Location, Regional Accessibility, and Price Effects

Evidence from Home Sales in Hennepin County, Minnesota

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Regional location factors exert a strong influence on urban property markets, and measures of accessibility are foremost among them. More local influences, such as proximity to urban highway links, also may positively or negatively influence the desirability of a location. This study used a cross section of home sales in Hennepin County, Minnesota, from the years 2001 through 2004, along with a set of disaggregate regional accessibility measures, to estimate the value of access to employment and resident workers. The effects, whether as amenity or disamenity, were estimated for locations near major freeway links that had recently undergone major construction to add capacity (or were scheduled to undergo such construction) at the time of the home sales. The richness of the home sales data set allowed for control of a number of structural attributes, as well as some site characteristics. Additional neighborhood characteristics (such as income levels and local educational quality) were added from supplemental data sources. Empirical results indicated that households highly valued access to employment. Access to other resident workers (i.e., competition for jobs) was considered a disamenity. Proximity to local highway access points associated positively with sale price, whereas proximity to the highway link itself associated negatively with that price. The study concluded with some implications for research and practice of the concept and measurement of the relationship between location and land value.

The level of regional accessibility provided by transportation networks has long been recognized as a critical factor in the shape of urban land markets, and hence urban structure. Land markets play a critical role in the conveyance of information about the value that households and firms place on location factors, and in the conveyance of information to developers of urban land about where to invest. Interest has grown in the dynamic relationship between location, development, and land value, and to understand and forecast the effects of various transportation policies at a spatially disaggregate level. Thus the need has grown to focus on the estimation of the relationship between accessibility and land value.

This study contributed to a growing body of literature that features attempts to estimate the relationship between accessibility and land value at a spatially disaggregate level. Spatially explicit and disaggregate measures of urban accessibility have been recognized in geography, urban planning, and related fields for many decades. Their emergence as measures of urban form in studies of urban land values, however, has largely been a more recent phenomenon. This study used a set of accessibility measures developed for the Minneapolis–Saint Paul (Twin Cities) metropolitan region. The study also used a large cross section of regional home sales with a rich set of statistical controls to estimate the marginal value of access to regional employment and resident workers. Some attention also was paid to local factors, such as proximity to the regional highway network. The study also examined whether or not recent construction projects to add highway capacity had an impact on local property values.

The paper proceeds as follows. The next section offers a brief overview of empirical studies of location and land value, with emphasis on those that have sought to use more disaggregate measures of accessibility to characterize urban location. The third section introduces the study methodology. It identifies the empirical specification used to estimate the determinants of home sale prices, and describes the data sets used to create the variables and fit the model. The fourth section describes the results of the empirical model. The paper concludes with some implications for research and practice of the concept and measurement of the relationship between location and land value.

STUDIES OF LOCATION AND LAND VALUE

For nearly half a century (and perhaps more), urban researchers have conducted empirical studies of the relationship between location and land value. Early studies were motivated by the desire to test theoretical models of urban structure and land rent (*1–4*). These theoretical models generally treated transportation quite crudely, mostly out of a desire to retain the analytical tractability of the models. Transportation was specified to have universal availability and a constant unit cost specified in terms of distance from a single central business district, where all employment in a city was located. Households traded off transportation costs against land and other consumption goods, which gave rise to a unique rent gradient that described equilibrium rents at a given distance from the central business district.

Many early studies were grounded in the theory of the monocentric model of urban structure, which provided satisfactory statistical fits to available data, usually with log-linear types of specifications. Yet from causal observation and empirical inquiry, it became increasingly clear over time that cities had evolved away from the monocentric

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model. Many economists and other urban researchers began to explore the role of subcenters as a common feature of urban structure in modern, polycentric cities (*5, 6*). The framework of hedonic regression was employed to generalize the monocentric model enough to empirically account for the influence of employment subcenters, as well as any other observable characteristics thought to influence land or property prices (*7*). One particular study by Heikkila et al. identified rent gradients that emanated from eight employment subcenters within the Los Angeles, California, region, although the Los Angeles central business district was not among them (*8*).

The current generation of studies of the relationship between location and land value is increasingly informed by the use of disaggregate measures of urban form. Their use has been spurred by improvements in computing technology and data storage, especially the adoption of geographic information systems and transportation modeling packages that can run on personal computers. Some examples exist of older empirical studies of property values that employed disaggregate measures of location. Brigham, for instance, computed an accessibility potential measure for Los Angeles, which computed access to employment by zone, with employment discounted by the distance between zones (a form of gravity-based measure) (*9*). Similarly, a study by Nelson sought to derive the value of time spent to commute through estimation of hedonic price functions for home prices. The explanatory variables consisted of a number of measures of accessibility, including two forms of cumulative opportunity (*10*).

Interest in understanding the spatial consequences of urban transportation and land use policies, and the feedback among them, in turn have spurred interest in the development of integrated models of transportation and land use, many of which have as key components modules that simulate urban real estate markets (*11–13*). Prices and quantities of housing and commercial floor space are predicted at a disaggregate spatial level, with accessibility levels of locations that serve as key explanatory factors (*14*). Typically, accessibility measures are derived from mode or destination (or both) choice modules of the transportation model and are utility-based in type (*15*). In addition to their use as a key component of integrated urban models, disaggregate regional accessibility measures often serve as important controls in studies of the impact of urban rail transit systems on property values (*16, 17*). The key advantage of disaggregate measures of location as predictors of land value is their ability to capture the effects' distributions of employment, which are highly decentralized and deconcentrated, and are a phenomenon that has been observed in many U.S. cities (*18*).

METHODOLOGY

Specification

Hedonic regression was the method used in this study to model home prices and to estimate the effects of accessibility levels and highway proximity. Hedonic price models seek to estimate the price of housing through the decomposition of the housing into the bundle of services it provides (attributes) and to gauge the implicit values that consumers place on each attribute. This method works best when it is possible to identify a large number of attributes, as was the case with the Multiple Listing Service (MLS) home sales data used here. The base estimation equation was the standard hedonic price function (*19*).

$$\ln P_{it} = \alpha_t + \delta_t U_i + \beta' \mathbf{X}_i + e_{it}$$

where

- $\ln P_{it}$ = natural logarithm of the price of house i at its sale at time t;
- α_t = indicator variable for houses that sold during time period t;
- U_i = dummy variable to indicate that house i is within a given distance of an upgraded road segment;
- δ_i = parameter associated with U_i variable;
- β' = vector of parameters to be estimated, associated with variables representing location, neighborhood, and housing characteristics (in X matrix); and
- e_{it} = disturbance term for house i at time t.

The influence of improved road segments was identified through the construction of buffer zones around upgraded segments of roads, and then the selection of houses within these buffer zones with the indicator variable, U_i. Because of the large sample size, the model was estimated with interactions between location and year of sale to test for any variations in the effect of proximity to an improved highway during the study period.

The measures of regional accessibility employed in this study were zone-based, cumulative opportunity measures of access to jobs and resident workers, and were measured at the transportation analysis zone level. Cumulative opportunity measures involve the designation of a threshold travel time (30 min in this study), within which opportunities (e.g., jobs) are counted. The opportunities in zones that are not accessible within this prescribed travel time are given no value. The accessibility for any individual zone is the sum of the opportunities in all zones accessible within the travel time threshold. Formally, the cumulative accessibility measure can be expressed as

$$A_i = \sum_{j=1}^{J} B_j a_j$$

where

- A_i = accessibility for zone i,
- j = indexes for jth zone,
- J = total number of zones in region,
- B_j = binary variable = 1 (if zone j is within the given travel time threshold from zone i) or = 0 otherwise, and
- a_j = number of opportunities in zone j.

A map of auto-based accessibility to employment by transportation analysis zone within the region in the year 2000 is shown in Figure 1.

A distinct advantage of the accessibility measures used in this study was that they represented zone-to-zone travel times drawn largely from actual observations of link flows. Freeway network link flows and travel times were drawn from loop detectors that provided continuous traffic counts. Arterial travel times were based on link performance functions that used traffic counts, where available, and were supplemented and updated with modeled flows from a stochastic user equilibrium traffic assignment, as described in Davis et al. (*20*).

The data constituted a relatively heterogeneous, cross-sectional sample of property sales. For that reason, ordinary least squares with heteroskedastic-consistent standard errors were used to estimate the model.

Data and Variables

The empirical model was fitted to MLS home sales data that covered sales in Hennepin County, Minnesota, from 2001 to 2004. Hennepin

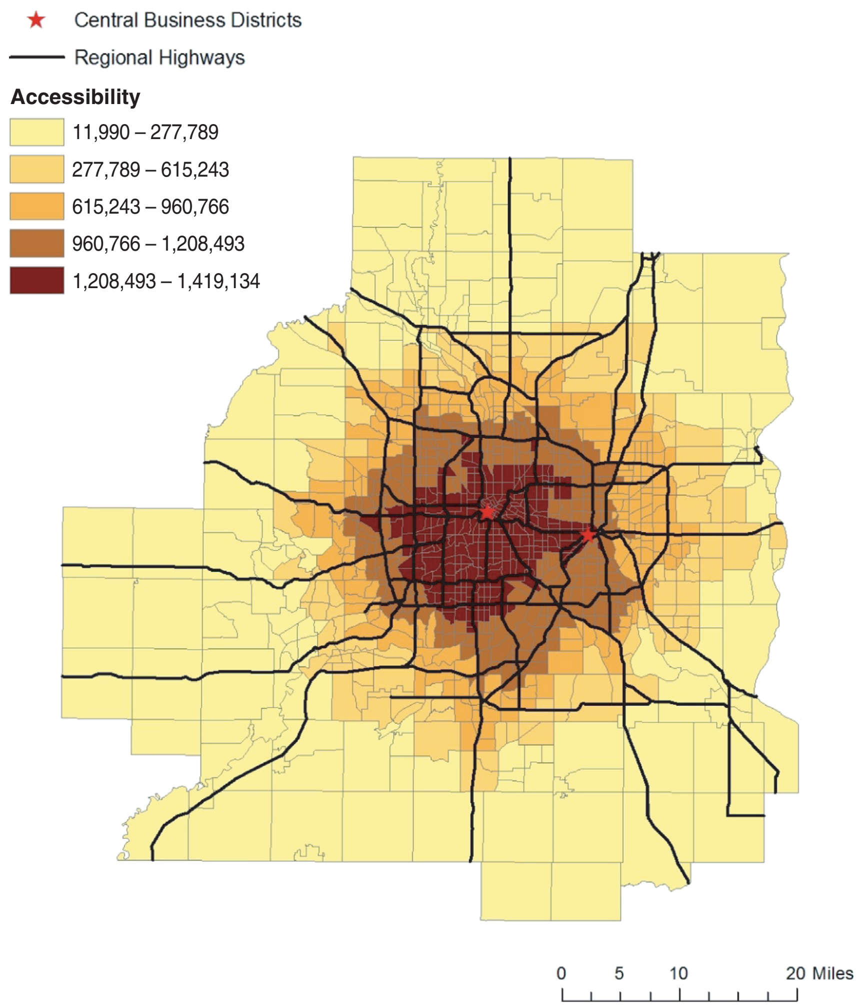

FIGURE 1 Number of jobs accessible by car within 30 min by transportation analysis zone, Twin Cities metropolitan area, 2000.

County, which includes Minneapolis, is Minnesota's most populous (estimated at 1.15 million as of 2007), and one of the seven, core metropolitan counties under the jurisdiction of the Metropolitan Council, headquartered in Saint Paul. The time period studied was a particularly vigorous one for sales activity in the Twin Cities real estate market. Median home sale prices in Hennepin County increased by more than 24% (from $177,000 to $220,000) in nominal terms from 2001 to 2003. The data set included more than 66,000 sales and contained information about the characteristics of each structure and the land on which it sat (e.g., acreage, lake frontage). The location of each of the sales is plotted in Figure 2.

The characteristics provided by the MLS data were supplemented with variables that represented neighborhood characteristics (e.g., income, school quality) and location. The latter included variables that identified a location near an upgraded highway and also variables that represented regional accessibility, which was defined as proximity by auto in the year 2000 to employment and to resident workers (i.e., eligible, working-age members of the labor force). Given the research into the effects of accessibility with respect to competition (*21, 22*), it could be expected that households would value increased access to employment but would perceive a disutility in greater access to competing resident workers (measured here simply as population). Dummy variables were included for both the year and month of sale. The former were used to control for seasonality in home sales and associated price impacts, while the latter were used to identify longer term, secular trends in prices. The year-specific variables may be seen as ones that traced out an index of sale prices over time, because they controlled for most relevant qualitative attributes. Table 1 provides a list of variables included in the analysis of the MLS home sales data. Table 2 presents descriptive statistics for each of the variables (i.e., mean, standard deviation, median, minimum and maximum values) in the MLS home sales data.

Multiple variables were defined to measure the impact of highway capacity improvements. At the most basic level, distance bands were defined around upgraded highway segments in ¼-mi (0.4 km) intervals, up to a distance of 1 mi (1.6 km). The choice of 1 mi was somewhat arbitrary as a threshold, beyond which highway improvements were assumed to have little measurable effect. Reviews of empirical work, however, revealed several examples of the use of this threshold (*23*), and the results here suggested that it was a reasonably good fit. The effect of distance from an improved highway was assumed to be nonlinear and of indeterminate form, which made the use of a series of dummy variables all the more appealing. These locational dummies interacted with the variables that represented individual years, which allowed for the impact of highway improvement (and perhaps

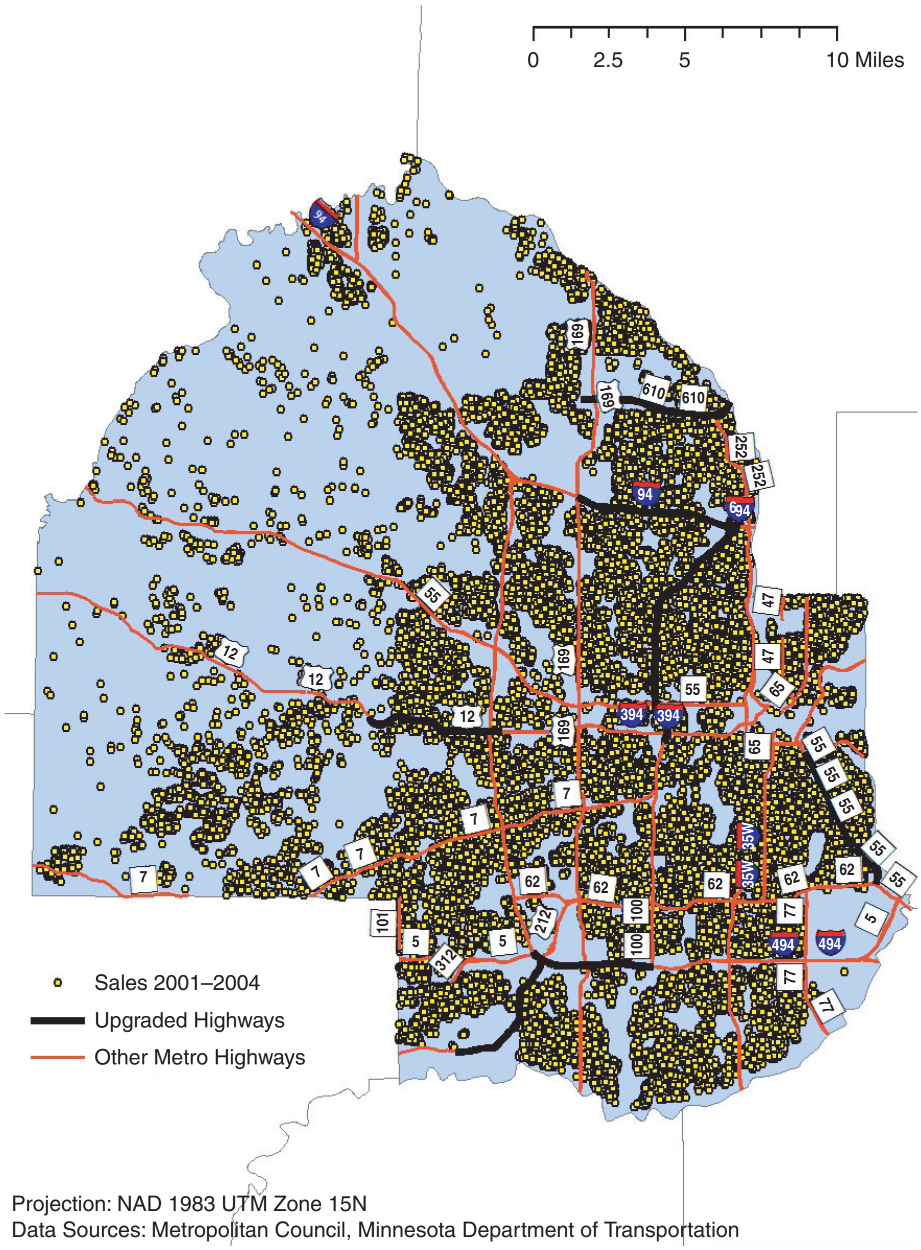

FIGURE 2 Location of MLS home sales in Hennepin County, 2001 to 2004.

also disruption during major construction periods) to vary over time. Another type of location variable was defined, which interacted the sale year dummy with a measurement of the distance from the home to the nearest highway access point (in meters). This distance also was limited to a 1-mi (1.6-km) radius. The use of this term was designed to represent the possibility that two effects of proximity to an improved freeway might be present. First, the location dummy represented linear distance to the facility itself, and might have uncovered externalities associated with location near a freeway (e.g., noise, air pollution), which were anticipated to have negative effects (*24–26*). Second, proximity to a highway access point might have yielded additional accessibility benefits, which might to some degree have offset the effect of proximity to the facility itself. It was hoped that the introduction of this variable would help to isolate separate proximity effects in certain cases, such as when a home was located near a highway but did not enjoy the benefit of a convenient, nearby access point.

RESULTS

Output from the estimation of the hedonic price model for home sales in Hennepin County is provided in Table 3. The table lists estimates for the various model parameters, their associated standard errors, *t*-values, and levels of statistical significance. Overall, the model provided a good fit to the home sales data. The large sample ensured that most of the variables were statistically significant and, in many cases, strongly so.

TABLE 1 List of Variables Included in Hennepin County Home Sale Price Model

Variable	Description
ln SalePrice	Natural logarithm of sale price
Bedrooms	Number of bedrooms
Bathrooms	Number of bathrooms
ln Age	Natural logarithm of age of house
ln AgeSq	Natural logarithm of age of house squared
ln FinishedSq	Natural logarithm of finished square feet
Fireplace	Number of fireplaces
GarageStall	Number of garage stalls
Acres	Acres of land
Creek	Dummy variable representing creek frontage
Lakefront	Dummy variable representing lakefront property
LakeView	Dummy variable representing lake view
Riverfront	Dummy variable representing river frontage
RiverView	Dummy variable representing river view
Pond	Dummy variable representing pond on property
ln IHMed	Natural logarithm of census tract–level median household income
NonWhite	Percent of population nonwhite (measured at census tract level)
ln MCA5Comp	Natural logarithm of school district mean comprehensive score of 5th-grade students on Minnesota comprehensive assessment tests
Graduation	School district graduation rate (percent)
ln Access30	Natural logarithm of jobs accessible within 30 minutes
¼ Mile	Dummy variable for location within ¼ mile of upgraded highway
½ Mile	Dummy variable for location within ½ mile of upgraded highway
¾ Mile	Dummy variable for location within ¾ mile of upgraded highway
Mile	Dummy variable for location within 1 mile of upgraded highway
¼ Mile02	¼ mile * 2002
¼ Mile03	¼ mile * 2003
¼ Mile04	¼ mile * 2004
½ Mile02	½ mile * 2002
½ Mile03	½ mile * 2003
½ Mile04	½ mile * 2004
¾ Mile02	¾ mile * 2002
¾ Mile03	¾ mile * 2003
¾ Mile04	¾ mile * 2004
Mile02	mile * 2002
Mile03	mile * 2003
Mile04	mile * 2004
¼ Dist	Distance to nearest freeway entrance ramp * ¼ mile
½ Dist	Distance to nearest freeway entrance ramp * ½ mile
¾ Dist	Distance to nearest freeway entrance ramp * ¾ mile
MileDist	Distance to nearest freeway entrance ramp * 1 mile
2002	Dummy variable representing sale in year 2002
2003	Dummy variable representing sale in year 2003
2004	Dummy variable representing sale in year 2004
February	Dummy variable representing sale in month of February
March	Dummy variable representing sale in month of March
April	Dummy variable representing sale in month of April
May	Dummy variable representing sale in month of May
June	Dummy variable representing sale in month of June
July	Dummy variable representing sale in month of July
August	Dummy variable representing sale in month of August
September	Dummy variable representing sale in month of September
October	Dummy variable representing sale in month of October
November	Dummy variable representing sale in month of November
December	Dummy variable representing sale in month of December

TABLE 2 Descriptive Statistics for Hennepin County Residential Sales Data

Variable	Mean	SD	Median	Min.	Max.
ln SalePrice	12.309	0.487	12.223	9.568	15.538
Bedrooms	3.038	0.943	3	0	10
Bathrooms	2.106	0.943	2	0	11
ln Age	3.581	0.801	3.807	1.386	5.063
ln AgeSq	7.163	1.603	7.613	2.773	10.125
ln FinishedSq	7.438	0.430	7.433	5.298	9.999
Fireplace	0.593	0.790	0	0	6
GarageStall	1.759	0.831	2	0	12
Acres	0.124	1.055	0	0	110
Creek	0.011	0.105	0	0	1
Lakefront	0.018	0.133	0	0	1
LakeView	0.018	0.134	0	0	1
Riverfront	0.002	0.043	0	0	1
RiverView	0.003	0.053	0	0	1
Pond	0.037	0.189	0	0	1
ln IHMed	10.838	1.671	10.977	–9.210	12.125
NonWhite	11.346	15.989	6.600	0	91.700
ln MCA5Comp	8.450	0.068	8.457	8.360	8.565
Graduation	76.343	20.189	88.000	46.000	99.000
ln Access30	13.847	0.388	14.007	10.794	14.159
¼ Mile	0.036	0.188	0	0	1
½ Mile	0.057	0.231	0	0	1
¾ Mile	0.062	0.241	0	0	1
Mile	0.056	0.230	0	0	1
¼ Mile02	0.009	0.092	0	0	1
¼ Mile03	0.009	0.095	0	0	1
¼ Mile04	0.010	0.099	0	0	1
½ Mile02	0.014	0.116	0	0	1
½ Mile03	0.015	0.120	0	0	1
½ Mile04	0.015	0.123	0	0	1
¾ Mile02	0.013	0.115	0	0	1
¾ Mile03	0.016	0.127	0	0	1
¾ Mile04	0.019	0.135	0	0	1
Mile02	0.013	0.113	0	0	1
Mile03	0.014	0.118	0	0	1
Mile04	0.017	0.129	0	0	1
¼ Dist	11.860	88.773	0	0	1,565.531
½ Dist	11.860	88.773	0	0	1,565.531
¾ Dist	41.774	207.543	0	0	1,608.767
MileDist	41.305	232.767	0	0	1,609.227
2002	0.231	0.422	0	0	1
2003	0.251	0.433	0	0	1
2004	0.295	0.456	0	0	1
February	0.051	0.219	0	0	1
March	0.068	0.252	0	0	1
April	0.081	0.272	0	0	1
May	0.095	0.293	0	0	1
June	0.112	0.315	0	0	1
July	0.107	0.309	0	0	1
August	0.113	0.316	0	0	1
September	0.090	0.286	0	0	1
October	0.089	0.285	0	0	1
November	0.075	0.264	0	0	1
December	0.069	0.254	0	0	1

NOTE: SD = standard deviation; min. = minimum value; max. = maximum value; *N* = 66,479.

TABLE 3 Hedonic Price Model for Home Sales in Hennepin County, 2001–2004

Variable	Coefficient	SD	*t*-Value	Sig.
Bedrooms	–0.013	0.001	–8.85	***
Bathrooms	0.075	0.002	45.46	***
ln Age	–1.399	0.251	–5.57	***
ln AgeSq	0.672	0.125	5.35	***
ln FinishedSq	0.632	0.004	146.93	***
Fireplace	0.060	0.001	40.11	***
GarageStall	0.052	0.001	39.02	***
Acres	0.032	0.001	37.36	***
Creek	0.076	0.008	9.02	***
Lakefront	0.511	0.007	74.09	***
LakeView	0.149	0.007	22.27	***
Riverfront	0.228	0.020	11.15	***
RiverView	0.195	0.017	11.62	***
Pond	0.023	0.005	4.76	***
ln IHMed	–0.0003	0.001	–0.52	
NonWhite	–0.007	0.00007	–96.47	***
ln MCA5Comp	1.387	0.034	40.85	***
Graduation	–0.007	0.0001	–62.62	***
ln Access30	0.138	0.003	47.03	***
¼ Mile	–0.054	0.011	–5.00	***
½ Mile	–0.022	0.008	–2.69	***
¾ Mile	–0.015	0.009	–1.65	*
Mile	0.012	0.009	1.31	
¼ Mile02	–0.026	0.014	–1.88	*
¼ Mile03	–0.001	0.013	–0.07	
¼ Mile04	–0.035	0.013	–2.65	***
½ Mile02	0.007	0.011	0.66	
½ Mile03	0.023	0.011	2.06	**
½ Mile04	–0.040	0.011	–3.68	***
¾ Mile02	–0.008	0.011	–0.70	
¾ Mile03	0.000	0.011	0.00	
¾ Mile04	–0.026	0.010	–2.52	**
Mile02	–0.003	0.012	–0.24	
Mile03	0.021	0.011	1.85	*
Mile04	–0.011	0.011	–0.98	
¼ Dist	0.0000837	0.0000141	5.94	***
½ Dist	N/A	N/A	N/A	N/A
¾ Dist	0.00000721	0.00000753	0.96	
MileDist	–0.0000209	0.00000633	–3.30	
2002	0.129	0.003	40.31	
2003	0.154	0.003	52.80	
2004	0.110	0.003	36.29	
Constant	–5.592	0.283	–19.75	

NOTE: Dependent variable is natural logarithm of sale price; Sig. = statistical significance; N/A = not applicable; *N* = 66,479; adjusted R^2 = .782.
* = variable is statistically significant at $p < .1$ level.
** = variable is statistically significant at $p < .05$ level.
*** = variable is statistically significant at $p < .01$ level.

Transportation-Related Variables

Of greatest interest were the effects of the transportation-related variables in the model. Employment accessibility appeared to be highly valued by households. The variable that represented year 2000 employment within a 30-min drive of a household's home was significantly positive. A 10% increase in this measure raised the sale price of a home by about 2.3%. Conversely, population access within the same travel shed, the measure of competing resident workers, was associated negatively with a home's sale price. The coefficient on this variable indicated that a 10% increase in competing resident workers was associated with a roughly 1% decline in sale price.

The variables that represented time-varying effects of proximity to an upgraded highway showed mixed results. Most were statistically significant and negative in sign. Regardless of year, properties closest to the upgraded highway showed a negative effect, which appeared to taper off with distance, and traced out the gradient for proximity to the highway itself. Values for all of the coefficients were larger in 2003 than in 2002 but were more negative in 2004.

The second set of variables, which related to location near an upgraded highway and measured the interaction of time and distance from the nearest access point, showed mixed results. The coefficient for the variable that represented distance from the nearest access point was negative and statistically significant in each case, as expected, which indicated that it was a benefit to have good access to an upgraded highway. The coefficient for distance from the nearest access point in 2002 was (–0.0000317). The interpretation was that a 100-m increase in distance from the nearest access point on an upgraded highway link was associated with a decline of 0.3% in home sale price, up to a distance of 1 mi (1.6 km). There was, however, no discernable trend in the value of this coefficient over the 3 years during which this effect was measured (relative to 2001). Most likely, this short period was not sufficient to capture the adjustments in local real estate markets that might be expected to occur in response to a highway improvement, to the extent that they did occur.

The marginal effect of the road upgrade on nearby property values in this particular model specification was the sum of the coefficients for the two highway proximity variables described above.

Other Determinants of Home Prices

Results indicated that, at the sample mean, an additional bathroom added about 7.5% to the price of a home. An additional fireplace added 6%, while each additional garage stall added roughly 5.5%. The effect of age was nonlinear, as expected, and was captured by adding a squared term to the age variable. The coefficients could be interpreted as meaning that, for each 1-year increase in the age of a house, there was a 0.6% decline in price, and for each 100-unit increase in the squared age of a house, there was a 0.5% increase. This interpretation explains the observation that newer houses tend to be more valuable. The same applies to very old houses, which tend to be of higher quality, attract more investment in preservation and rehabilitation, and are less likely to be torn down and replaced.

Variables that related to land and site characteristics were shown to be highly significant. It was estimated that each additional acre (0.4 ha) of land added about 3.1% to the sale price of a home. Homes located on or near bodies of water commanded a premium. Separate effects were identified for lakefront homes, homes with a lake view, riverfront homes, homes with a river view, and homes with a pond or creek on their property. Lakefront property had the largest effect, and on average added 49% to the sale price of a home. Homes with a lake view (but no frontage) sold for about 15% more than those with no water feature nearby. Likewise, riverfront homes commanded a premium of about 28.9%, while homes with a river view sold for prices about 24.2% higher than comparable homes with no water features. Creeks and ponds also had positive and statistically significant impacts on the sale price of a home, although the effects were demonstrably smaller.

Neighborhood variables added some explanatory power to the model. Of particular importance were measures of local school quality, which was measured through the addition of two variables related to school performance at the school district level. The first (average school scores on comprehensive tests) showed a strong, positive effect. The test score, measured as mean 5th grade student comprehensive scores on the Minnesota Comprehensive Assessment, had a large coefficient. A 1% increase in mean test scores in a given school district was associated with a 1.25% increase in home sales price. The second educational variable (school graduation rate) had a negative sign and small magnitude. This result was a likely indication that, after other measures of school quality were controlled for, graduation rates had little residual effect. The percent of population in a census tract that was nonwhite was associated with lower home sale prices, and the median household income in the tract in which a home was sold appeared to have no significant effect on its sale price.

CONCLUSIONS

From the empirical model that was specified and estimated in the previous sections, estimates were obtained of the value of accessibility to regional employment and to resident workers. These estimates indicated that the effect on home prices of regional accessibility to employment was substantial. For each 10% increase in the amount of employment accessible within 30 min by car, home prices were estimated to increase by 2.3%. Evaluated at the sample mean (about $213,000), this represented an increase of about $5,000. Conversely, the effect on access to resident workers was negative. A 10% increase in access to resident workers was associated with a 1% decline in sale price. Variables that indicated location near an expanded freeway link had the expected signs: proximity to an access point had a positive impact, while proximity to the right-of-way itself had a negative impact, although this negative externality effect appeared to be confined to the area within about ¼ mi (0.4 km) of the right-of-way.

This study might be improved on or expanded to answer related questions that have not received as much attention as they should. Although this study has drawn its conclusions largely from cross-sectional data on property sales, the relationship between accessibility and land or property value is inherently a dynamic one, and perhaps involves lagged adjustment periods. Longitudinal data on accessibility and property prices that covered a longer time period would permit important insights, not only into the magnitude of this relationship but also into the adjustment process. In a few instances, series of sales data were collected over a longer time period. Typically, however, the studies were limited to a specific project or corridor and did not examine regionwide changes (*27, 28*).

Other improvements might relate to the quality and quantity of the data used and the focus of the study. Because theory suggests that changes in location premia are capitalized into the value of unimproved land, it would be helpful to study these questions with data on vacant or undeveloped land, and thus reduce the need to control for the influence of building attributes. Studies might focus more intently on the behavior of nonresidential land prices. Although transactions data on nonresidential properties often are harder to come by, the value of the insights gained from their use may be substantial. Studies also should broaden their focus to include measures of accessibility to multiple types of activities. Franklin and Waddell, for example, have measured the value of accessibility to retail opportunities (*15*).

From the standpoint of transportation practitioners, the changes in land value that result from a transportation improvement represent a plausible alternative measure of user benefit. Given the difficulty to obtain an accurate forecast of the complete set of travel-behavior responses to major transportation improvements, and to estimate the actual travel-time savings attributable to such, the aggregate land value response might provide a useful second opinion on the estimate of user benefits, provided both measures were not used together.

Likewise, from a transportation planning and financing standpoint, the land value appreciation associated with the accessibility improvements delivered by major transportation projects remains a major source of untapped revenue in most locations. Shortages of funds for ongoing maintenance and improvement of transportation networks at all levels of government may force a reappraisal of unconventional sources of funding, such as value capture methods, in which taxes or fees are imposed on a portion of land value appreciation associated with an improvement. Evidence already exists that similar proposals have advanced to the planning stage in certain parts of the United States. (*29*).

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