent of his annual income. For Sheila, transportation and housing costs would account for 68 percent of her income, and Jim would have a substantial savings from living closer to his Minneapolis job.

Putting it All Together: Midway Neighborhood in St. Paul, Minnesota



Transportation Costs for Homeowners in Midway

\$1,100 to \$1,340
\$900 to \$1,100
\$600 to \$900
0 to \$600

Bus Route

Highway/Interstate

Park

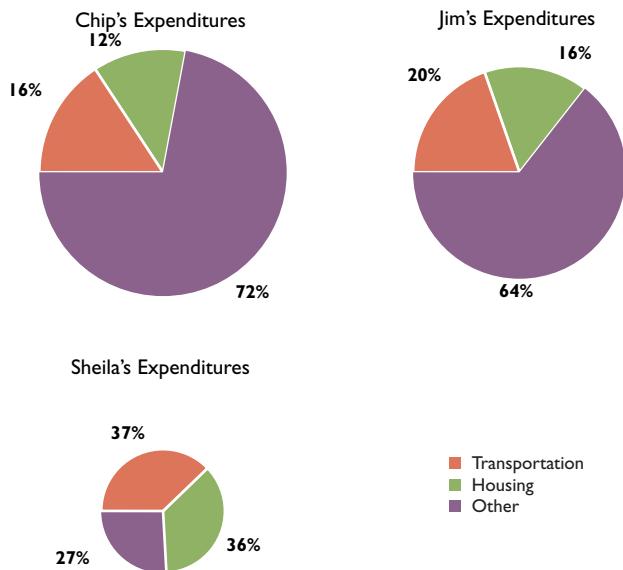
Neighborhood Boundary

Midway is an older neighborhood in central St. Paul along University Avenue. The avenue has a variety of commercial activities and connects the University of Minnesota in Minneapolis with the State Capitol in St. Paul. Although less densely populated than Longfellow and Seward, it is still far above the regional average.

The households in the Midway area represent an extremely diverse population both economically and ethnically. The neighborhood is split evenly between family and non-family households, which can, in part, be attributed to the large number of colleges and universities in the area. Housing is more affordable in this area, and most of the housing stock was constructed prior to 1940. The average monthly mortgage payment in 2000 for this neighborhood was \$577, compared with \$893 for the seven-county region.

The Affordability Index calculated a monthly transportation cost of \$698, roughly 25 percent lower than the regional average. Given lower housing costs, the combined housing and transportation costs were 39 percent of annual household income for homeowners and 37 percent for renters.

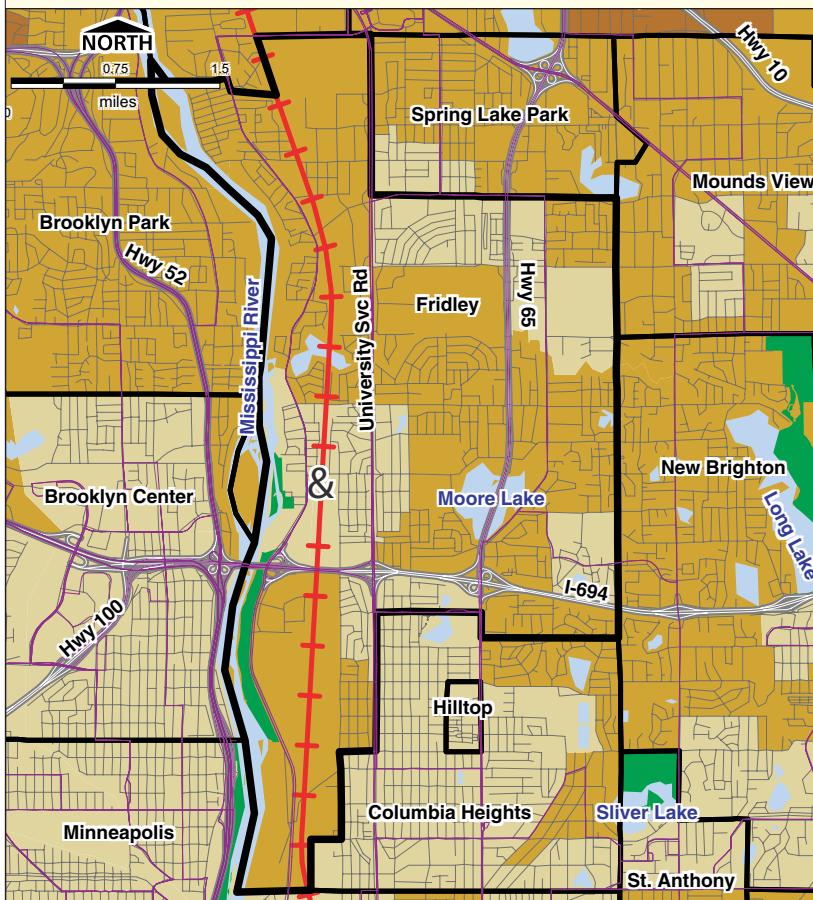
Cost of living in Midway to hypothetical “case” families



The Cost of Living in Midway: Examining the Housing—Transportation Trade-Offs

Focusing on the pie chart illustrating the cost of living for Sheila, a renter and college student earning less than 50 percent of the Seven-County region's median income (\$16,830 versus \$54,304), the varying costs of transportation and housing by neighborhood have a significant impact on her pocketbook. None of the neighborhoods analyzed are affordable meet the threshold of allowing Sheila to spend less than 47 percent of her income on these two costs. However, living in Midway allows her to have 26 percent of her income available for other uses, while the higher transportation costs of living in Fridley would allow her only 12 percent, and Farmington even less at 7 percent.

Putting it All Together: Fridley, Minnesota: Location of future commuter rail station



Transportation Costs for Homeowners in Fridley

\$1,100 to \$1,340
\$900 to \$1,100
\$600 to \$900
0 to \$600

& Northstar Proposed Station

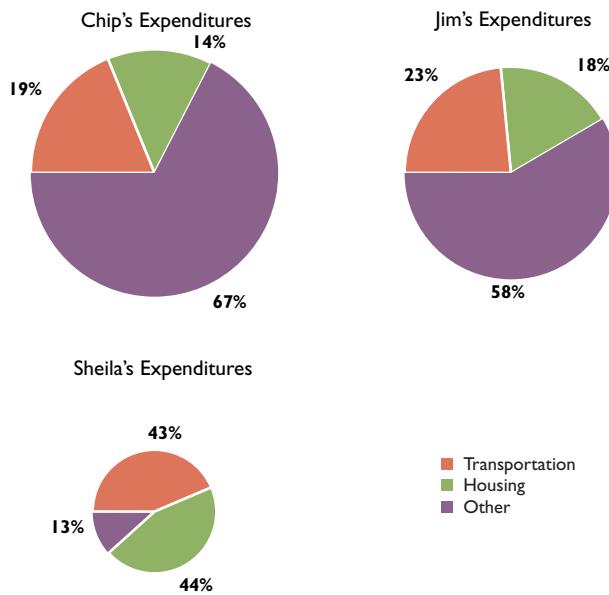
- Northstar Proposed Commuter Rail
- Bus Route
- Highway/Interstate
- Park
- Place Boundary

Fridley is an inner-ring suburban community with more than 27,000 residents. This suburban community is located to the northwest of Minneapolis and primarily accessible by Interstate 694. The median household income in 2000 was \$59,196, and the variation between income levels was

not as marked as in the three central city neighborhoods previously discussed. Although vehicle ownership is slightly below the regional average, only 5 percent of residents commute to work by transit, bicycling, or walking. Average commute time is relatively short at 22 minutes. As a consequence, average monthly transportation costs were \$877 in 2000, higher than the previous two study neighborhoods but still below the regional average.

Most of the housing in Fridley is owner-occupied, and the median house value in 2000 was \$120,000. As with other inner-ring suburbs, the community's population growth began in the 1950s and lasted through the early 1980s. It remains a fairly homogenous population in both income levels and racial backgrounds. Housing costs in 2000 accounted for only 13 percent of income, reflecting the higher average income levels in Fridley. When combined with transportation costs, however, the Affordability Index for Fridley rises to 31 percent of income spent on these two costs. Despite the lower housing costs, the higher transportation costs increase expenditures on these two items.

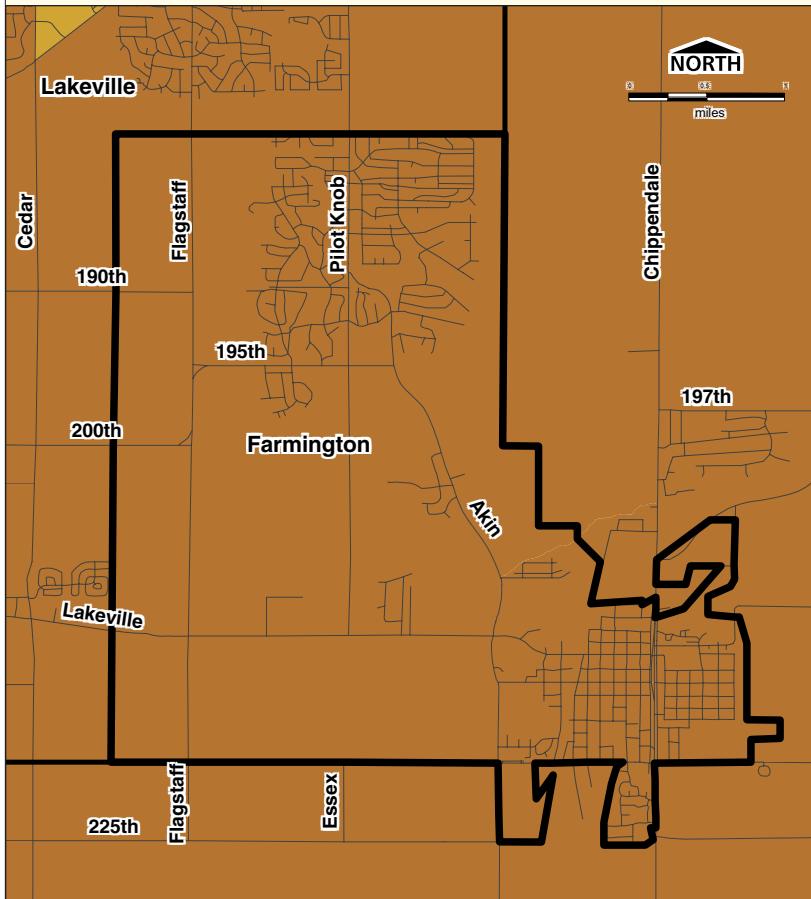
Cost of living in Fridley to hypothetical "case" families



The Cost of living in Fridley: Examining the Housing—Transportation Trade-Offs

For Chip Johnson and his family, Fridley is a relatively affordable community. The family spends less than 50 percent of their annual income on housing and transportation. Additional savings could potentially be realized if they lived in one of the urban neighborhoods examined. But for a 3-person family earning above the region's median income, most communities located near the Twin Cities are affordable. For Sheila, in comparison, affordability is greatly constrained in those neighborhoods outside the CBD as transportation costs rise substantially.

Putting it All Together: Farmington, Minnesota: Development on the suburban edge



Transportation Costs for Homeowners in Farmington

- \$1,100 to \$1,340
- \$900 to \$1,100
- \$600 to \$900
- 0 to \$600

Place Boundary

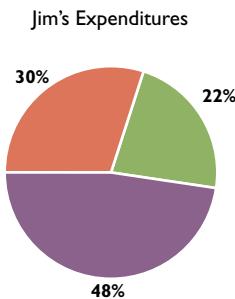
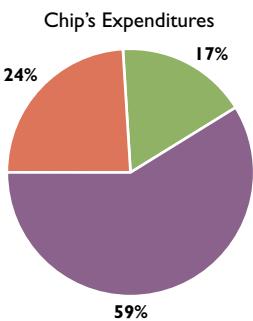
Twenty-five miles south of Minneapolis is the small but growing town of Farmington, population 12,365, and where 81 percent of the housing has been constructed since 1990. Census 2000 data report median housing value at \$146,000, slightly higher than the region's median of \$141,200, but the median household income was lower than the overall region's, \$43,443.

Although Farmington's housing is affordable for a household earning the median income or slightly higher, the Affordability Index shows the impact to the cost of living in a town where the average household owns at least two cars, there is no metro bus service, and the nearest large employment centers are two counties to the north. In Farmington, households spend 54.3% of their incomes for housing and transportation, the highest combined rate of our four study areas. Many of the households moving to Farmington for more affordable housing are likely instead taking on more expensive transportation.

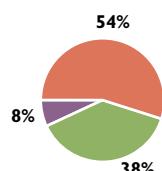
The Cost of Living in Farmington: Examining the Housing—Transportation Trade-Offs

Tracking Jim Dorgan's relative costs of living in these different neighborhoods, we see that affordability varies greatly between communities when transportation and housing costs are combined. Whereas he spends over fifty percent of his income on these two costs in Farmington, were he to live in Fridley he would be spending only 40 percent on these same factors, and if he lived along the Hiawatha corridor in Longfellow/Seward he would have 67 percent of his income to spend on costs other than transportation or housing. Jim accepts the significantly higher transportation cost of living in Farmington (\$1085 per month versus \$574 per month in Seward/Longfellow), as a trade-off for lower cost housing in Farmington and proximity to his aging parents.

Cost of living in Farmington to hypothetical "case" families



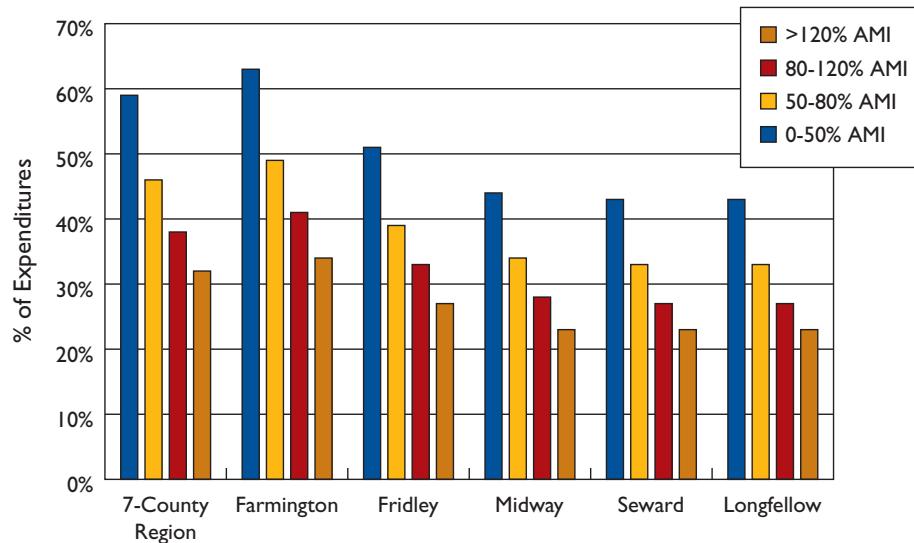
Sheila's Expenditures



■ Transportation
■ Housing
■ Other

Figure 2. Affordability by income level and community

Affordability Index in 4 Areas in Minneapolis-St. Paul



Moving beyond the hypothetical case families to understand the relative affordability of different neighborhoods in Minneapolis-St. Paul, we applied the index to households at various levels of area median income (AMI). Figure 2 shows the results of applying the Affordability Index to the four neighborhoods for households at less than 50 percent AMI, 50 to 80 percent AMI, 80 to 120 percent AMI, and greater than 120 percent AMI. Not surprisingly, affordability varies greatly by location and across income levels. When transportation costs are added to housing costs, which are high throughout the metropolitan region, only the central city neighborhoods are affordable to low-income families at less than 50 percent AMI. Proximity to better transit service in the central cities, access to more jobs, and the availability of some lower priced housing improves the overall cost of living for these households. For middle-income families, reduced transportation costs in these same communities also have a positive effect on the family pocketbook.

Table 4. Potential Affordability Index policy applications for Minneapolis-St. Paul and other regions

Households	Evaluate the true household budget impact of each neighborhood in a region to better determine the trade-offs in costs and lifestyle choices between different geographic locations
Community and civic leaders	<p>Incorporate cost-of-living benefits in campaigns for transit and reinvestment</p> <p>Inform policymakers of the connection between housing and transportation costs to advocate for policies that help retain affordable housing across income levels as part of a transit-oriented development strategy</p> <p>Advocate for including cost-of-living information in the Regional Framework Plan and for compliance with Livable Communities Act</p> <p>Educate households on the true cost of driving versus taking transit: do not just teach how to drive, but teach individuals what the costs are of driving</p>
Transit agencies	<p>Use broad transit benefits to support funding requests: transit is a great deal for public investment, for the household pocketbook, and for economic development</p> <p>Determine the impact of service cuts to the overall affordability of various communities</p> <p>Better measure the true value of investments in mass transit</p> <p>Make more effective decisions about routing, service enhancements, and station deployment</p>
Realtors, lenders, investors, and developers	<p>Provide complete information to buyers on the full costs and amenities associated with a location, adding these data elements to listings</p> <p>Make lending decisions based on total affordability of a place</p> <p>Screen investments for transportation choice and cost of living; focusing affordable housing projects near quality transit service</p> <p>Design housing and commercial products to complement and support transportation choice.</p> <p>Help find housing that fits within a family's budget.</p>
Government agencies	<p>Require alignment between and across government jurisdictions: state, Metropolitan Planning Organizations (MPO), counties, and cities on housing, transportation and land use decisions</p> <p>Incorporate cost-of-living criteria into state's housing and transportation plans</p> <p>Better inform MPOs required state transportation and housing plans, targeting future investments in those areas where transportation or housing costs are prohibitive</p> <p>Supplement The Department of Housing and Urban Development's (HUD) current measures of housing affordability to recognize that transportation costs are inextricably linked to housing costs</p>



IV. The Affordability Index: A Tool to Use Information to Drive Housing and Transportation Markets

The Affordability Index provides a useful tool for a variety of groups actively investing in and planning affordable and mixed-use developments. Overall, the index clearly suggests the need for improved coordination and planning between housing and transportation policies and investments. Considering both factors during decision making, families and public officials can make better decisions about the trade offs, overall costs of living, and cost of providing government services for different locations.

The Affordability Index can also inform to what degree transit investments can improve how affordable different communities are for households of varying income levels. It can also help affordable housing programs to give greater weight to investing in locations that will also reduce household transportation expenditures. Nationally, the number of households with housing cost burdens increased by nearly 5 million in just three years, despite stagnant rents and falling interest rates.⁷ Individuals decide where to locate on the basis of more than just housing price and transportation cost. Neighborhood amenities, property size, quality of schools, and crime rates are all variables that influence their decision. However, data on those other variables are widely available, whereas little to no information has been made available to home buyers or renters about the relative transportation costs associated with different locations. The Affordability Index offers a more comprehensive picture of “affordability” to help individuals more fully evaluate a range of factors that are important to their cost of living.

For a household with limited financial resources, making a careful decision about where to locate involves assessing the value of their choices and weighing the relative costs. How much is it worth to have a private yard, be within walking distance of their child’s school, or to be close to a transit line? If having a large yard means moving to a community where it is necessary to have two or three cars, the results of this study indicate that extra car could cost at least an additional \$4,000 per year. Is it worth it? Maybe. But unless households know the transportation costs associated with their housing choice, they will not know the financial impact of their choice until it is too late.

The Affordability Index is a tool with utility far beyond high-level policy and planning applications. A family might purchase a house in the future from a real estate agent whose multiple listing service provides a link to the Affordability Index. In addition to data on school districts, property tax burden, parish and physical characteristics of the parcel, the family might also be provided with maps and aerial photos that show nearby green space, transit connections, and an Affordability Index ranking that depicts housing and transportation costs. A realtor could assist individuals in comparing their dream home along the transit rail line with one in a neighboring suburb. A more complete picture of costs and amenities would better inform the family of the trade-offs between a variety of amenities and cost savings. These cost savings translate into increased opportunities for wealth creation.

In summary, the Affordability Index could be used by a variety of actors, from the individual household to local, state, and federal officials. Table 4 highlights some of the policy applications for households, community leaders, transportation and housing professionals, and the financial community. Thinking more strategically about combining transportation and housing investments to leverage the connections between both can help to improve affordability and increase accessibility, which will drive healthier housing and transportation markets in cities.

V. Housing Affordability Reconsidered

The Affordability Index allows us to rethink the issue of true housing affordability. If all the participants in the housing market—developers and consumers, regulators, and politicians—began thinking differently about the affordability of place, it could have a substantial positive effect on households, neighborhoods, regions, and businesses.

People must make their own decisions about where they want to live, but it is important to provide them with the information they need to better understand the financial implications of those decisions. The Affordability Index makes clear that for a family, affordability goes beyond just “affordable housing,” and the costs of shelter. It allows us to demonstrate that in most cases, transit-rich environments have a positive effect on household disposable income. It illuminates the critical role of public investment in transportation and housing in supporting wealth-building strategies for low- to moderate-income families.



Detailed Methods

The model theorizes that each transportation cost component—auto ownership, auto use, and public transit—is a function of the local environment (V_{le}) of that place and household income and size (V_{hh}). The simple equation is:

$$\text{Total Transportation Cost} = [C_{aO} * F_{aO}(V_{le}) * G_{aO}(V_{hh})] + [C_{aU} * F_{au}(V_{le}) * G_{au}(V_{hh})] + [C_{pt} * F_{pt}(V_{le}) * G_{pt}(V_{hh})]$$

where C represents a cost factor (i.e., dollars per mile driven), and F and G are generic functions of the local environment and the household variables.

By separating the urban variables from the household variables, we remove the correlation of wealth and family size with the characteristics of place to allow us to assign the intrinsic value of the efficiency of any given place, without confusing the cost of transportation with the characteristics of households residing there.

The three base transportation costs were each calibrated against existing measured data: average autos per household per block group (based on U.S. census data), vehicle miles traveled (VMT) (based on the national Household Travel Survey [NHTS]), and percent of journey to work trips by transit, and share of FTA transit revenue database. Block groups were used as the base geography of analysis given they are smaller in area than census tracts—yet detailed census data and other variables used in the analysis are still widely available.

Although this is a social science model and household behavior is impossible to precisely predict in every situation, we attempted to address as many variations as possible in auto ownership, auto use, or transit ridership through the design of the model and the selected data. The following items are key notes about transportation costs and how they are addressed in the model and data sources:

- Federal Highway Administration (FHWA) research shows that VMT per vehicle varies as the number of autos per household increases. Therefore, we adjust the model to assign the estimated miles per auto based on the NHTS results for multiple vehicles per household.
- The model is able to estimate transportation costs for renters and owners separately, because households in each tenure represent a different cohort both in household size and income. The rental and ownership housing markets are different, which affects location choices.
- The costs for auto ownership and use are from FHWA estimates from the 2001 editions of *The Complete Car Cost Guide and Complete Small Truck Guide* from IntelliChoice, Inc., and sales figures from Automotive News. Auto ownership costs include depreciation, insurance, financing, and state fees. Auto use costs include fuel, maintenance, fuel tax, and repairs. The FHWA estimates the fixed annual ownership and use costs by the type and age of vehicle. We use a weighted average for the two costs on the basis of the existing fleet of U.S. vehicles, which results in \$5,068 for the ownership component and 9 cents per mile for the use component. Because these costs are averages, in some cases, the model will over- or underestimate the ownership, use, or total costs. For instance, the ownership costs will be too high for vehicles that are older, smaller, or less expensive than the average vehicle on the road, and the auto use costs may be too low for these same vehicles, especially if they require more maintenance or are less fuel efficient. The pricing model also does not account for variations in local economies or state regulations and how that might affect insurance rates, gasoline, and other auto costs.
- Other than the CTOD national database, there is no single current and complete national source for all bus and rail lines in the United States. We made our best attempt to gather this data for each of the 28 major U.S. metropolitan areas; however, several cities have no data or Geographic Information Systems (GIS) files for their bus systems. For the Minneapolis-St. Paul area, we obtained complete and current information on the bus routes and frequencies from the Met Council, but the Transit Connectivity in our model does not include bus stop locations.
- Lacking a source for exact information on the number of trips taken and distance to work and all other destinations by households at the census block group level, we instead used the National Household Travel Survey (NHTS) to estimate the total vehicle miles driven per household on the basis of the census block group characteristics of the households in the survey. We were able to identify the actual block group for approximately 6,840 survey records in the NHTS dataset and used these records to determine the relation between the characteristics of those block groups and the annual miles per vehicle reported by the households in the block groups. We then assign annual miles to households in each block group on the basis of the characteristics of that block group.
- To account for access to jobs and services, which influence a household's transportation demand, we developed a method to identify employment centers both in size and location. We assigned the number of jobs within each census tract using the CTPP 2000. This allowed us to identify and group those census tracts that were adjacent to each other and had a high employment density as major employment centers. The distance from each block group to the closest employment center is then used as an independent variable in the model.

Table 1. Independent and dependent variables in the transportation cost model

Independent variable	Source	Purpose
Households per residential acre	Census 2000	Provides a measure of density, which influences auto ownership and use
Households per total acre	Census 2000	Provides a measure of density, which influences auto ownership and use
Average block size in acres	Census/TIGER/Line®	Block size contributes to walkability of the area, which influences auto ownership, auto use, and transit use
Transit Connectivity Index*	CTOD national database: FTA 1995 bus routes database, local transit agencies	Availability and extent of transit influences transit use
Distance to employment centers	Census Transportation Planning Package (CTPP) 2000	Distance to nearby jobs influences auto ownership and auto use
Job density: number of jobs per square mile	Jobs and locations, CTPP 2000	Number of nearby jobs influences probability of working at the nearby employment center
Access to amenities	Service jobs in the CTPP 2000	Nearby services within walking distance influences auto use and ownership, as well as transit availability and use
Household income	Census 2000	Influences auto ownership and use
Household size	Census 2000	Influences auto ownership and use
Dependent variable	Source	Use
Auto ownership (vehicles per household)	Modeled from independent household and local environment variables	To determine the number of autos a household owns and the associated ownership costs
Auto use (annual miles driven per household)	Modeled using the 2001 NHTS reported VMT fitted to the independent variables	To determine the number of miles a household drives each vehicle and the associated usage costs
Transit Rides per day	Modeled from independent household and local environment variables	To determine the number of transit rides per day per household.

*The Transit Connectivity Index (TCI) is a measure developed by Center for Neighborhood Technology using bus and train system route and service data to estimate the quality of transit in proximity to a census tract by measuring the frequency and location of the bus and train routes and train stations. Bus stops are not currently part of the TCI owing to the lack of readily available and consistent data at the national level. A high TCI score represents frequent and extensive transit in relation to other locations within that region. The categories in Minneapolis are >0-600 Low, 600-2700 Medium, and >2700 High.



Endnotes

1. Creating the model relies on complete data sets for a particular area; the model can be created in any city with data on the transit routes and their service frequencies.
2. Several researchers have shown the relation between the built environment and transportation use and costs, including the following studies. Scott Bernstein, Carrie Makarewicz, and Kevin McCarty, "Driven to Spend: Pumping Dollars Out of Our Households and Communities" (Washington: Center for Neighborhood Technology and Surface Transportation Policy Project, 2005). See <http://www.transact.org>. John C. Bernbach and Scott Bernstein, "Pursuing Sustainable Communities: Looking Back, Looking Forward," *Urban Lawyer* 35 (495) (Summer 2003): ADD PAGE NUMBERS OF JOURNAL ARTICLE. John Holtzclaw, Robert Clear, Hank Dittmar, David Goldstein, and Peter Haas, "Location Efficiency: Neighborhood and Socio-Economic Characteristics Determine Auto Ownership and Use—Studies in Chicago, Los Angeles, and San Francisco," *Transportation Planning and Technology* 25(1) (2002): 1-27, available online at www.tandf.co.uk/journals/online/0308-1060.html. John Holtzclaw, "Using Residential Patterns and Transit to Decrease Auto Dependence and Costs," *Journal of the Transportation Research Board Record* 1805 (2002): D. B. Hess and P. M. Ong, "Traditional Neighborhoods and Automobile Ownership," *Journal of the Transportation Research Board Record* 1805 (2002): 35–44. Natural Resources Defense Council, San Francisco, and California Home Energy Efficiency Rating Systems, Costa Mesa, California, 1994. Peter Newman and Jeffrey Kenworthy, *Cities and Automobile Dependence: An International Sourcebook* (Aldershot, UK: Gower Publishing, 1989). Gary Pivo, Paul Hess, and Abhay Thatte, "Land Use Trends Affecting Auto Dependence in Washington's Metropolitan Areas, 1970–1990" (WA-RD 380.1) (Olympia: Washington State Department of Transportation, 1995). Charles Komanoff, "Public Transit: The Vision for 2020" (Chicago: Center for Neighborhood Technology, 1990).
3. Walkability is measured in the Affordability Index model by the average census block size. Block sizes are measured by the Census in acres. Smaller block sizes are an indication of streets on a grid that likely have sidewalks and where housing, amenities, and other locations are within easy walking distance of each other because there is a greater network of streets and intersections and therefore more options for traveling between destinations on foot.
4. Holtzclaw et al.. "Location Efficiency."
5. For a complete description of the model's development and methodology, see the Reconnecting America website, www.reconnectingamerica.org.
6. For the sample households, wage levels and occupations are based on the wages and occupations cited in "Paycheck to Paycheck," (Washington: Center for Housing Policy, 2001), and Bureau of Labor Statistics median wages for Minneapolis-St. Paul metropolitan statistical area (MSA), 2003. Household total and component expenditures, except for housing and transportation, which are based on the CTOD Affordability Index model calculations, are based on average expenditures for households of these income levels and sizes reported in 2001 Consumer Expenditure Survey of the Bureau of Labor Statistics.
7. Lipman, Barbara, "Something's Gotta Give: Working Families and the Cost of Housing", *New Century Housing*, Volume 5, Issue 2, Center for Housing Policy , p. 10

Acknowledgments

To develop and pilot the measure, Reconnecting America's Center for Transit-Oriented Development (CTOD)—with generous grants from The Brookings Institution's Urban Markets Initiative, the McKnight Foundation, and Surdna Foundation—used the Minneapolis-St. Paul region as a prototype to refine our methodology and calibrate the Affordability Index. The pilot model for Minneapolis-St. Paul was reviewed by a group of local stakeholders, academics, and planning professionals in August and September 2005. After reviewing the model in the region and with national advisors from the housing, transportation, finance, and business communities, the CTOD adjusted the model and will apply the methodology developed in the Twin Cities to an existing national data set of the 27 other major U.S. cities. The expected timeframe for the national model is early 2006.

Shelley Poticha, of Reconnecting America, and Peter Haas, Ph.D., of the Center for Neighborhood Technology, co-directed the project team. Principle staff included Albert Benedict, Scott Bernstein, and Carrie Makarewicz of the Center for Neighborhood Technology; Maria Zimmerman of Reconnecting America; and Pari Sabety and Brian Nagendra at The Brookings Institution's Urban Market Initiatives program.

For More Information

The Housing and Transportation Affordability Index is designed for use in more than 42 cities in the United States.

See www.brookings.edu/metro/umi.htm or www.cnt.org or www.reconnectingamerica.org.

Living Cities: The National Community Development Initiative is the founding funder for the Urban Markets Initiative. Living Cities is a partnership of leading foundations, financial institutions, nonprofit organizations, and the federal government committed to improving the vitality of cities and urban communities.



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