

# **The Impact of Hiawatha Light Rail on Commercial and Industrial Property Values in Minneapolis**

*Kate Ko, HDR, Inc., and University of Minnesota  
Xinyu (Jason) Cao, University of Minnesota*

## **Abstract**

*The impact of proximity to transit on property values has become a key question in the debate on the relationships between public infrastructure investment and economic development. The focus has been on value captured by residential properties, with far fewer studies examining non-residential properties. Furthermore, few studies differentiate the effect of rail access and the effect of access to major interactions that later become station sites, and even fewer addressed the gradient of the accessibility effect. Based on the economic theory of firm location choice, this study develops hedonic pricing models to assess the value-added of the Hiawatha LRT on commercial and industrial properties, using data on properties sold before and after its completion. The results show that the LRT has induced a significant price premium for properties nearby and that the impact extends to almost 0.9 miles away from LRT stations.*

## **Introduction**

As evidenced by the recent rounds of Transportation Investment Generating Economic Recovery (TIGER I–IV) Grants, economic development spurred by transit has been deemed as one of the key drivers for many awarded projects. In particular, policy makers and planners are interested in knowing the return on transit investment, which is often captured in the accessibility effect of rail transit

on property values. If the willingness to pay for the access is positive, among others social benefits, it counters the claim that rail investments “almost always waste taxpayer dollars” (O’Toole 2010, p.18). Further, due to inadequate capital funding, tax incremental financing (TIF) has increasingly become a potential funding strategy for transit investment (Zhao, Das, and Larson 2010). Empirical studies related to value-capturing of transit investment in property prices are able to provide essential evidence for the adoption and implementation of transit finance strategies (that can also include special assessment, joint development, and other tools, aside from TIF) (Iacono et al. 2009). Thus, it has become a common practice in the transportation economics and planning literature to investigate the impact of rail transit on property values.

Rail transit has been touted as an effective way to promote economic development (Litman 2011). Transportation investment on a corridor increases its accessibility relative to the whole transportation network. According to urban economics, the increase is likely to be capitalized in properties nearby because the demand for highly-accessible locations drives up the bid for lands in those locations (Mills and Hamilton 1994). It is the monetized amount of the change in demand, or willingness to pay, that can be inferred as the amount of value-capturing of transportation investment. On the other hand, property values may not increase if the investment on a single corridor does not significantly reduce travel costs of households and firms, due to unpredictable travel patterns associated with a polycentric urban structure (Ryan 1999). In this case, the quantifiable benefits for accessing such locations may be negligible.

Using the Hiawatha light rail transit (LRT) as a case study, we explored the impact of accessing rail transit on commercial and industrial property sales prices. In particular, we develop two hedonic models—one for subregion and the other for station area—to capture firms’ willingness to pay for proximity to rail transit, also defined in this study as accessibility effect of rail transit. The selection of explanatory variables in the models is guided by the theory of firm location choice. Using longitudinal data, the study examines properties sold before and after the opening of the LRT. This allows us to disentangle the extents to which the observed effect is attributable to accessing rail stations or major intersections/activity centers (which later become LRT stations). Moreover, by our definition of accessibility effect, the willingness to pay for proximity to rail transit reduces as the distance to rail station increase. This study employs a nonlinear function and determines the boundary of the accessibility effect.

The paper is organized as follows: Section 2 reviews the accessibility effect of rail transit on commercial property values; the next section describes the background of

the Hiawatha LRT and associated economic development since its opening; Section 4 presents methodology, data, and variables; Section 5 discusses hedonic models; and the last section replicates the key findings and discusses their implications.

## **Literature Review**

In this section, we provide a review of studies to examine the current state of research in evaluating the impact of transit investment on non-residential properties and to demonstrate the need for such an assessment.

### ***Limited Efforts on Non-Residential Properties***

Many recent studies have examined the impact of rail transit on residential property values (Debrezion, Pels, and Rietveld 2011; Duncan 2011; Hess and Almeida 2007) with analytical rigor. Previous studies measured residential property values in terms of sales price, assessed market value, or rental rates. Although the results are mixed, most studies concluded positive associations between access to rail transit and residential property values. This offers supportive evidence for the accessibility benefits of rail transit.

However, less effort has been made for non-residential properties. The data are the major barrier. Previous studies usually use either sales prices or rental rates to measure property values. Compared to non-residential properties, it is relatively easier to obtain the rental and sales data on residential properties. Specifically, researchers often use assessor's data, parcel data, or multiple listing service (MLS) data for residential properties (Iacono and Levinson 2011; Hess and Almeida 2007), and rental rates can be obtained from self-administered surveys or rental offices of apartment complex (Bina, Warburg, and Kockelman 2006; Cao and Hough 2008).

However, various challenges arise with the use of different types of non-residential property value data. In particular, the quality of rental data for non-residential properties is inferior to that for residential properties for several reasons. First, tenant leases are proprietary in many states and, hence, not obtainable from public sectors. An assessor for the City of Minneapolis stated that even if lease information could be released, the number of records was rather limited because property owners were reluctant to report their leases to City assessors (personal communication with Scott A. Lindquist, June 26, 2008). Therefore, a few authors turn to private database for lease data (Weinberger 2001). However, even if leases are available, contract rents can be problematic because they may not reflect effective rents due to non-rent-related incentives, concessions, and rent escalation during the lifespan of leases (Cervero and Duncan 2002c; Nelson 1999; Fuerst 2007). Due

to the scarcity of lease data, other authors use asking/advertising/quoted rents to measure property values (Ryan 2005; Fuerst 2007; Landis and Loutzenheiser 1995; Bollinger, Ihlanfeldt, and Bowes 1998). However, asking rents are often expressed as a range rather than a scale, and they do not precisely reflect the real estate market equilibrium prices. More importantly, the error between asking and actual rents is often systematic depending on market cycles (Fuerst 2007).

Sales data may also present some challenges to researchers. Many studies are conducted a few years after the opening of rail transit, while the Federal Transit Administration (FTA) requires a before-after study for New Start projects shortly after their completion. Because non-residential properties are sold not as frequently as personal homes, the sample size for sold non-residential properties in a short period tends to be much smaller than that for residential properties. For example, Nelson (1999) uses only 30 properties in his hedonic model when analyzing the impact of the Metropolitan Atlanta Rapid Transit Authority (MARTA) on property values. Any statistical analysis (let alone a regression model) with a small sample size may generate insufficient power of the test (Utts 2003): a statistically insignificant relationship between access to rail transit and property values may not mean “no effect.” Further, sales prices of non-residential properties in some states are also proprietary (ten Siethoff and Kockelman 2002).

### ***Empirical Relationships and Research Gaps***

Notwithstanding the data challenges, empirical studies have shed light on the impact of rail transit on non-residential property values. Ryan (1999) provides a summary of the findings of seven studies, and among them, a positive relationship is found in about half of the location-industry combinations; Landis et al. (1995) find a negative relationship between rail access and sales prices; and others conclude no significant effect. Most studies published thereafter demonstrate a positive impact of rail transit on property values (Cervero and Duncan 2002b; Fuerst 2007; Nelson 1999; Weinberger 2001; Cervero and Duncan 2002c), whereas a few others find a negative impact (Bollinger, Ihlanfeldt, and Bowes 1998; Ryan 2005; Cervero and Duncan 2002a). Overall, these studies produce mixed outcomes, although a positive impact is prevalent in more recent studies. Because the studies explore different types of rail transit, adopt different regression functions, use data during different periods, examine different dependent variables, measure access to rail station differently, and control for different sets of confounding variables, the extent of the impact varies substantially. Debrezion, Pels, and Rietveld (2007)

report that the impact ranges from -62 percent to 145 percent between properties within and beyond  $\frac{1}{4}$  mile of rail stations, and the average is about 16 percent.

One factor that contributes to the lack of consensus is that the model specification of many studies is ad hoc. Specifically, profit maximization is the goal of operating a business. A number of factors are expected to influence a firm's profit maximizing location choice (Parsons Brinckerhoff Quade Douglas 1998), although the extent of their influences varies for different types of firms (Raper and Ihlandfeldt 1993). These factors include costs of space, access to transportation network, access to labor pool, access to market, agglomeration economies, amenities of locations, public services, and taxes. Essentially, location choice will implicitly price these factors as it reflects one's willingness to pay for a property in a specific location, *ceteris paribus*. To isolate the impact of access to rail transit, it is necessary to control for as many confounding factors as possible. Otherwise, omitted variable bias can be a concern. The consequence is that the rail access variable may absorb the effect of omitted variables and the resulting model estimate is biased. For example, Bollinger, Ihlandfeldt, and Bowes (1998) speculate that the unexpected negative connection between rail access and asking rents shown in their model results from the unsafe environment around MARTA station areas; Ryan (1999) concludes that once travel times savings are included, the connection tends to be consistently significant and positive. Due to the lack of data, many studies control for only a limited set of confounding variables; to our knowledge, Cervero and Duncan (2002c) include the most complete list. Therefore, it is desirable for future studies to investigate the potential influence of most (if not all) confounding factors, especially when the model produces an unexpected and/or biased result.

Second, many studies rely on longitudinal data after the opening of rail transit or cross-sectional data to capture its accessibility effect. Because rail stations are often located at major interactions or activity centers, the properties close to those locations may have already had a higher value than those farther away before any rail transit investment. That is, the accessibility effect found in previous studies may not represent the effect of rail transit, but the effect of the locations. Therefore, it is important to conduct a before-after study to test whether the effect of the locations exists before the opening of rail transit, and to identify the extent to which the premium being close to station is attributable to rail transit itself.

Third, the size of the accessibility impact is influenced by the measurement of access to rail station. Some studies measure distance to rail station using dummy variables (such as within  $\frac{1}{2}$  mile) rather than continuous variables. An implicit

assumption is that the impact within the buffer is constant. This simplifying assumption is unrealistic because the impact has been found to diminish as the distance increases (Weinberger 2001). More importantly, the use of station area dummy variables hinders the ability to precisely estimate the boundary of the accessibility impact. Cervero and Duncan (2002c) conclude a premium for a property located within  $\frac{1}{4}$  mile of light rail station, yet planners believe that people are willing to walk more than  $\frac{1}{4}$  mile to reach rail stations. Weinberger (2001) includes several dummy variables in her models. She finds that dummy variables indicating within  $\frac{1}{4}$  mile and  $\frac{1}{4}$ – $\frac{1}{2}$  mile are significant, whereas the variable indicating  $\frac{1}{2}$ – $\frac{3}{4}$  mile is insignificant. It suggests no effect when a property is located within  $\frac{1}{2}$ – $\frac{3}{4}$  mile of a station. However, it is unclear whether the accessibility impact disappears at  $\frac{1}{2}$  mile,  $\frac{3}{4}$  mile, or somewhere in between. Due to the insufficient information, Weinberger conducts a further analysis to determine distance gradient.

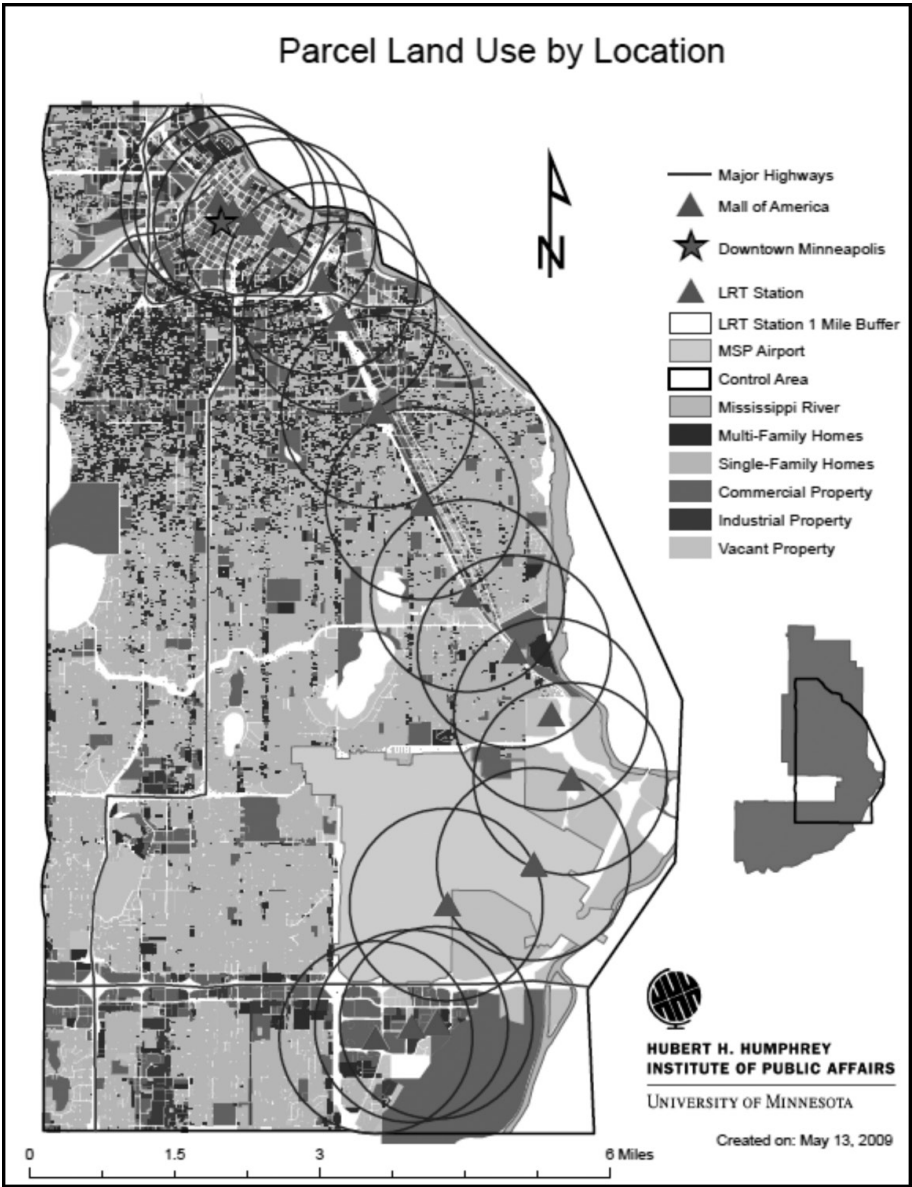
An accurate estimate for distance gradient is important for policy concerning the boundary for TIF districts, special assessment, and joint development. Therefore, the research question should go beyond “does rail transit impact property value?” to “how far does the impact extend?” To answer the latter question, we can use a continuous variable to measure distance to rail station and employ a nonlinear function of the variable to capture the accessibility effect, as was done by Chen, Rufolo, and Dueker (1998).

As indicated, the purpose of this study is to address the gaps and further shed light on the impact of rail transit on non-residential property values.

## **Background**

The Hiawatha LRT in Minneapolis was completed in 2004. The 12-mile line has 19 stations and runs north to south between downtown Minneapolis and the Mall of America in Bloomington, Minnesota, through the Minneapolis–Saint Paul International Airport (MSP). There are five stations located in the northernmost downtown Minneapolis area, and six stations located at the southernmost part of the line, starting at the MSP, the Bloomington corporate center, and ending at the Mall of America. The station areas at either end of the line are dominated by commercial developments or institutional land uses, while the station areas in the middle of the line are dominated by industrial land uses and residential properties (Figure 1).

The Hiawatha LRT is the first line in a network of transitways proposed by the Metropolitan Council (Metropolitan Planning Organization, MPO). NorthStar Commuter Rail, running between downtown Minneapolis and the north suburbs,



**Figure 1. Land use pattern in station and subregion areas**

opened in 2009. The Central Corridor, connecting downtown Minneapolis and downtown St. Paul, has started construction and will open in 2014. The Southwest LRT has entered the stage of preliminary engineering, and a few other transitways



are in various planning stages. Given the immense interest in rail transit in the Twin Cities, the experience of the Hiawatha LRT can offer valuable input for other transitways. It is evident that the completion of the LRT has affected economic development nearby; it has attracted and/or sustained a steady growth of several corporate commercial and retail developments at both ends of the line, as well as other smaller retailers and restaurants in neighborhoods along the line (Metropolitan Council 2006). In addition, the positive premium induced by the LRT has been capitalized in residential property prices (Goetz et al. 2010).

## **Methodology and Data**

To evaluate the impact of the LRT, we specified treatment study areas as one-mile buffers from all station areas. Also, we identified a subregion (defined by the boundary intersections of one mile west of I-35W [Lyndale Avenue], one mile north of the last downtown Minneapolis station, the Mississippi River, and one mile south of the Mall of America [see Figure 1]) of Minneapolis and Bloomington so we could compare the overall price fluctuations in the real estate market in the region.

Although previous studies employed various techniques (such as meta-analysis of transit premium, benefit-cost analysis, and production function) to investigate the economic impact of transportation investment, a hedonic pricing model is the most prevalent in capturing its impact on property values (Iacono and Levinson 2009). Specifically, the model assumes that goods are characterized as a package of inherent attributes, and the observed prices of goods reflect the utility (or implicit prices) of the attributes (Rosen 1974). Therefore, the value of a property is the summation of implicit prices for the characteristics associated with the property, such as location and structural attributes.

We employed hedonic models to capture the effect of access to the Hiawatha LRT on commercial and industrial properties while controlling for other factors. Based on a theoretical framework of firm location choice (Parsons Brinckerhoff Quade Douglas 1998), the model specification is as follows:

$$p_i = f(L_i, T_i, E_i, S_i, N_i)$$

where,

$L_i$  is the set of structural characteristics for the  $i$ th property

$T_i$  is the set of transportation network accessibility characteristics for the  $i$ th property

$E_i$  is the set of agglomeration economies characteristics for the  $i$ th property



$S_i$  is the set of socioeconomic characteristics for the  $i$ th property

$N_i$  is the set of labor poor accessibility characteristics for the  $i$ th property

In this specification, the transaction price of a property is a function of five sets of explanatory variables, and the key variables are transportation network accessibility characteristics. In this study, we used a network analysis of ArcGIS to measure the transportation network distance from a property to the closest LRT station and the distance to the closest highway on-ramp. We did not include variables pertaining to access to specific markets because of the diverse industries in the study area, and we did not include variables related to public services and taxes due to their limited variation.

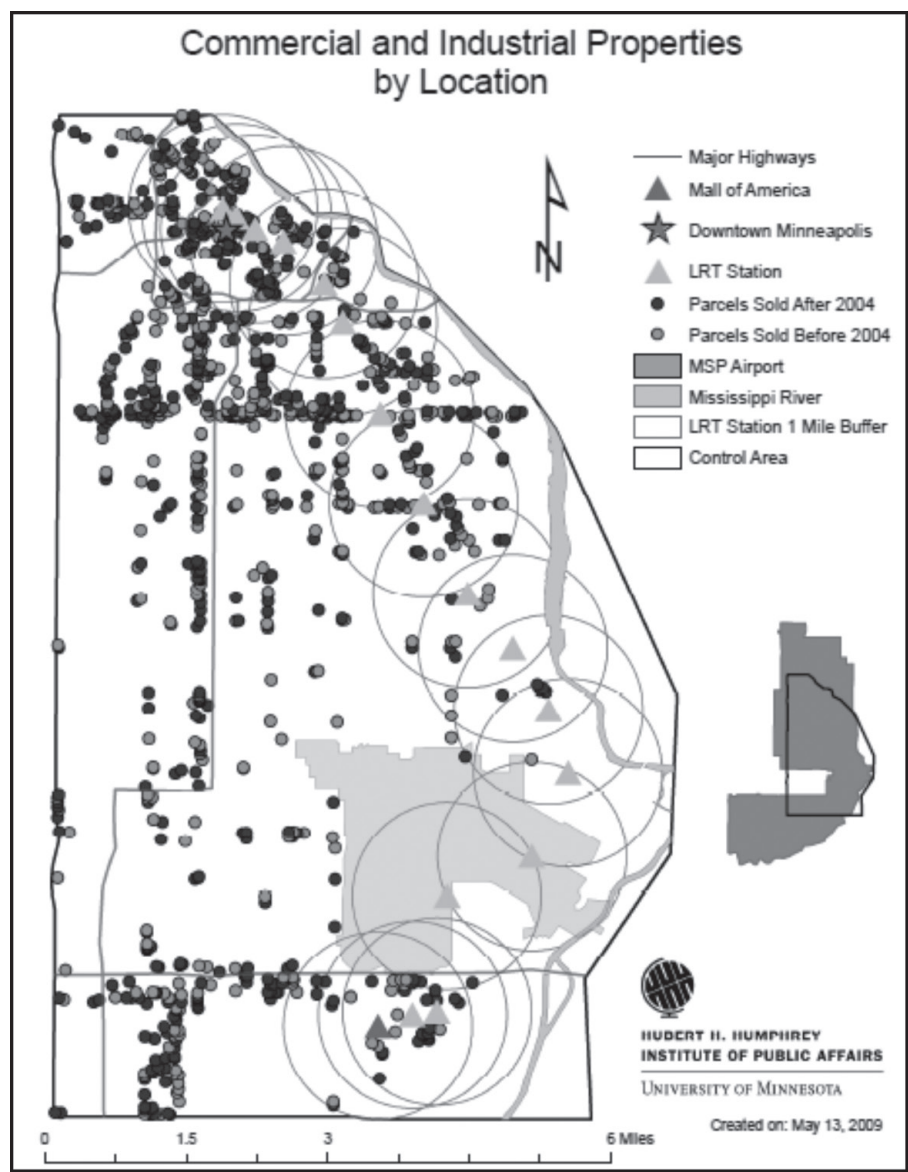
In this study, we used the sales price of commercial (including retail sales, offices, services, hotels, motels, health care facilities, and recreational services that are privately owned and operated for profit) and industrial (manufacturing, transportation, construction, communications, utilities, and wholesale trade) properties (defined by the Metropolitan Council) as the dependent variable. The property data set was the individual parcel data from the Metropolitan Council, and structural characteristics were from the City of Minneapolis. Since the research focused on the impact of access to the LRT before and after its opening, we included properties sold between 2000 and 2008. All monetary values were adjusted to constant year 2000 dollars, using Gross Domestic Product deflators from the Nation Income and Product Account. Table 1 summarizes the number of observations in the dataset, and Figure 2 shows that the majority of sales occurred near downtown Minneapolis and the Mall of America in Bloomington. We took the most recent sales into consideration (as opposed to repeat sales). Taking data inconsistency and structural information availability into account, the number of observations used in the models is smaller than what is available in the parcel data.

**Table 1. Property Sales Volume**

Area	Subregion	Station Area		Subregion	Station Area	
		1 mile	0.5 mile		1 mile	0.5 mile
		(with structural information)				
Total Observation	5,012	2,700	1,412	2,037	1,073	564
Sold*	1,761	828	427	1,054	529	254
Sold After 2000**	817	375	184	493	251	109
Sold After 2004	469	214	109	288	154	73

\* Number of parcels sold with sale price greater than \$1; does not include repeat sales.

\*\* Number of parcel sold after 2000 with sale price greater than \$1; does not include repeat sales.



**Figure 2. Sales activity in station and subregion areas**

Table 2 summarizes the data within the subregion. Socioeconomic variables were derived from the 2000 Census (at the block group level), and the number of jobs and labor pool are from 2002–2006 Census Longitudinal Employment Household Dynamics (at the block group level). On average, the parcels were 83 percent

commercial, less than 2 stories, and built around 1939. The properties are located around 2,000 meters from LRT stations (which are located at major traffic intersections of Hiawatha Avenue–State Highway 55) and highway on-ramps and are much closer to downtown Minneapolis than to the Mall of America. Within a one-mile buffer of a typical property, about 41 percent are single-family homes, 25 percent are multi-family homes, 13 percent are commercial properties, and 10 percent are industrial properties.

**Table 2. Summary of Variables**

Variables	Mean	Std. Dev.	Min	Max
<b>Dependent Variable</b>				
sales price	1,465,103	5,825,522	91	85,400,000
<b>Potential Independent Variables</b>				
<i><b>Structural Characteristics</b></i>				
commercial property	0.83	0.37	-	1.00
lot size (sq. ft)	17,719	30,685	1,307	373,309
gross building (sq. ft.)	22,536	82,591	128	1,119,475
number of stories	1.80	2.80	-	33.00
building age	68.89	26.51	3.00	143.00
<i><b>Transportation Network Accessibility Characteristics</b></i>				
network dist. LRT stn (meters)	2,533	1,712	105	8,288
network dist. Hwy on-ramp (meters)	2,222	1,251	306	7,114
<i><b>Economic Agglomeration Characteristics</b></i>				
network dist. Downtown (meters)	3,820	2,214	173	9,526
network dist. Mall of America (meters)	10,979	2,484	4,956	16,113
number of jobs	2,560	8,018	-	40,193
retail area w/in 1-mile buffer (acres)	205	134	17	555
office area w/in 1-mile buffer (acres)	23.0	28.6	-	92
mixed commercial and industrial area w/in 1-mile buffer (acres)	14.8	22.9	-	83
institutional area w/in 1-mile buffer (acres)	170	73	35	477
industrial area w/in 1-mile buffer (acres)	146	142	-	558
multifamily housing and residential-mixed area w/in 1-mile buffer (acres)	403	218	63	850
single-family housing area w/in 1-mile buffer (acres)	665	435	5	1,452
<i><b>Socioeconomic Characteristics</b></i>				
median household income	35,489	14,420	10,503	98,363
median owner-occupied housing value	103,308	55,066	-	300,000
portion of African American	0.20	0.14	0.00	0.73
<i><b>Labor Pool Accessibility Characteristics</b></i>				
labor pool size	410	215	20	1,575

## Results

When we developed models in Stata 10, both the distance to the LRT station and its quadratic term were included to capture the boundary of the accessibility effect. To isolate the effect of the Hiawatha LRT, we used a dummy variable, post LRT, to indicate a parcel sold after 2004. Some of the variables listed in Table 2 were removed. Specifically, using a variation inflation factor (VIF) to eliminate variables

with large variances due to the dependency of other variables, we examined multicollinearity among independent variables. This required examining the VIF of the model and then one by one eliminating variables that were not statistically significant. In the final model, we manually removed the following variables: building age, distance to downtown Minneapolis, distance to Mall of America, distance to LRT track (to capture nuisance effect), interaction between commercial property and distance to LRT station, single-family housing area, and multi-family housing area. We included a downtown dummy variable. After examining preliminary regression results, we discarded properties that were sold for more than \$50 million as they were distorting some of the regression coefficients in counterintuitive manners in both magnitudes and signs. The removal of the 10 outliers produced more intuitive results and increased the explanatory power of several variables.

### ***Subregion Area***

Table 3 presents the hedonic model for the subregion. As expected, the value of commercial properties was, on average, \$801,821 more than industrial properties. The estimated coefficients for the structural characteristics were statistically significant (except for number of stories) with expected signs. The coefficient for building size increased substantially after the opening of the LRT, as shown by its interaction term with the post LRT dummy.

Property values tended to increase as the number of jobs within a one-mile buffer increased. This substantiates the effect of economic agglomeration on property values. Further, the proportion of African Americans had a negative association with property values. The areas with a higher share of African Americans were more likely to be neighborhoods with a high level of diversity. It is hard for businesses to get established in these areas because of the diverse tastes and purchasing power of their residents.

The coefficients for network distance to LRT stations and its quadratic term were not significant in the model. Neither were their interaction terms with the post LRT dummy. In other words, we did not find any significant impact of the LRT on property values in the subregion before and after the opening of the LRT. Thus, the accessibility impact of the LRT, if any, seems to be localized. Access to highway ramps also was not significant.

Access to labor tended to increase property values; however, it was statistically insignificant. All other variables were also insignificant in explaining changes in a firm's willingness to pay for non-residential properties.

**Table 3. Hedonic Model for Subregion**

Variable	Coef.	Std. Err.	t
post LRT	-658,471	695,256	-0.95
commercial property	801,821	321,622	2.49**
lot size (sq. ft)	22.63	4.06	5.57**
gross building (sq. ft.)	16.32	5.78	2.83**
post LRT x gross building	24.62	5.64	4.37**
number of stories	78,082	67,373	1.16
network dist. LRT stn (meters)	-37.2	381	-0.10
post LRT x network dist. LRT stn	351	460	0.76
network dist. LRT stn squared	0.009	0.048	0.18
post LRT x network dist. LRT stn squared	-0.031	0.062	-0.50
downtown	45,740	516,011	0.09
network dist. Hwy on-ramp (meters)	43.6	154	0.28
retail and office area w/in 1-mile buffer (sq. ft)	1,091	1,826	0.60
industrial area w/in 1-mile buffer (sq. ft.)	-522	1,172	-0.45
median household income	-14.3	12.3	-1.17
median owner-occupied housing value	1.65	2.81	0.59
portion of African American	-2,145,326	1,004,059	-2.14**
number of jobs	90.8	18.8	4.84**
labor pool size	443	547	0.81
constant	-495,108	1,284,431	-0.39

Number of obs = 483

F(19, 463)= 39.91

Prob > F = 0.0000

R-squared= 0.6209

Adj R-squared= 0.6053

\*\* Significant at 5% level

\* Significant at 10% level

### ***Station Areas***

We now turn to the model for stations that are within a one-mile radius from LRT stations. The adjusted R-square increased from 0.605 to 0.800. Thus, independent variables carried more explanatory power for prices in station areas than for the subregion. As shown in Table 4, the dummy variable for property type was not statistically significant, and lot size was negatively associated with sales prices. We attribute these to the distorting impact of the high concentration of industrial properties (mainly grain elevators and storage facilities). Since taller buildings occupy a smaller amount of land, it is not surprising to find that property values were inversely related to the number of stories, after controlling for building size. All other variables significant in the model for the subregion were significant in this model.

**Table 4. Hedonic Model for Station Area**

Variable	Coef.	Std. Err.	t
post LRT	2,485,718	1,582,487	1.57
commercial property	92,703	337,836	0.27
lot size (sq. ft)	-8.39	4.16	-2.02**
gross building (sq. ft.)	36.0	5.23	6.88**
post LRT x gross building	19.9	4.93	4.03**
number of stories	-141,796	60,563	-2.34**
network dist. LRT stn (meters)	296	1,855	0.16
post LRT x network dist. LRT stn	-4,578	2,322	-1.97**
network dist. LRT stn squared	-0.17	0.65	-0.26
post LRT x network dist. LRT stn squared	1.70	0.83	2.06**
downtown	444,487	628,880	0.71
network dist. Hwy on-ramp (meters)	-48.7	192	-0.25
retail and office area w/in 1-mile buffer (sq. ft)	162	2,588	0.06
industrial area w/in 1-mile buffer (sq. ft.)	-1,007	1,382	-0.73
median household income	-19.9	19.9	-1.00
median owner-occupied housing value	0.35	4.76	0.07
portion of African American	-3,376,699	1,616,134	-2.09**
number of jobs	65.1	18.8	3.46**
labor pool size	1,400	848	1.65
constant	1,234,858	1,943,991	0.64

Number of obs = 246

F(19, 226)= 52.61

Prob > F = 0.0000

R-squared= 0.8156

Adj R-squared= 0.8001

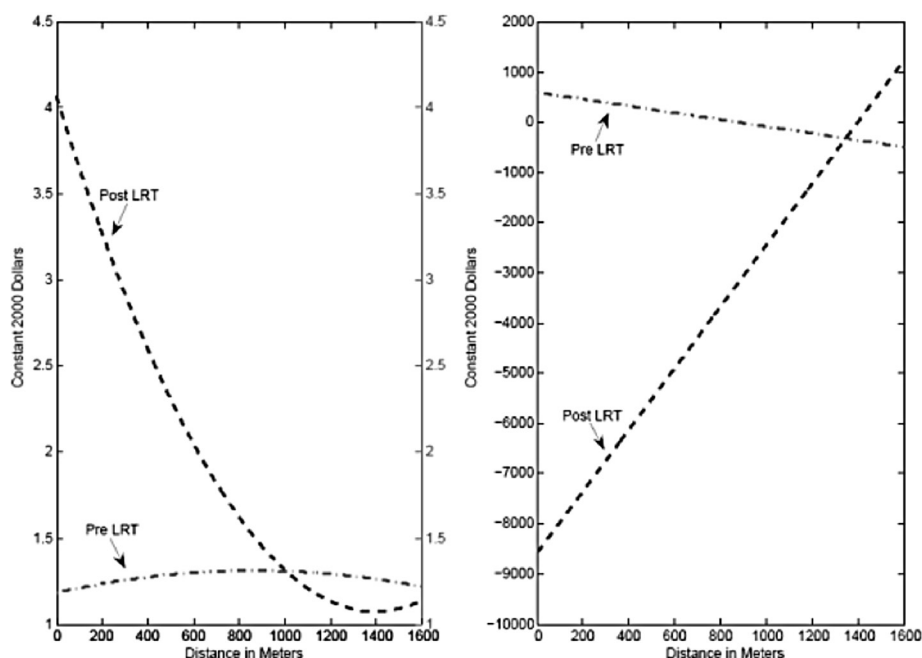
\*\* Significant at 5% level

\* Significant at 10% level

We compared the coefficients for building size in Tables 3 and 4 and found that, in terms of sales prices per square foot, the properties in the station areas are more expensive than those in the subregion. After the opening of the LRT, the increase in sales prices per square foot in the subregion (\$24.60) was larger than that in station areas (\$19.86). The difference was statistically insignificant, however.

The regression coefficient on the interaction term between the post LRT dummy and distance to LRT station (post LRT x network dist. LRT stn) suggests a significant accessibility effect of the LRT on sales prices after its opening. Since this coefficient for the distance to LRT station and its quadratic term were significant, proximity to LRT station increases property values and does so in a nonlinear fashion. Figure 3 illustrates that the premium of the LRT extends to about 1,400 meters (0.875 miles)

away from stations and substantiates the need for including properties within a one-mile radius for this study. The finding suggests that the benefits associated with access to LRT declines with distance. For example, the price gradient (defined as the first derivative of the price function with respect to distance away from station) is approximately \$6,000 per meter for a typical property located 400 meters ( $\frac{1}{4}$  mile) away from LRT station, while it drops to about \$4,000 for a property 800 meters ( $\frac{1}{2}$  mile) away.



Left figure: accessibility effect; Right figure: price gradient. Unit \$ million  
 Left vertical axis is for post LRT and right axis is for pre LRT.

### **Figure 3. Price Premium and Access to LRT Station**

Table 4 also reports the accessibility effect of the major intersections of Hiawatha 55 (which later became the sites of LRT stations) on property values (network dist. LRT stn). Although, graphically, we illustrated a negative price gradient associated with access to these intersections in Figure 3, the coefficients for distance to the intersections that later became sites of LRT stations and their quadratic terms were not statistically significant. In other words, we did not observe the effect of being close to major interactions. Therefore, the accessibility effect on property values after opening solely results from the Hiawatha LRT.



## **Conclusion**

Given the recent rounds of applications and awards of TIGER Grants, the impact of access to rail transit on property values has become a centerpiece in the discussion on the relationships between rail investment and economic development. Based on firm location choice theory, this study explores three aspects of the value-added effect of the Hiawatha LRT on commercial and industrial properties: when, where, and how much.

After controlling for multiple structural and location factors, the model for station areas generated a continuous price function that suggests property prices decrease with distance away from LRT stations since the line became operational. The results demonstrate how much and how far the LRT may have increased property prices in Minneapolis. Further, before the opening of the LRT, the distance to station sites and its quadratic term are not significant. That is, the proximity to major interactions does not significantly add values for properties nearby. Thus, the observed effect after its opening results from access to the LRT.

The size of the effect boundary has implications on value-capture and, ultimately, project financing. In general, the value-capture districts should not include areas where development would have happened, regardless of the transportation investment or other reasons. In this case study, which accounted for demographic and socioeconomic factors, distance to LRT station and related variables are insignificant in the model for the subregion, but they are significant in the model for station areas. These confirm the localized impact of the LRT. Based on previous research, Ryan (1999) states that "property [including both residential and commercial properties] value effects occur close to a facility, within 1 mile for highways and 0.33 of a mile for rail transit" (p.423). Weinberger (2001) concludes that rail transit has no effect on the rental of properties beyond  $\frac{3}{4}$  mile of stations. This study adopts a quadratic function and found that the effect on sales prices extends to almost 0.9 mile away from stations. This suggests that future studies that assess property value effects should go beyond the traditional  $\frac{1}{4}$ -mile and  $\frac{1}{2}$ -mile buffers while imposing some form of boundary limitations. Such a refinement on the study area of transportation investment can help reconcile the differences in the size of impact area of transit voiced by various stakeholders, especially in applications for federal and state funding such as TIGER or in developing financing instruments such as TIF.

Other potential benefits related to the LRT investment were not quantified and monetized in this study. Besides the accessibility effect of the Hiawatha LRT itself, proactive planning and policies associated with the LRT play a key role in creating a

sustainable community for both residents and businesses: the City of Minneapolis encourages redeveloping surface parking lots for efficient use of downtown lands served by mixed transportation options; the Minneapolis Planning Department recommends a maximum parking requirement in downtown areas; the City created pedestrian overlay districts and changed zoning regulations in the neighborhoods along the line and finished station area planning for most stations (Curtner 2009). In Bloomington, because of the LRT, the development plan for the Central Station areas, which previously were vacant lands, was completely overhauled to take advantage of the LRT. Accordingly, one station on American Boulevard was added to meet the demand of riders in 2009.

Overall, the Hiawatha LRT has increased commercial and industrial property values nearby, and, to some extent, revitalized the neighborhoods and stimulated economic development along the corridor. However, this may not represent a net increase of economic activities in the region. Transportation investment may shift business activities from one area to the other within a region (Giuliano 2004; Handy 2005). On the other hand, the increase in property values and, hence, taxes may create challenges for small businesses, especially those serving low-income people. Some business owners along the Central Corridor LRT have longstanding concerns about its potential impacts on their businesses. To alleviate the accessibility impact, governments can provide tax relief for long-term small businesses and establish a loan fund to support the transition of small businesses.

## References

- Bina, Michelle, Valdemar Warburg, and Kara Kockelman. 2006. Location choice vis-à-vis transportation: Apartment dwellers. *Transportation Research Record* 1977: 93-102.
- Bollinger, Christopher R., Keith R. Ihlanfeldt, and David R. Bowes. 1998. Spatial variation in office rents within the Atlanta region. *Urban Studies* 35(7): 1097-1118.
- Cao, Xinyu, and Jill A. Hough. 2008. Hedonic value of transit accessibility: An empirical analysis in a small urban area. *Journal of the Transportation Research Forum* 42(3): 171-183.
- Cervero, Robert, and Michael Duncan. 2002a. Land value impacts of rail transit services in Los Angeles County. Prepared for National Association of Realtors, Urban Land Institute.

- Cervero, Robert, and Michael Duncan. 2002b. Land value impacts of rail transit services in San Diego County. Prepared for National Association of Realtors, Urban Land Institute.
- Cervero, Robert, and Michael Duncan. 2002c. Transit's value-added effects: Light and commuter rail services and commercial land values. *Transportation Research Record* 1805: 8-15.
- Chen, Hong, Anthony Rufolo, and Kenneth Dueker. 1998. Measuring the impact of light rail systems on single-family home values: A hedonic approach with geographic information system application. *Transportation Research Record* 1617: 38-43.
- Curtner, Sarah. 2009. Land use changes at Hiawatha light rail stations to encourage development. Humphrey School of Public Affairs, University of Minnesota.
- Debrezion, Ghebreegziabiher, Eric Pels, and Piet Rietveld. 2007. The impact of railway stations on residential and commercial property value: A meta-analysis. *The Journal of Real Estate Finance and Economics* 35(2) :161-180.
- Debrezion, Ghebreegziabiher, Eric Pels, and Piet Rietveld.. 2011. The impact of rail transport on real estate prices. *Urban Studies* 48(5): 997-1015.
- Duncan, Michael. 2011. The impact of transit-oriented development on housing prices in San Diego, CA. *Urban Studies* 48(1): 101-127.
- Fuerst, Franz. 2007. Office rent determinants: A hedonic panel analysis. Hanley Business School, University of Reading.
- Giuliano, Genevieve. 2004. Land use impacts of transportation investments: Highway and transit. In *The Geography of Urban Transportation*, edited by S. Hanson and G. Giuliano. New York: The Guilford Press.
- Goetz, Edward G., Kate Ko, Aaron Hagar, Hoang Ton, and Jeff Matson. 2010. The Hiawatha Line: Impacts on land use and residential housing value. Center for Transportation Studies, University of Minnesota.
- Handy, Susan. 2005. Smart growth and the transportation-land use connection: What does the research tell us? *International Regional Science Review* 28(2): 146-167.
- Hess, Daniel Baldwin, and Tangerine Maria Almeida. 2007. Impact of proximity to light rail rapid transit on station-area property values in Buffalo, New York. *Urban Studies* 44(5-6): 1041-1068.

- Iacono, Michael, and David Levinson. 2009. The Economic impact of upgrading roads. Minneapolis, MN: Department of Civil Engineering, University of Minnesota.
- Iacono, Michael, and David Levinson. 2011. Location, regional accessibility and price effects: evidence from Twin Cities home sales. *Transportation Research Record* 2245: 87-94.
- Iacono, Michael, David Levinson, Zhirong Zhao, and Adeel Lari. 2009. Value capture for transportation finance: Report to the Minnesota Legislature. Minneapolis, MN: Center for Transportation Studies, University of Minnesota.
- Landis, John, Subhrajit Guhathakurta, William Huang, and Ming Zhang. 1995. Rail transit investments, real estate values, and land use change: A comparative analysis of five California rail transit systems. Berkeley, CA: University of California Transportation Center.
- Landis, John, and David Loutzenheiser. 1995. BART access and office building performance. The University of California Transportation Center, University of California Berkeley.
- Litman, Todd A. 2011. Rail transit in America: A comprehensive evaluation of benefits. Victoria Transport Policy Institute.
- Metropolitan Council. 2011. Hiawatha light rail transit development 2006 [cited May 15 2011]. Available from [http://www.metrocouncil.org/directions/transit/transit2006/hiawatha\\_TODMar06.htm](http://www.metrocouncil.org/directions/transit/transit2006/hiawatha_TODMar06.htm).
- Mills, Edwin, and Bruce Hamilton. 1994. *Urban Economics*. 5th ed. New York: Harper-Collins.
- Nelson, Authur C. 1999. Transit stations and commercial property values: A case study with policy and land-use implications. *Journal of Public Transportation* 2(3): 77-95.
- O'Toole, Randle. 2010. Defining success: The case against rail transit. CATO Institute.
- Parsons Brinckerhoff Quade Douglas. 1998. Land Use Impacts of Transportation: A Guidebook. Prepared for National Cooperative Highway Research Program, Transportation Research Board.
- Raper, Michael, and Keith R. Ihlandfeldt. 1993. Towards understanding how office-location decisions differ. In *Dynamics of Office Markets: Empirical Findings and*

*Research Issues*, edited by J. M. Clapp. Washington, DC: The Urban Institute Press.

Rosen, Sherwin. 1974. Hedonic prices and implicit markets: Product differentiation in pure competition. *Journal of Political Economy* 82: 34-55.

Ryan, Sherry. 1999. Property Values and transportation facilities: Finding the transportation-land use connection. *Journal of Planning Literature* 13(4): 412-427.

Ryan, Sherry. 2005. The value of access to highways and light rail transit: Evidence for industrial and office firms. *Urban Studies* 42(4): 751-764.

ten Siethoff, Brian, and Kara Kockelman. 2002. Property values and highway expansion: Timing, size, location, and use effects. *Transportation Research Record* 1812: 191-200.

Utts, Jessica. 2003. What educated citizens should know about statistics and probability. *The American Statistician* 57(2): 74-79.

Weinberger, Rachel. 2001. Light rail proximity: Benefit or detriment in the case of Santa Clara County, California? *Transportation Research Record* 1747: 104-113.

Zhao, Zhirong, Kirti Das, and Kerstin Larson. 2010. Tax increment financing as a value capture strategy in funding transportation. *Transportation Research Record* 2187: 1-7.

## About the Authors

**KATE KO** ([kox0053@umn.edu](mailto:kox0053@umn.edu)) is a senior economist at HDR Decision Economics and a Ph.D. candidate at the University of Minnesota. She is active in research on community livability in relation to transit infrastructure investments, with focuses on the quantification of the interconnectedness of household consumption and infrastructure investment.

**XINYU (JASON) CAO** ([cao@umn.edu](mailto:cao@umn.edu)) is an assistant professor at the Humphrey School of Public Affairs at the University of Minnesota, Twin Cities. He is interested in transportation planning and policy and travel behavior analysis, including the relationships between the built environment and travel behavior and the impact of information and communication technologies on travel demand.