Property Values and Highway Expansions: An Investigation of Timing, Size, Location, and Use Effects

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ABSTRACT

This research examines commercial property responses to a major capacity expansion of a roadway facility in Austin, Texas, by analyzing parcel-level real estate assessment data over an 18-year period (1982-1999). A land value model, an improvement or structure value model, and a total property value model were each estimated separately. Since total land values are fundamentally related to parcel acreages and improvement values are related to improvement size, parcel and improvement areas were interacted with appropriate access variables and structural variables. Empirical results suggest that improvement type, freeway proximity, parcel location at key network points (e.g., corner parcels), and timing of construction and completion play key roles in property valuation. The estimates of impacts should prove very helpful in comprehensive cost-benefit assessments of projects of this nature by public agencies and corridor property owners.

KEY WORDS

Highway expansion, property valuation, commercial properties, cost-benefit analysis

INTRODUCTION

The effects of transportation improvements on real estate markets have been well-studied but are still not well understood. There have been numerous studies on the effects of transportation improvements on real estate values. (See, *e.g.*, Huang [1994] and TRB [1995] for summaries of recent highway capitalization studies.) Most analyze the effects of highway expansions or original construction on residential sale prices, with the goal of establishing the economic impacts of highway construction.

In his extensive literature review, Huang (1994) found that virtually every major land use study came to the conclusion that transportation improvements positively affect the value of nearby land. While the estimates of those effects ranged from almost nonexistent to over a 10 percent increase in property values over the region-wide sale prices, it was difficult for Huang to compare the model results due to differences in externalities across regions.

In a study of median housing prices and monthly rents in the San Francisco Bay Area, Kockelman (1997) showed a strong positive association between accessibility and land prices, after controlling for a wide variety of other variables, including parcel size and square footage of development. Evidently, homeowners and renters do value improvements to the transportation network, whether their perception of the travel benefits is direct or indirect. Mikelbank's recent work (2001) suggested that home prices rise in response to transportation improvements that occur along shortest-path routes connecting individual homes to the region's CBD or to the local shopping center; in general, however, prices fell as a response to nearby transportation-related construction. Mikelbank's work relied on spatially correlated hedonic models, and controlled for a series of minor and major transportation investments prior to and during a 13-year period in two Ohio counties.

This research differs from existing work in that it examines commercial property responses to a major capacity expansion of a roadway facility in Austin, Texas, by analyzing parcel-level real estate assessment data over an 18-year period (1982-1999). The expansion of interest represented more than a doubling of corridor capacity along with an elevation of the freeway mainlanes.

According to classical economic theory, when a highway is initially built, large parcels of land that previously had poor accessibility – or none at all – are suddenly underpriced. Often, the market immediately responds: the area is quickly developed and the real estate market establishes a new equilibrium based on the new transportation technology. The land-value impacts that are experienced can be significant (Giuliano, 1989).

According to the same theory, major improvements to existing transportation infrastructure should also have a strong, positive effect on nearby real estate values. However, the impacts may be highly localized and of a much lesser degree than those caused by the original construction (see Landis et al. [1995] and Tomasik [1987]). Moreover, land values may fall elsewhere, due to changes in *relative* access (Mohring 1961) and certain land uses may be negatively impacted by the noise, emissions, and vibrations that close proximity to major roadways presents (e.g., Nelson, 1982). Construction-associated impacts can also reduce values in the short term, while projects are underway: Downs's data (1992) suggested that values did not reach pre-construction levels until approximately five years after roadway-project completion.

Freeway design is also important. Lewis et al.'s (1997) property-value models predicted that depressed freeways contributed most to residential property values, while at-grade freeways were most valued by commercial uses, and elevated freeways were least valued by both land use types. The roadway of interest in this work began at grade and was converted to a set of raised freeway lanes bordered by at-grade frontage roads.In the context of this research, the real estate value analysis can be used to determine whether a highway's expansion has an effect on land values in anticipation of construction or completion of a project. This chapter presents three models of the property-valuation impacts of highway capacity expansion. The data includes assessments of land, improvement to the land, and total property value for the years 1983 through 1999. All properties come from the U.S. 183 corridor in northwest Austin, Texas.

DESCRIPTION OF STUDY CORRIDOR

Over the last decade, the U.S. 183 (Research Boulevard) corridor in Northwest Austin experienced rapid commercial growth. Several major employers in the high-tech sector are located in business parks in the corridor or have announced plans to relocate there. In addition, over two million square feet of retail space was added to the corridor in the 1990's, including a regional shopping center and a large mixed-use office/retail center. Yet large tracts of land near U.S. 183 remain undeveloped.

As part of a major facility improvement, the highway was expanded (in phases) from a four-lane divided highway to a six-lane controlled-access facility with dual three-lane frontage roads. The expansion represents a more than doubling of capacity. The Texas Department of Transportation began to acquire land for the additional right of way needed for this expansion in 1986; many of the proposed takings resulted in condemnation cases and then lawsuits. However, along the sections of this corridor that were modeled here, construction on the segment under study began in 1992 and was completed in 1997 along the mainlanes (and in mid-1998 along the frontage roads). The northernmost sections of the roadway are still under construction, but no data were taken for the areas adjacent to those sections.

Figure 1 shows a map with the location of the U.S. 183 study corridor and the extent of its expansion. Figure 2 shows a more detailed map of the study corridor including dates of construction and the sequence of construction phases.

DATA ASSEMBLY

Data Sources

The primary data source for this portion of the analysis was the Travis (County, Texas) Central Appraisal District (TCAD) records (TCAD, 2000). The State of Texas requires the appraisal district to keep yearly updated records of the data on which they base property tax assessments. For 1991-1999, the records were stored on computer, and for years prior to 1991, the data was collected from microfiche at the Austin History Center.

Since tax assessment values were used, rather than actual purchase prices, the data is only an approximation of market values during the study period. Purchase prices in Travis County are not available to the public due to Texas state non-disclosure statutes. However, according to Tx. Tax Code tit. 1, §23.01 (2000) (Appraisal Methods and Procedures), taxable property in the State of Texas must be appraised at 100 percent of market value. In addition, the Texas State Comptroller publishes an annual property value study (Texas State Comptroller, 2000) which includes an audit of property tax assessments in all Texas counties. According to the Comptroller's audit, in Travis County the mean appraisal ratio is 1.0 times the market value and the price-related differential (a measure of regressivity) of 1.02, which indicates that parcels in Travis County are treated uniformly with regard to level of appraisal.

TCAD maintains records of assessed values of land and any improvements on that land, and has separate listings of what it considers to be market values of the land and improvements. Since the only consistent data were for appraised values, those are the numbers used in this analysis. In addition to appraised values, information about property acreage, square footage of improvements, and property use was collected. TCAD also lists the “effective year of construction”, which is the age of structures on the property after taking into account, for example, any renovations or additions that have been made to the original construction, after controlling for square footage.

Data were collected for every parcel with frontage on U.S. 183, and for a random sample of roughly 10 percent of the parcels within a half-mile band surrounding the facility. This second sampling frame of non-fronting parcels was area-weighted to ensure that larger parcels were more likely to be selected than smaller parcels (in proportion to their areas), and the sample results were examined to ensure that they accurately represented a diverse cross-section of the parcels in the study corridor.

Continuous, Texas-style frontage roads with frequent entrances and exits from the main freeway lanes (the design used for the reconstruction of U.S. 183) can influence property values in unique ways. The distance to an entrance or exit ramp can affect a parcel’s accessibility, as can the distance to an intersection with a major arterial. Along the section of roadway studied, each parcel is within a half mile of a major arterial cross streets and a ramp connecting to or from the freeway main lanes. In general, because the frontage roads themselves provide excellent access to bordering parcels, the only parcels along a frontage road that enjoy significantly enhanced access are those on corners. Corner parcels at major cross streets can be easily accessed from both directions of the freeway’s frontage roads (via u-turn ramps at underpasses) as well as the cross street.

Using plat maps, also obtained from TCAD, a “corner lot” variable was developed to indicate whether or not the parcel is located on a corner lot along the facility. The variable was further specified to distinguish lots on major, crossover streets (i.e., those that cross the facility via an underpass) from lots on lesser, non-crossover streets (i.e., those that dead-end into the facility’s frontage roads).

Figure 3 illustrates corner parcel designations for the study facility. Parcels A and B are situated at the corners of a minor street and a one-way frontage road, at an unsignalized intersection; thus, they are termed “unsignalized corner” parcels. This designation also requires that the minor street have another outlet so that parcels A and B could be accessed either from the major facility or via some other route through the bordering neighborhood. In contrast, parcels C, D, E, and F have excellent access, due to an underpass connecting the two sides of the highway and signalized intersections on the frontage roads. Both cross traffic on the minor cross-street and u-turning or left-turning traffic from the frontage roads can access any of the four parcels. Of the parcels analyzed, 13% were unsignalized corners, and 7% were signalized corners.

Since not every parcel in the data set was located along the frontage roads, another parcel-level accessibility measure used in the analysis was the distance from each parcel to the study facility. Using the TCAD plat maps, the distance was measured along streets to obtain the driving distance to the facility, as opposed to the straight-line distance.

Sample Formation

The TCAD assessment data forms the basis for the data set. The data were organized into three files: one with land values only, a second with improvement values only, and a third with both land and improvement values.

Land uses were coded into various categories, as follows:

1. Detached Single-Family Dwelling
2. Apartment Building
3. Retirement Home or Day Care Center
4. Convenience Store, Gas Station, or Auto Service Center
5. Small- to Medium-Sized Store or Neighborhood Shopping Center
6. Small Office
7. Showroom, Warehouse
8. Bank
9. Restaurant or Night Club (includes fast food restaurants)
10. Grocery Store, Discount Store, or Department Store

The above ten categories are not an exhaustive listing of possible land uses; rather, the categories represent all land uses present in the U.S. 183 corridor during the period of the study and without any missing data in their TCAD records. For the land and total value models, any undeveloped parcels were assigned to category 0 (zero), and these comprised 25% of all data records. The other parcels were most commonly described as use category 5 (36% of all records), 1 (25% of records), and 2 (18% of records).

For parcels adjacent to each section of construction of the roadway, the years since right-of-way annexation, start of construction, and construction completion were calculated, with each time-based variable taking a value of zero for years before each event. These variables may reveal whether the annexation of right of way (indicating the first major step taken towards construction of the facility), the start of construction, and/or the completion of construction affected the real estate market.

Characteristics of the Data Set

The initial data set acquired for the corridor contained over 3,000 observations of parcel-level assessment data, and over 300 unique parcels. Of these parcels, 90 formed complete panels of data for the 18-year study period (for a total of 1,620 observations). The incomplete panels have data missing for several years at the beginning and/or end of the time series. Depending on the model structures being examined, complete panels or the larger data sets were used. Model specifications are described in the following section, and Table 1 contains definitions for the variables used in the analysis.

The primary explanation for a panel's missing data is parcel subdivision, which eliminates a record for the old, large parcel and creates several unique records for the new, smaller parcels. Historical plat maps were not available to determine which parcels were subdivided or whether parcels were combined into one large parcel.

To illustrate the data, Figures 4 and 5 plot average assessed land values per acre and average improvement values per (improved) square foot, respectively, for each year in the study period. In 1986, when the Texas Department of Transportation (TxDOT) began to acquire the additional right of way needed for the expanded facility, property assessments rose significantly. For seven years after the right of way acquisition, property values declined, remained flat during the mid-90's and then rose again at the end of the decade. Assessments of parcel improvements followed a similar, although less dramatic, course. After a peak in 1986, the improvement values dropped throughout the late 80's, before rising again through the 90's.

Much of the variation in land and improvement valuations was in fact a response a speculative bubble that Austin – and much of the United Stated – endured in the early 1980s. Austin's land market began its ascent in about 1983 and staged its dramatic fall in late 1986, corresponding to the collapse of the savings and loan industry. Of the 20 largest S&L losses in the United States, 14 were in Texas, which accounted for more than half of the total losses nationwide (FDIC, 1999). Office occupancy rates in Austin fell to 70 percent after the amount of retail space grew from 10 million square feet in 1982 to 22 million square feet in 1987 (Restrepo, 1997). Much of this was clearly independent of any network expansions, such as U.S. 183. And TCAD's appraisal of these properties simply lagged the actual market trades during that period. However, the DOT's right-of-way acquisition for U.S. 183's expansion also may have inflated property assessments, in excess of any response to a forecast of increased access through capacity additions. A multivariate analysis of the data, using the regression models discussed below, permits a more controlled observation and estimation of effects.

DATA ANALYSIS

The land values were thought to be fundamentally related to the parcel acreages, so parcel areas were interacted with a variety of independent variables in the land value model. Likewise, the square footage of improvements on each parcel was interacted with the independent variables in the improvement value model. For the total value model, almost all the land-value and improvement-value models' interacted terms were included, along with a constant. In essence, the three resulting model specifications are the following:

1. Total Value Model:

$$TotValue = \beta_o + SF_{Impr} \sum_i \left(\beta_{i,Impr} X_{i,Impr} \right) + SF_{Land} \sum_j \left(\beta_{j,Land} X_{j,Land} \right) + u$$

where SF_{Impr} is the square footage of improved structure on the parcel, $X_{i,Impr}$ is a vector of variables related to such improvements (i.e., a constant term, a time trend, use-type indicator variables, and age of structure), SF_{Land} is the square footage of the parcel's land area, and $X_{i,Land}$ is a vector of variables related to the land's valuation (i.e., a constant term, time trends, and parcel location variables). The random error component, *u*, is expected to contain parcel- and/or year-specific terms and demonstrate serial autocorrelation. A description of assumptions made for two distinct stochastic set-ups is provided below, in the section on Model Estimation.

2. Improvement-Value Model Specification:

$$ImpValue = \beta_o + SF_{Impr} \sum_i \left(\beta_{i,Impr} X_{i,Impr} \right) + u$$

where variables are defined as above[1].

3. Land-Value Model Specification:

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[1] In order to assess whether location details and construction timing affected improvement valuations, and not just land values, some of the explanatory information interacted with improvement size in the improvement value model (i.e., the $X_{i,Impr}$) duplicated that interacted with parcel size in the land value and total value models.

$$LandValue = \beta_o + SF_{Land} \sum_j \left(\beta_{j,Land} X_{j,Land} \right) + u$$

where variables are defined as above.

Model Estimation

A variety of models were examined, to permit recognition of the panel and time-series nature of the data. The most successful of these was a rather basic autoregressive structure of the first order (AR1), and this model permitted use of all full-panel and sub-panel observations. However, in order to recognize unobserved parcel-specific components (as well as year effects), two-way random effects models and variance-component moving average (MA) models also were investigated, using the smaller, full-panel data set. (Greene 2000, SAS 2000) Parks' (1967) autoregressive structure was also considered; however, its provision for distinct contemporaneous (as well as serial) correlations over-specified the data structure (due to the high number of distinct parcels).

The results presented here describe the results of the AR1 models. To estimate such models, a two-step feasible generalized least squares (FGLS) estimation procedure was used, where an initial ordinary least squares (OLS) provided a set residuals u_{it} (for each year t and each cross section i) and these were regressed on the previous year's residuals, using the AR1 equation (Greene 2000)[2]:

$$u_{it} = \alpha + \rho u_{i,t-1}.$$

Next, the dependent and independent variables were transformed, using the Prais-Winsten (1974) equations:

$$y^*_{it} = y_{it} - \hat{\rho}\, y_{i,t-1}$$

$$x^*_{it} = x_{it} - \hat{\rho}\, x_{i,t-1}$$

Finally, these transformed variables were used in a second OLS regression to produce the desired coefficients.

Empirical Results

Tables 2, 3 and 4 show the results of the total property value, land value, and improvement value models, respectively. The improvement value model generally offered the closest predictions to the observed data (as evidenced by its 0.87 adjusted R^2 or "goodness of fit" index); the land value model performed least well (adjusted $R^2 = 0.32$). This result may be due to difficulties and uncertainties in land valuation; the value of a property's land requires a thorough appreciation of the parcel's relative access and recognition of its highest-and-best use. Many other variables beyond those accommodated here may be at play (e.g., terrain, presence of trees, and views), and the district (TCAD) appraisers may also introduce substantial variation (through personal subjectivity). In general, however, the models predicted a great deal of variation and offered intuitive estimates of access, use, and timing impacts. The serial correlation in the data is also rather strong, with estimates of ρ falling between 0.50 and 0.75.

For the total-value model, the constant term is estimated to be \$84,436; one interpretation is that simply owning some sort of property along this corridor – with almost no improvement or

[2] Only residuals within the same panel were compared, so the first observation of each panel was not always used.

acreage – is highly valued.[3] In the total-value model single-family dwelling improvements are estimated to be worth an average of $43.50 per square foot – but this falls to $26.92 in the improvement-value model (see Figure 5). Both estimates are highly statistically and economically significant estimates; a value somewhere in between these two is probably a robust predictor of such construction. Of all the improvement types or uses, banks are most highly valued (per square foot); while retirement and day care centers, convenience stores, and gas stations are least valued (on the order of $15 to $20 per square foot, overall). Many of the improvement use variables are not statistically significant in the total-value model, but they claim significance in the improvement value model. In both cases, however, showrooms/warehouses were predicted to be worth significantly less than single-family homes; this is very reasonable, given the large scale and construction needs of such facilities, relative to homes (which have a high proportion of expensive fixtures, per square foot). In general, most uses are less valued – per square foot – than single-family homes. Figure 6 summarizes improvement values per square foot by improvement type for both the improvement and total value models. Values that are not statistically significant are excluded from Figure 6.

The simple yearly time trends in all models are very positive. Marginally, these are on the order of $1 per square foot of structure/improvement and per square foot of land (an acre contains 43,560 square feet of land), suggesting strong inflationary effects, speculation, and/or underlying demand in the corridor (due to, e.g., dramatic growth of the region and travel network pressures). However, the basic time-trend's positive coefficients are strongly tempered by the cumulative effects of construction-related deductions. These are reflected in interactions with parcel size and, in the case of the improvement value model, with structure size.[4]

The year of ROW acquisition, 1986, is associated with a high point in the data – and year zero of a downward trend. The steep up-trend preceding this year is felt to be related to the land market speculation affecting much of the country in the early 1980s; this speculative period collapsed in the mid-1980s, and the TCAD appraisals probably reflected the ascent a year late, and coincident with corridor ROW acquisition. It is unlikely that the acquisition itself prompted the high 1986 assessments; however, two other dates related to the roadway's expansion are thought to be of practical significance to property valuations: they are the construction start and completion dates, for the roadway sections closest each of the observed parcels.

Construction imposes a variety of costs on adjacent land uses, including noise, dust, vibration, and often substantial travel delays. Such costs are reflected by the negative time trends interacted with land uses (in the total value and land value models) and with improvement size (in the improvement value model). Per year following start of construction, these negative impacts are on the order of $0.05 to $0.50 per square foot of land, and $0.50 per square foot of structure (Tables 2 through 4). U.S. 183's expansion ended (in some locations) in 1997, and in the total value model (Table 2) this event was predicted to almost wholly negate the marginal negative impacts of the speculative bust (coincident with the variable "ROW Acquisition") and the construction itself. By negating additional negative effects of these events, completion permitted the positive underlying time trend effects to eventually raise total property values. For

[3] Constant terms ensure the average predictions correspond to the average observed value, regardless of functional form. The absence of quadratic terms in the models facilitates interpretation of first-order effects, but it also removes some of the constant term's flexibility.

[4] Another time effect is that captured by the variable "Age of Improvement". This effect is, as expected, negative, and on the order of $0.75 per square foot of structure per year ($0.87 in the total-value model and $0.60 in the improvement-value model).

a typical parcel, the end of the 18-year period's predictions (per acre) are expected to reach their mid-period peak. These calculations account for the negative starting estimates of acreage values (for year zero, before the time trend effects set in).

In terms of the improvement values alone (Table 3), the end of construction was predicted to carry a very strong benefit of $2.72 per square foot of structure, more than negating the marginal yearly effects of construction (-$0.48/sf) and ROW acquisition/speculative downturn (-$1.21). This model's results effectively suggest a steady increase in improvement values (per square foot) over time. In contrast, construction completion impact's was predicted to be negative (thought not statistically significant [p-value = 0.225]) in the land value model. So, by the end of the 18-year period of data, predicted values (per acre) are declining; however, this result is not statistically significant and thus may be negligible.

In addition to construction timing effects, location information of parcels was also highly useful. The presence of a signal and a corner with side access was predicted to raise the per-acre values of land (in both the total and land value models [Tables 2 and 4]) by roughly $50,000 per acre ($1.10/sf). Effects on improvement values (Table 3) were also very favorable, at a rate of $4.61 per square foot (of structure). In contrast, parcels at non-signalized corners were predicted to have roughly $100,000 lower per-acre land values than all remaining parcels locations, on average, though the apparently positive effect on improvement value (at $0.75/sf) may overcome this negative effect (when improvements are present and occupy roughly one third of the property). It should be noted that the corner-without-signal indicator variable may be proxying for locations between major intersections, which are accessible to or from the main freeway lanes only by passing through one or more traffic signals and driving a lengthy distance along the frontage road.

Properties were examined for travel distances along the nearby network to reach the corridor's frontage road lanes. Most properties were along the corridor itself, and the average of these distances across the data set was 0.19 miles. The distance reductions in value were predicted to be severe: at $511,000 per acre per squared-mile in the total-value model (Table 2), $12 per square foot (of structure) per squared-mile in the improvement value model (Table 3), and $111,000 per acre per squared-mile in the land-value model (Table 4). Note, however, that no properties further than 0.5 miles away were considered in this analysis, so the maximum value of the distance-from-facility-squared variable is 0.25 miles^2. Thus, the maximum discounts actually predicted for the data set would be on the order of $130,000, $3, and $28,000, respectively. Moreover, the predictions of the total-value and land-value models may best be merged, to provide a reduction estimate on the order of $50,000 (for the furthest properties considered, per acre). Since urban land values in Austin, Texas, presently rarely exceed $200,000 per acre, this is a sizable difference. The tremendous benefit of access is clear, and it can on the order of a hundred million dollars per square mile[5]. Clearly, highway location choices can dramatically affect property values.

CONCLUSIONS

This paper has presented an analysis of data for parcel-level land and improvement values along the U.S. 183 corridor in northwest Austin, Texas, over an 18-year period. These properties were examined during a period of significant highway upgrade: 6 elevated mainlanes were added along with six at-grade frontage road lanes, resulting in a more-than-doubling of

[5] A square mile contains 640 acres.

corridor capacity. As illustrated by model results, the timing of this freeway project's construction and completion were significant events for property valuations. Parcel proximity to the corridor, corner location, property size, and land use were also very valuable to the predictive models.

The results of these models are intended to assist highway agencies with estimation of roadway impacts and right-of-way acquisition costs. Most studies of property valuation have examined residential uses, yet many properties lining current or future freeways are commercial in nature, with a few industrial uses. This work provides estimates for these land use types – as well as for single-family and multi-family residential uses.

In general, roadway projects can have dramatic effects on property values, and this is evidenced here, through the signs and magnitudes of the parameter estimates. For example, construction impacts accumulated at the rate of -$0.05 to -$0.50 per square foot of land per year and -$0.50 per square foot of structure per year; fortunately, construction completion generally removed these negative impacts, allowing the corridor's properties to again appreciate.

A parcel's corner location with a signalized intersection (for cross-corridor access) was predicted to raise the per-acre values of land (in both the total and land value models) by roughly $50,000 per acre. Such effects on improvement values also were very favorable; these were estimated to be $4.61 per square foot (of structure). Corner and signal impacts suggest why developers tend to lobby highway design engineers so fiercely for creation of such parcels (via interchanges and other design decisions).

Dramatic valuations also accrued to those properties most proximate the freeway corridor. At a distance of one-half mile from the corridor – relative to a fronting property – values were predicted to have dropped roughly $50,000 per acre of land and $3 per square foot of improvement/structure. Clearly, a roadway's alignment has a critical impact on (future) land values, so design engineers will want to take this decision very seriously. Moreover, roadway agencies may do best avoiding such high costs of later right-of-way expansion by protecting corridors early on and preserving rights of way (for later expansion).

While this work provides a variety of estimates of highway construction and location impacts as well as land acquisition costs, there are several improvements to the modeling approach and the data that would prove very useful extensions. For example, a longer period of study would be helpful in sensing long-term impacts after construction completion. An examination of the size and timing of land use changes and improvement additions (both as discrete events) would highlight the development impacts of highway projects. An examination of roadway facilities elsewhere in Austin, Texas and the United States – including those not undergoing expansions – would add context, while controlling for other market and network forces. And incorporation of variables that track bank lending practices and the local economy also would be useful, to explicitly capture certain variations in the real estate market. Finally, data on actual property transactions/market values would be very useful (though it would be biased toward parcels that sell more frequently).

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Table 1. Summary of Variables Used in the Assessment Data Analysis.

Dependent Variables	Description
Improvement Value [$]	Sum of assessed values of all parcel improvements. (Mean = $410,000; SD = $1.62M; Max = $34M)
Land Value	Assessed value of parcel. (Mean = $750,000; SD = $1.7M; Max = $21M)
Total Value	Sum of the land and improvement values. (Mean = $1.1M, SD = $2.9M, Max = $52M)
Independent Variables	**Description**
Sq. Feet of Improvement	Sum of the square footage of all improvements on a parcel. (Mean = 21k; SD = 76k, Max = 950k)
Age of Improvement [years]	Takes into account any substantial improvements or additions made to structures which reduce the overall age of the improvements. For multiple structures on one parcel, the age is weighted based on square footage of each improvement. (Mean = 14, SD = 12, Max = 65)
Land Uses:	
Single-Family	Both attached and detached units are included in this category.
Multi-Family	Includes both multi-family rental units and condos.
Retirement/Day Care	Retirement homes and day care centers.
Conv. Store/Gas Sta.	Also includes minilubes and service stations.
Small-Med Store	Stores less than 25,000 square feet, including small neighborhood shopping centers.
Small Office	Offices less than 38,000 square feet.
Showroom/Warehouse	Includes car dealerships and manufacturing warehouses.
Bank	Bank branch offices and drive-thrus.
Restaurant/Night Club	Includes bars, full-service restuarants, fast food resturants, and night clubs.
Grocery/Discount Store	Includes "big box" retailers, discount stores, and grocery stores over 25,000 square feet.
Land Area [acres]	Total area of parcel. (Mean = 5, SD = 23, Max = 386)
Time Trend	Ranges from 0 in 1982 to 17 in 1999.
Number of Years Since:	
ROW Acquisition	Right-of-way (primarily for frontage roads) was largely acquired by TxDOT in 1986.
Construction Start Construction Completion	Construction start & completion dates ran from 1987 to 1997, for the corridor parcels modelled here. Figure 2 contains more detailed timing information.
Distance from Facility Squared [mi2]	Distance from facility along street network, raised to the second power. [miles squared]
Corner with Signal Indicator	Indicator variable for parcels on corners with traffic signals and underpasses or crossovers.
Corner without Signal Indicator	Indicator variable for parcels on corners without traffic signals or underpasses or crossovers.

Table 2. Total Property Value Model Regression Results

Dependent Variable:	Total Value (Improvement + Land)		
Number of Cross Sections & Time Series:	317, variable		
Number of Observations:	2271		
Adjusted R-Squared:	0.61		
Variable Description	**Estimate**	**t-Stat.**	**p-value**
Intercept	84,436	6.10	0.000
Sq. Feet of Improvement	43.50	11.70	0.000
Variables Interacted with Sq. Feet of Improvement:			
Time Trend	0.384	1.56	0.119
Land Uses (relative to single family dwellings):			
Multi-Family	-8.74	-2.64	0.008
Retirement/Day Care	-14.67	-0.25	0.801
Conv. Store/Gas Sta.	-30.19	-0.91	0.364
Small-Med Store	-2.42	-0.76	0.446
Small Office	-2.85	-0.49	0.623
Showroom/Warehouse	-7.56	-2.17	0.030
Bank	28.97	0.75	0.456
Restaurant/Night Club	3.36	0.14	0.885
Grocery/Discount Store	-9.38	-2.31	0.021
Age of Improvement	-0.870	-8.39	0.000
Land Area (acres)	-123,318	-12.49	0.000
Variables Interacted with Land Area:			
Time Trend	50,557	26.27	0.000
Number of Years Since:			
ROW Acquisition	-36,882	-22.04	0.000
Construction Start	-20,202	-11.31	0.000
Construction Completion	51,652	4.51	0.000
Distance from Facility Squared	-511,261	-2.81	0.005
Corner with Signal Indicator	53,063	1.19	0.236
Corner without Signal Indicator	-96,206	-10.17	0.000

Table 3. Improvement Value Model Regression Results

Dependent Variable:	Improvement Value		
Number of Cross Sections & Time Series:	399, variable		
Number of Observations:	3148		
Adjusted R-Squared:	0.87		
Variable Description	**Estimate**	**t-Stat.**	**p-value**
Intercept	14,756	2.5	0.012
Sq. Feet of Improvement	26.92	29.5	0.000
Variables Interacted with Sq. Feet of Improvement:			
Time Trend	1.86	8.8	0.000
Land Uses (relative to single family dwellings):			
Multi-Family	-8.66	-13.7	0.000
Retirement/Day Care	-13.83	-2.6	0.010
Conv. Store/Gas Sta.	-12.19	-1.2	0.221
Small-Med Store	-8.20	-15.4	0.000
Small Office	-5.73	-2.5	0.014
Showroom/Warehouse	-8.17	-11.4	0.000
Bank	34.39	4.0	0.000
Restaurant/Night Club	0.95	0.1	0.908
Grocery/Discount Store	-7.92	-7.6	0.000
Age of Improvement	-0.60	-22.9	0.000
Number of Years Since:			
ROW Acquisition	-1.21	-5.1	0.000
Construction Start	-0.48	-3.3	0.000
Construction Completion	2.72	8.9	0.000
Distance from Facility Squared	-11.98	-3.5	0.000
Corner with Signal Indicator	4.61	9.0	0.000
Corner without Signal Indicator	0.75	0.7	0.493

Table 4. Land Value Model Regression Results

Dependent Variable:	Land Value		
Number of Cross Sections & Time Series:	317, variable		
Number of Observations:	3148		
Adjusted R-Squared:	0.32		
Variable Description	**Estimate**	**t-Stat.**	**p-value**
Intercept	70,286	5.9	0.000
Land Area (acres)	-111,193	-12.3	0.000
Variables Interacted with Land Area:			
Time Trend	42,041	25.9	0.000
Number of Years Since:			
ROW Acquisition	-31,976	-24.5	0.000
Construction Start	-2,647	-1.6	0.103
Construction Completion	-11,531	-1.2	0.225
Distance from Facility Squared	-111,660	-0.6	0.581
Corner with Signal Indicator	50,459	1.0	0.324
Corner without Signal Indicator	-102,635	-13.5	0.000

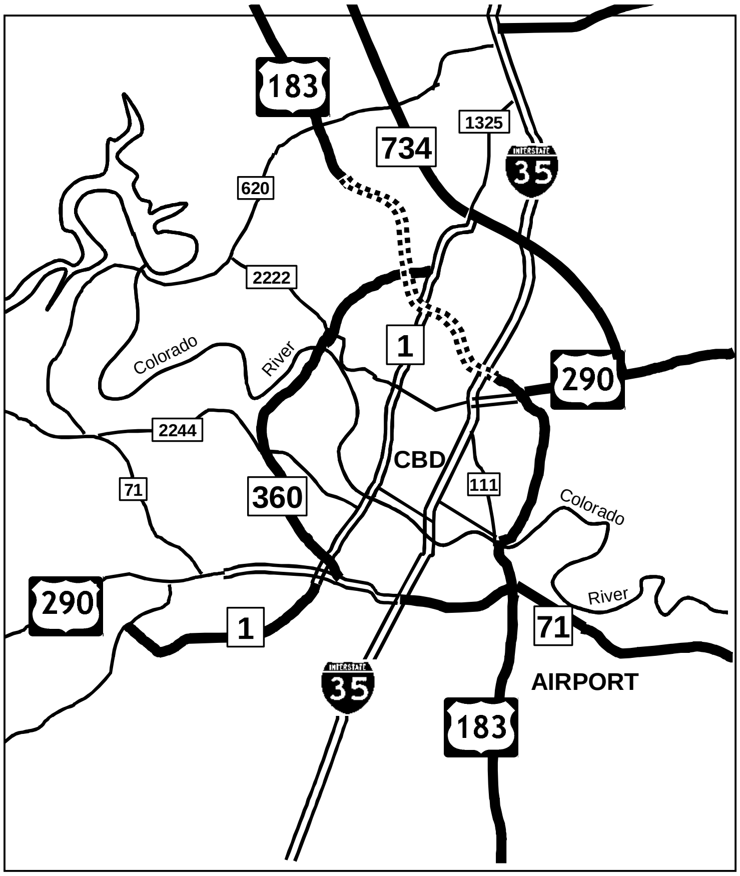

Figure 1. Map of Austin Area with Major Transportation Arteries.

(Dashed lines indicate the extent of construction on U.S. 183.)

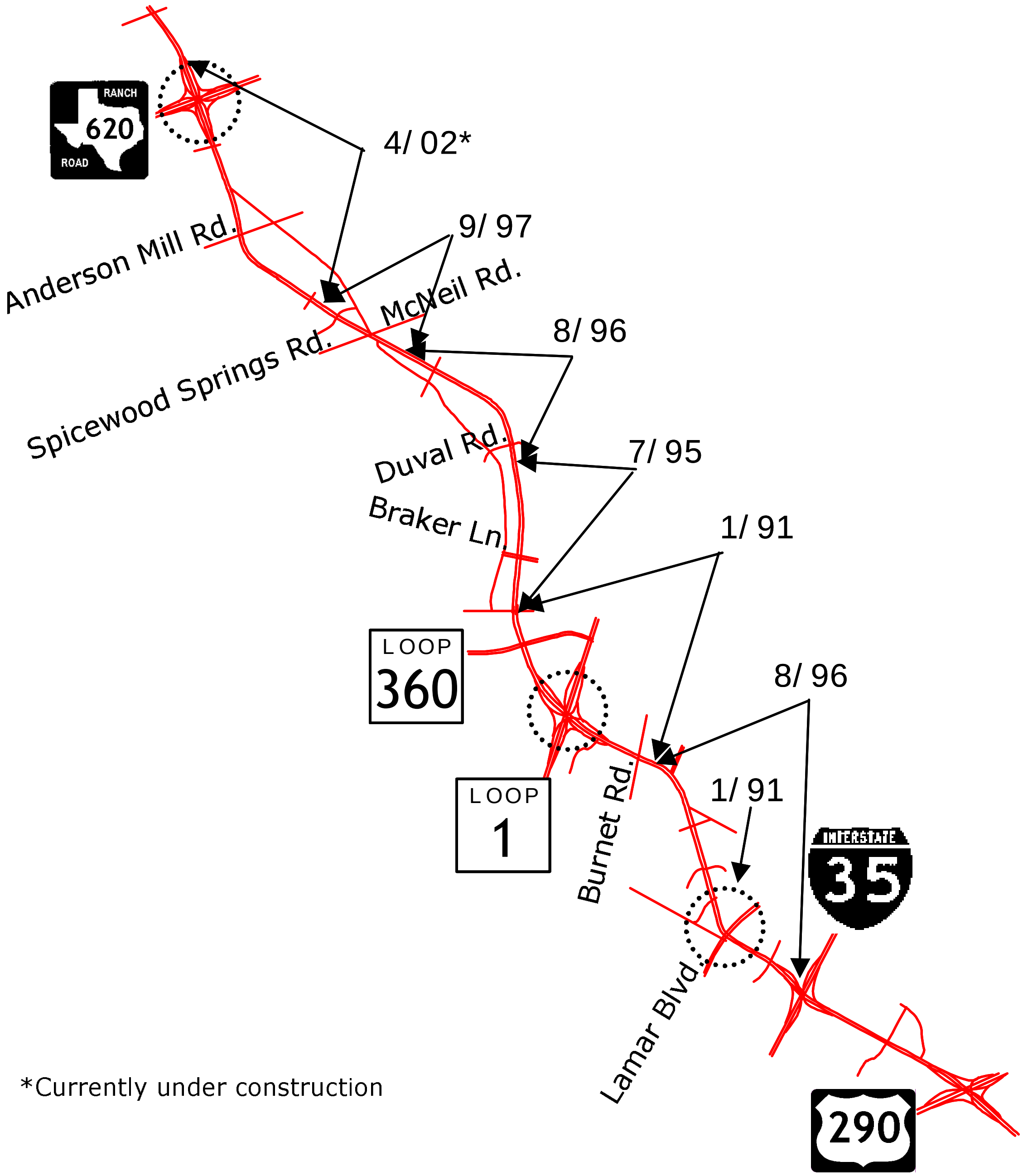

Figure 2. Map of U.S. 183 (Research Blvd.) Corridor, with completion dates for each construction phase.

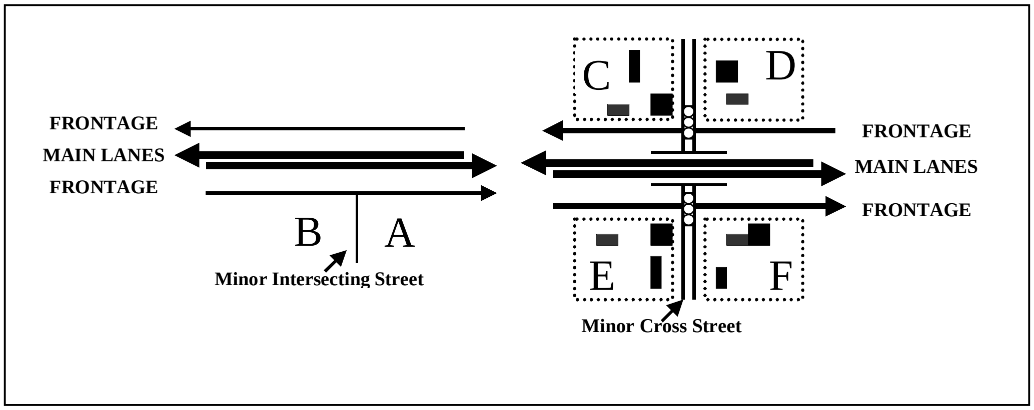

Figure 3. Corner Parcel Designations: Unsignalized (A & B) and Signalized (C through F).

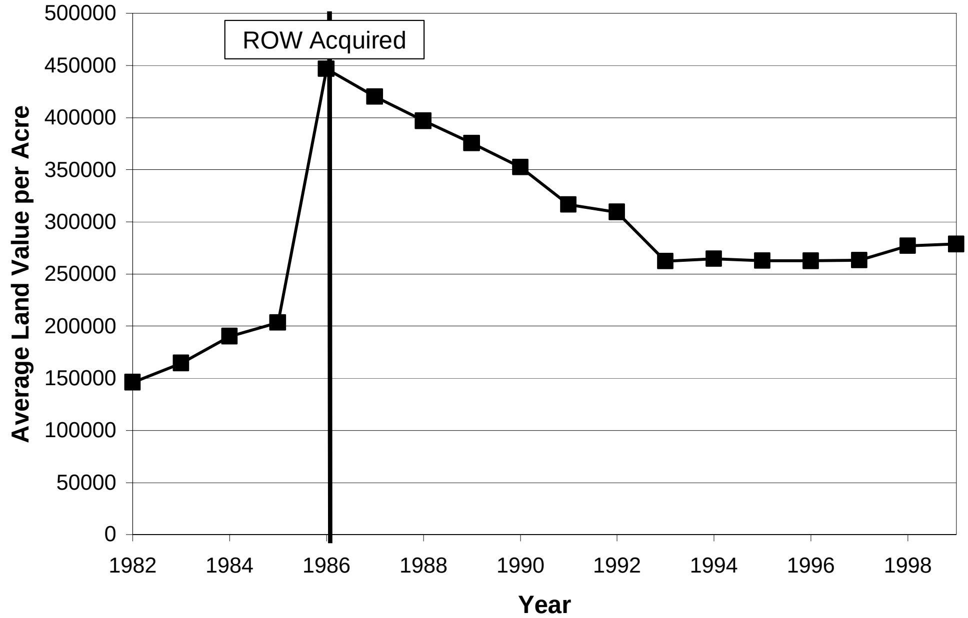

Figure 4. Average Assessed Land Values ($) per Acre

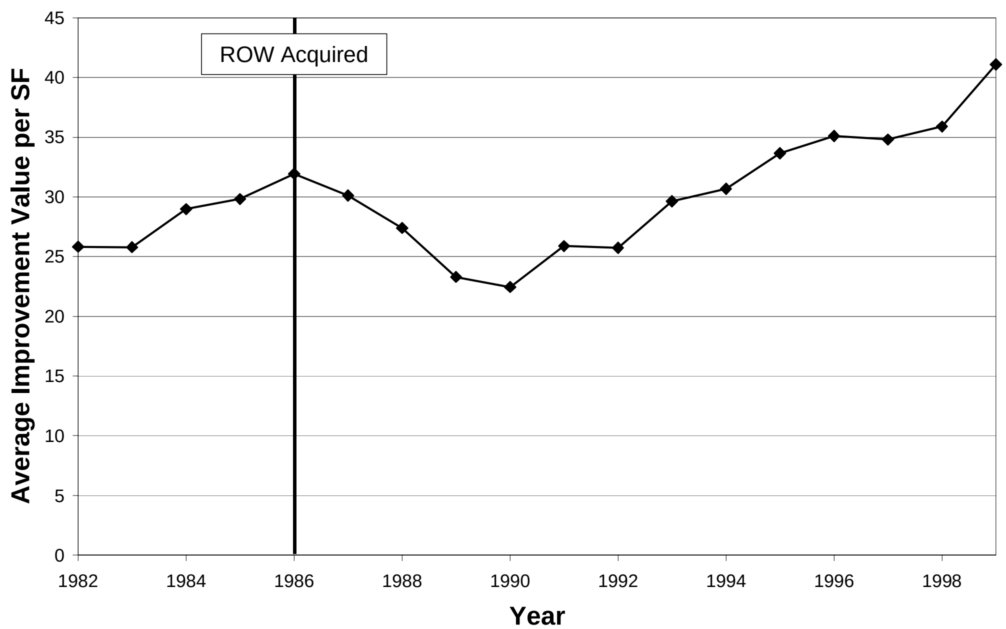

Figure 5. Average Assessed Improvement Value ($) per Square Foot

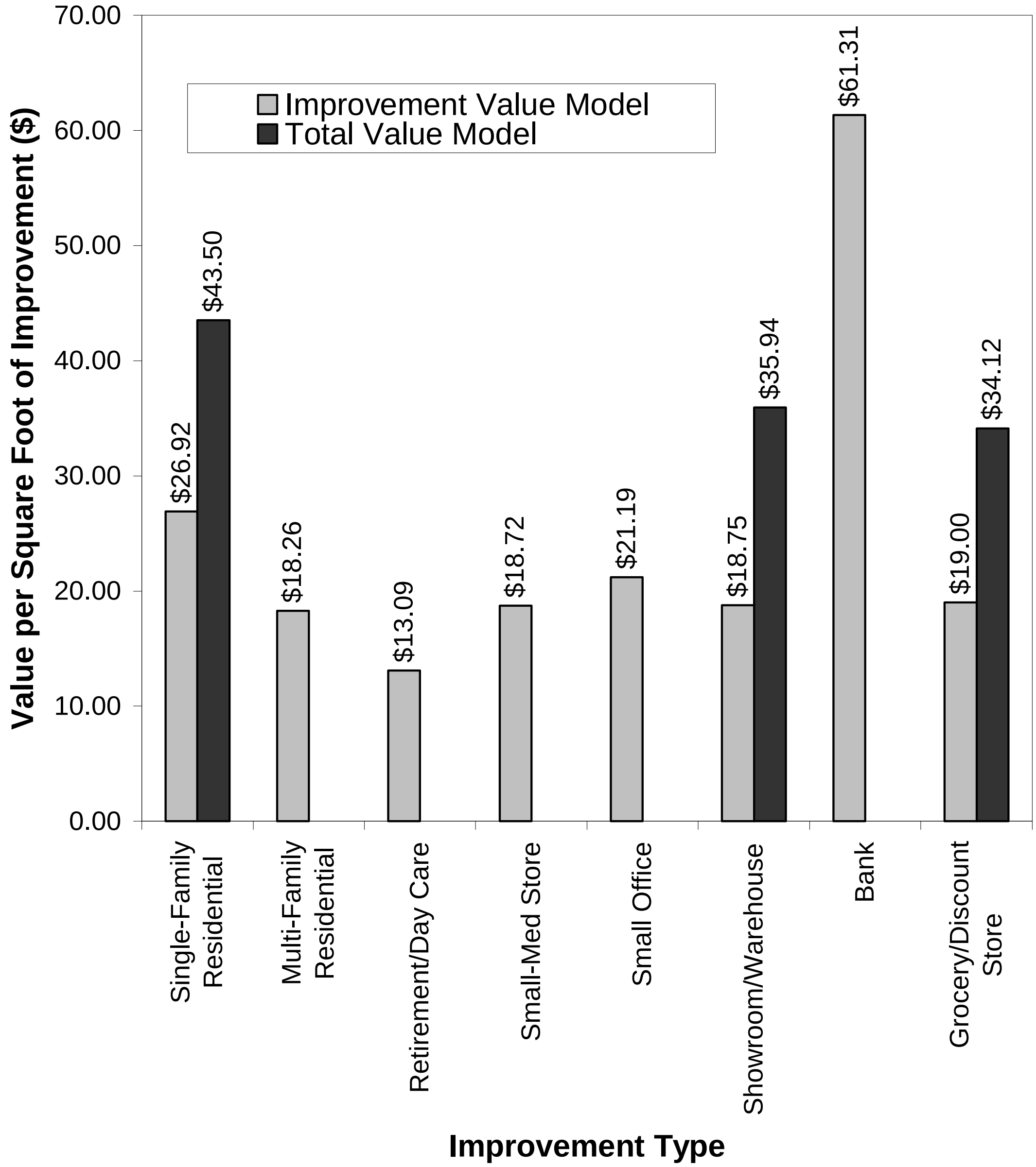

Figure 6: Estimated Improvement Values per Square Foot by Type of Improvement (with statistically insignificant values excluded)