Title
From Elevated Freeway to Linear Park: Land Price Impacts of Seoul, Korea's CGC Project

Authors
Kang, Chang Deok
Cervero, Robert

Publication Date
2008-08-01

From Elevated Freeway to Linear Park: Land Price Impacts of Seoul, Korea's CGC Project

Chang Deok Kang and Robert Cervero

WORKING PAPER

UCB-ITS-VWP-2008-7

UC Berkeley Center for Future Urban Transport

A VOLVO Center of Excellence

August 2008

From Elevated Freeway to Linear Park:

Land Price Impacts of Seoul, Korea's CGC Project

Chang Deok Kang and Robert Cervero

Track One

Berkeley Center for the Future of Urban Transport

A Volvo Center of Excellence

August 2008

From Elevated Freeway to Linear Park:

Land Price Impacts of Seoul, Korea's CGC Project

1. Introduction

Freeways and other high-performance roadway investments have long been considered vital to the economic well-being of metropolitan areas. Empirical research shows that limited-access, grade-separated freeway systems increase a region's economic productivity by lowering transportation costs, a factor input to economic production (Aschauer, 1990; Boarnet, 1997). Past studies also reveal that urban land markets capitalize the benefit of proximity to freeway interchanges, especially for non-residential uses and in areas experiencing worsening traffic conditions (Gillen, 1996; Boarnet, 1997; Bhatta and Drennan, 2003).

Increasingly, city leaders are turning to a different kind of public asset to grow local economies, notably public amenities, urban parks, and other civic functions that enhance quality of central-city living. In an increasingly competitive, knowledge-based global marketplace, improved civic spaces and expansion of the arts and cultural-entertainment offerings, proponents contend, will appeal to highly sought professional-class workers, Richard Florida's (2002) so-called "creative class".

The desire for high-speed mobility, and freeways in particular, and quality of place pose a dilemma. On the one hand, access-controlled, grade-separated freeways provide vital mobility, funneling suburbanites to good-paying white-collar office jobs and providing connectivity to the region at large. On the other hand, they sever longstanding neighborhoods, form barriers and visual blight, cast shadows, and spray noise, fumes, and vibrations on surrounding areas. Do the mobility benefits of freeways offset their nuisance effects, particularly in today's amenity-conscious workplace? Some city leaders have decided no, opting to tear down long-standing elevated freeway structures and replace them with linear parkways or less obtrusive, more human-scale surface boulevards. In a sense, this represents a re-ordering of public priorities and perhaps even a paradigm shift -- from a focus on "automobility" to a focus on "liveability", from an emphasis on expediting the movement of professional-class suburbanites to central cities to one of attracting professional-class workers to reside in central cities.

Freeway deconstruction is not new. More than 30 years ago, residents of Portland, Oregon voted to bulldoze the Harbor Drive freeway and replace it with a 37-acre waterfront park on the edge of downtown. Following the 1989 Loma Prieta earthquake, San Francisco razed double-deck freeways along its waterfront and several miles inland in favor of attractively landscaped, multi-way boulevards. Milwaukee recently tore down its Park East Freeway, opting to use the vacated land for housing, shops, and offices. Hoping to reverse the flight of households and businesses from the central city, then-Mayor John Norquist spearheaded a community-based effort to transform 26 acres of prime urban real estate to a New Urbanism-type "new town/in town". A ground-level six-lane boulevard, McKinley Avenue, has since been constructed, adorned with tree-lined medians, granite pavers, and wide sidewalks. At present, freeway demolition is planned for the Innerloop in Rochester, NY, Route 29 in Trenton, NJ, and the Whitehurst freeway in Washington, D.C. and serious discussions are presently under way to remove the Jones Falls Expressway in Baltimore, Seattle's Alaska Way Viaduct, Buffalo's Skyway, the Sheridan Expressway in the Bronx, Robert Moses Parkway in Niagra Falls, sections of Interstate-5 in Portland, and segments of Paris's Pompiedou Expressway (Preservation Institute, 2007).

Without question, the boldest and most dramatic freeway removal to date has been Seoul, Korea's Cheong Gye Cheon (CGC) project. Under the leadership of then-Mayor (and recently elected president of South Korea) Myung-Bak Lee, Seoul's CGC elevated expressway was torn down in 2003. A stream buried beneath the freeway was soon thereafter brought back to the surface as a linear park and bike path. The mayor staked his 2002 mayoral election campaign on this $313 million stream-restoration project, calling it "a new paradigm for urban management in the new century" (Seoul Metropolitan Government, 2003). Echoing the sentiments of urban visionaries like Jaime Lerner of Curitiba, Brazil and Enrique Penalosa of Bogotá, Colombia, Mayor Lee defended the project on the grounds: "we want to make a city where people come first, not cars". The CGC project, perhaps more than any freeway removal to date, represents a recasting of public priorities.. Specifically, it marks a shift from infrastructure that enhances "automobility" to infrastructure that enhances public amenities and quality of urban living. In this paper, we investigate the land-price impacts of replacing the CGC freeway with a linear park/waterway on commercial and residential properties. First, the literature is reviewed. Next, we present background information on the project, discuss methodology and data sources, and then present a hedonic price model that isolates the influences of proximity to the freeway and its successor, the urban-stream/linear-park, on property values. Multilevel modeling is used to estimate land-value impacts during the 2001-2002 and 2005-2006 periods. The article concludes with discussions on the public policy implications of the research findings.

2. Literature Review

The impact of high-capacity urban highways on neighborhoods has been studied in depth since freeways first appeared on the urban scene over 50 years ago. Past studies suggest that under receptive conditions, urban highway networks significantly influence the location choices of firms and households (Boarnet, 1998; Boarnet and Chalermpong, 2001). Rapid population and employment growth, matched by worsening traffic congestion, must be present if nearby properties are to capitalize the accessibility benefits conferred by highway and freeway interchanges. Even then, other preconditions, like supportive zoning and complementary infrastructure, must also be in place if road investments are to have significant and lasting land-use impacts (Giuliano, 2004). One study in California concluded that land-value appreciation attributable to highway investments depend on the network structure and the composition of economic growth (Boarnet and Haughwout, 2000). The marginal accessibility benefits of an improvement to an already extensive roadway network might be relatively small, thus bringing about modest land-value gains. Site features also matter. For commercial activities that rely on visibility, exposure, and ease of site access, land appreciation is often limited to parcels close to an interchange (Voith, 1993).

The impacts of highways on development and land prices also vary by length of time and geographical scale of analysis (Bhatta and Drennan, 2003). Impacts on urban structure might be immeasurable in the near term yet appreciable over a number of years due to time-lags in land development (Giuliano, 2004). Furthermore, a macro-scale study may reveal modest land-use effects while a micro-scale study, such as at the neighborhood level, might find a significant degree of land-use adjustments.

Valuation impacts have also been carried out in the past on a number of different site amenities as well as dis-amenities, including open space, waste facilities, building designs, streetscapes, and waterfronts. As an externality, a site amenity or dis-amenity typically exerts its price influences on a specific aspect of a property, such as a view or proximity (Kain and Quigley, 1970; Cheshire and Sheppard, 1995). In middle and upper income settings, property owners are often willing to pay for aesthetics and architectural design to increase property premium (Asabere, Hachey, and Grubaugh, 1989; Vandell and Lane, 1989). The impacts of nature, however, are not always as clear. In the case of open space, studies show the land price impacts vary tremendously. Open space can increase land prices by its intrinsic qualities (e.g., greenery, spaciousness) but also by reducing the amount of developable land available. However, the noise and foot traffic generated by nearby popular parks and open areas might be viewed as a nuisance by residential property owners (Frech and Lafferty, 1984). Proximity to nuisances like toxic waste sites or airport flight paths universally lowers property values, with residential parcels losing the most (Kohlhase, 1991). Other forms of neighborhood amenities rarely overcome such nuisances. One study, for example, showed that average land prices were no different in nicely landscaped districts than in less lavished ones with similar levels of traffic congestion (Polinksy and Shavel, 1976).

Research also shows that the land-price effects of open space vary by size and type. One study found that small neighborhood parks increased residential property values the most (Espey and Owusu-Edusei, 2001). Another study found that natural area parks were more highly valued than urban parks (Lutzenhiser and Netusil, 2001). A Portland, Oregon study found proximity to private parks and golf courses increased residential sales prices (Bilitzer and Netusil, 2000). In general, research shows, the benefits of open space are most capitalized in residential property values in areas that are denser, have higher household incomes, and are closer central business areas (Anderson and West, 2006; Dehring and Dunse, 2006). The impacts of open space and public amenities on non-residential properties are less clear. Urban economists like Glaeser et al. (2001) contend that urban parks, open space, and waterfront improvements can help cities attract skilled workers and knowledge-based industries in addition to stabilizing declining neighborhoods. One study in greater Los Angeles found that public amenities like parks did influence the location patterns of firms (Sivitanidou, 1995).

Far less is known about the price impacts of converting from one form of public amenity to another, such as replacing an elevated freeway with a linear parkway. A study of Boston's notorious "Big Dig" project (wherein an elevated freeway was replaced by a tunnel and a linear park) found that proximity to open space had a positive impact on residential and commercial property values (Tajima, 2003).. This, however, was a crosssectional study that looked only at post-freeway impacts. Our study aims to extend such work by examining impacts on residential and commercial properties both before and after the replacement of an elevated freeway with a linear park.

3. Project Description

A combination of factors weighed in on the decision to tear down Seoul's CGC elevated freeway and restore the urban stream – flanked by a linear park-- that pre-dated the freeway. Cheong Gye Cheon, which means "clear valley stream," has long been a source of fresh water and centerpiece of urban life in Seoul, going back to the 14th century. During the Chosun dynasty (1392-1910), city dwellers did their laundry in the stream and frequently socialized on its banks. Following the Korean War (1950-1953), the stream's character quickly changed when temporary refugee housing was built along its banks. Untreated waste was dumped directly into the waterway, turning it into a veritable cesspool and eventually prompting city officials to cover the stream with an elevated freeway.

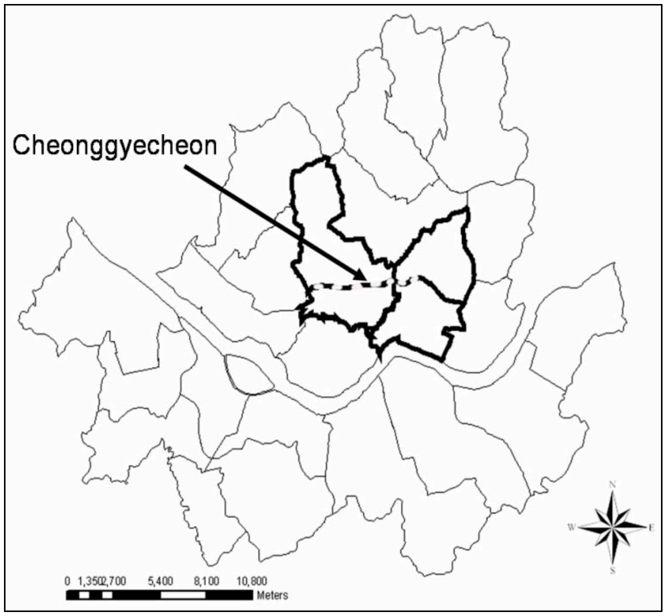
The Cheong Gye Cheon freeway, 50 to 80 meters in width and 6 kms in length, opened in 1971.. Below the road was stream and a sewer trunk-line. The freeway quickly became an important conduit for movement within central-city Seoul. A 1992 study by the Korean Society of Civil Engineers, however, found that more than 20% of the freeways steel beams were seriously corroded and were in need of urgent repair (CGC Restoration Project Headquarters, 2004). The Seoul Metropolitan Government immediately began repairing the road's understructure however due to concerns about the road's long-term safety and stability, this was seen as a stopgap to either totally reconstructing the freeway or tearing it down altogether.

At roughly the same time the CGC freeway was being repaired and under increased scrutiny, an urban regeneration movement was taking place in Seoul. In the 1980s, numerous new towns were built on the periphery of Seoul in hopes of relieving central-city congestion and population growth pressures. Rising automobile travel and the convergence of more and more radial commutes from the periphery into the urban center led to steadily worsening traffic conditions. By the late 1990s, some critics charged that new towns were a failed experiment, exacerbating traffic congestion and environmental quality due to lengthier, more car-dependent commutes. The idea of re-urbanizing Seoul's central areas through "new towns/in town" began to surface.

The person who led the charge of re-generating Seoul city was Myung-bak Lee. In 2001, Lee ran for mayor of Seoul, largely on a platform of reinvigorating Seoul's central city as means of creating a more sustainable yet productive city. Lee campaigned on the premise that Seoul could achieve a better balance between function and the environment. Prior to becoming major, Lee found and led the Hyundai Group for three decades, Korea's largest builder of public works and infrastructure projects. During this time, he earned the nickname "Bulldozer" Lee, partly due to the company's legacy of constructing massive roadways throughout the country but also because he reputedly once took apart a bulldozer to study its mechanism and figure out why it kept breaking down..

Once taking office in early 2002, Mayor Lee quickly began acting upon his campaign promises. His vision for future urban transportation called for not only expanding public transit services but also reducing the ecological footprint of the private car by reclaiming urban space consumed by roads and highways. The Cheong Gye Cheon freeway-to-linear park conversion was a natural choice to launch Lee's vision of a more sustainable urban landscape for Seoul. Change was swift. By February 2003, a plan for the freeway removal was completed and five months later, the freeway had been completed disassembled. Some two years later, in October 2005, the restored CGC stream and linear parky was opened to the public following a high-profile public celebration and ribbon cutting by Mayor Lee. The entire cost of the freeway demolition and stream restoration was US$313 million.

Figure 1.. Location of Case Areas in Seoul



Source: Seoul Metropolitan Government

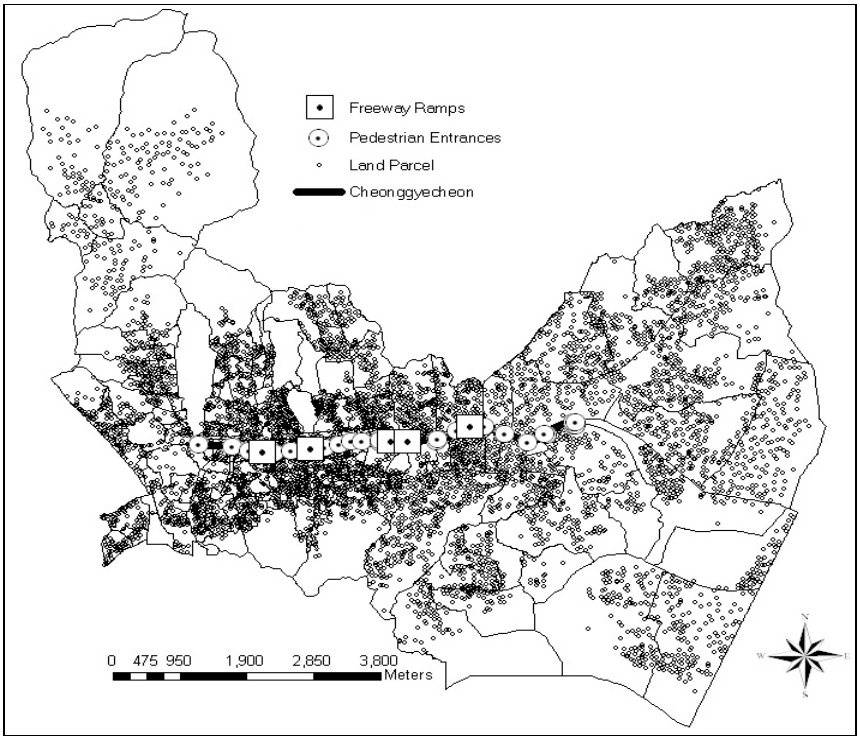
Today, the restored CGC stream flows east to west in central Seoul (Figure 1), passing through 13 districts (the smallest municipal administrative unit) in four different wards. In 2003, the land-use composition of building floorspace in these 13 districts was: offices (29%), commercial-retail (49%), residential (13%), and other miscellaneous uses (9%).

The CGC project has not been without controversy. One obvious concern would be the effects of taking out a 6 km freeway on traffic congestion. To help relieve possible congestion impacts, the Seoul Metropolitan Government opened 68 kms of rapid-bus-only median lanes along major arterials in 2004 and reconfigured bus routes to better fed into the city's extensive subway system. Additionally, many small shopkeepers and merchants were against the project out of fear of losing business. Alongside the former elevated freeway was an assembly of small-scale shops and markets selling shoes, apparel, tools, and appliances. Through intensive negotiations, the Seoul Metropolitan Government was able to head off this opposition by financially compensating merchants and relocating a number of shops to a newly constructed market center south of the Han River that was easily accessible by highways and public transit.

4. Study Area and Cases

In order to study the capitalization effects of converting the CGC freeway to a restored stream and linear park, data were compiled on land prices and site as well as neighborhood attributes of individual land parcels in the four wards (of Seoul's 25 total wards) that contain stretches of the CGC corridor. Figure 2 shows the CGC corridor along with plots of the following points in these four wards: land parcels; five freeway interchange ramps (when the freeway existed); and 29 pedestrian entrances to the linear park (that currently exist).

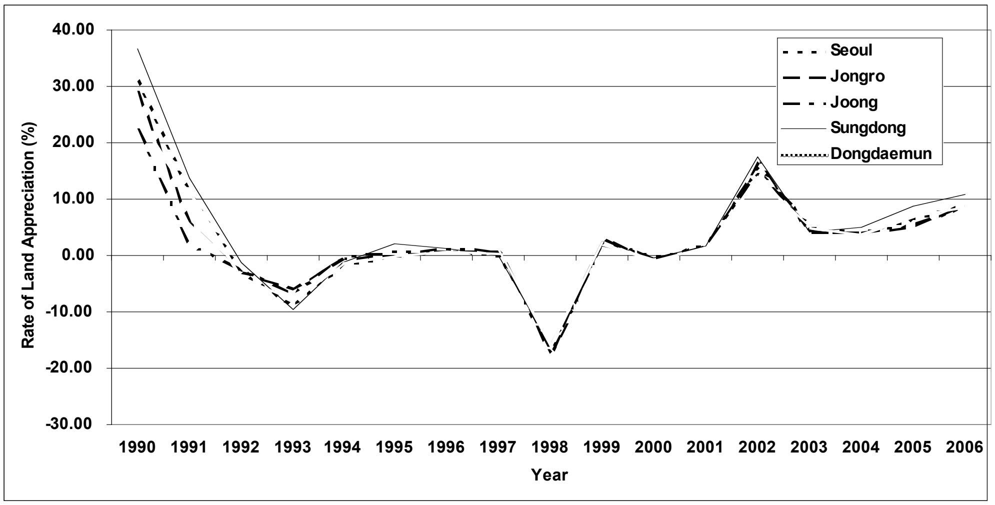
Figure 2. Spatial Distribution of Land Parcels and Access Points



Source: Authors' work and Seoul Metropolitan Government

Land prices in Seouls' four central wards vacillated during the 1990s but have trended upwards since 2000. As shown in Figure 3, land prices plummeted by about 20% in 1998 in the wake of Asia's financial crisis. Prices rebounded in 2001 and 2002, and in more recent years have appreciated at an annual rate of 5% to 10%.

Figure 3. Annual Rate of Land Appreciation (1990~2006)



Source: Seoul Statistics Office

5. Data and Methodology

The principal database used in this research was the Publicly Announced Land Price data maintained by South Korea's central government, obtained for the periods of 2001-2002 to 2005-2006. The database contains records on property address, land use, assessed land price, and ordinal values for property's shape, slope, and level of road access. The South Korean government assesses the price of each land parcel annually for taxation purposes. Once the central government estimates the value of base parcels, the local government assesses individual parcel values based on location and site attributes.

Supplementing parcel data were obtained from other government sources on the economic, demographic, location, land use and public finance attributes for the wards and districts surrounding land parcels that were studied. Tables 1 and 2 list these additional variables in addition to presenting descriptive statistics for both residential and non-residential (i.e., office and retail-commercial) parcels. Of note are location variables that measure the straight-line and network distances of each parcel to the CGC corridor (specifically to the former freeway ramps and current pedestrian entrances) as well as City Hall and major transportation infrastructure (using the proximity function of ArcMap 9.2 and network distance measurement of Arc Workstation).

Multilevel modeling (MLM) was used in estimating the price effects of proximity to the former freeway and present-day linear park to account for the hierarchical structure of the data – i.e., parcels nested within neighborhoods. MLM also allowed for the statistical control of various covariates, such as attributes of sites (e.g., parcel shape) and neighborhoods (e.g. population density). MLM improves the quality of model estimates since it accounts for the fact that nearby land parcels share neighborhood characteristics. Figure 4 diagrams the nature of this interdependence among variables. The failure of the more traditional approach to hedonic price modeling using ordinal least squares (OLS) to account for this violation of independence assumption can result in biased parameter estimates. Our use of MLM, we believe, represents an important methodological improvement over past hedonic price studies.

Additionally, we estimated MLM in log-log form for two reasons: one, it provided better statistical fits than linear formulations and two, it moderated the effects of heteroschedastic error terms and variables with non-normal distributions. In the models that follow, all continuous-scale dependent and independent variables were converted to natural log form. A side benefit of log-log formulations is that estimated coefficients represent elasticities, revealing the relative sensitivity of land prices to changes in the right-hand side predictor variables.

The multilevel hedonic models we explicitly accounted for the non-independence of error terms of parcels that share the same wards. Our MLMs took the following random intercept form:

$$P_{ij} = \gamma_{00} + \beta_1 L_{ij} + \beta_2 S_{ij} + \beta_3 D_{ij} + \beta_4 N_{ij} + \mu_{0j} + \varepsilon_{ij}$$

Where:

P_{ij} = the CPI-adjusted assessed land price (per square meter) of parcel i (Level 1) in ward j (Level 2);

L_{ij} = a vector of land attributes such as land use, shape, slope, and road accessibility in parcel i
(Level 1) in ward j;

S_{ij} = a vector of neighborhood socio-demographic characteristics, such as population density, employment density, percentage of age class, percentage of college graduation from Seoul Statistics and Population and Housing Census in Korea in ward j (Level 2) that is assigned to each parcel i in that ward;

D_{ij} = a vector of distance to Cheong Gye Cheon, CBD, subway stations, and roads from each parcel i (Level 1) in ward j; and

N_{ij} = a vector of neighborhood land use and public finance such as park density, developable land ratio, road ratio, retail ratio, permit ratio of residential and commercial, and local tax per households in ward j (Level 2) that is assigned to each parcel i in the ward.

The statistic used to justify MLM is the intraclass correlation (ρ), representing the proportion of the variance explained by the grouping structure in the population. The intraclass correlation also reveals the expected correlation between two randomly chosen units that are in the same group. By convention, a intraclass correlation of 0.05 or more indicates MLM should be used to account for the non-independence of error terms.

Figure 4. Data Structure by Level 1 and 2

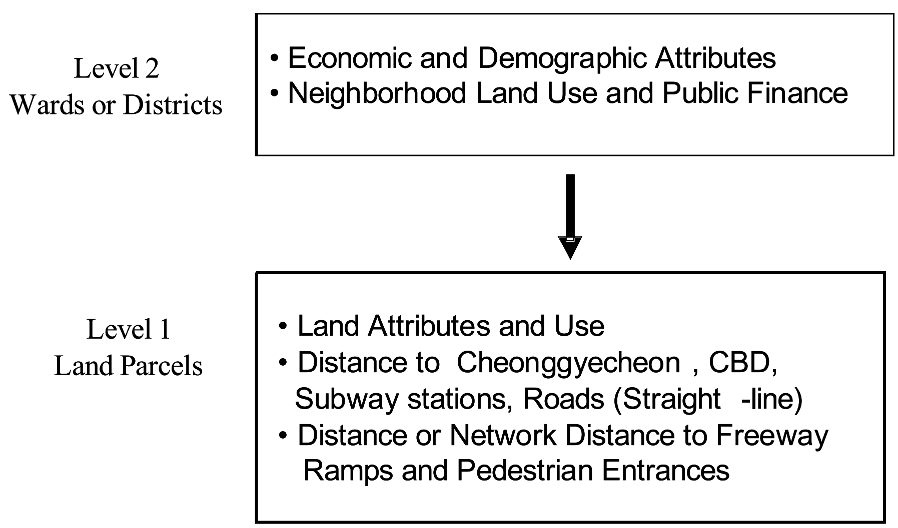
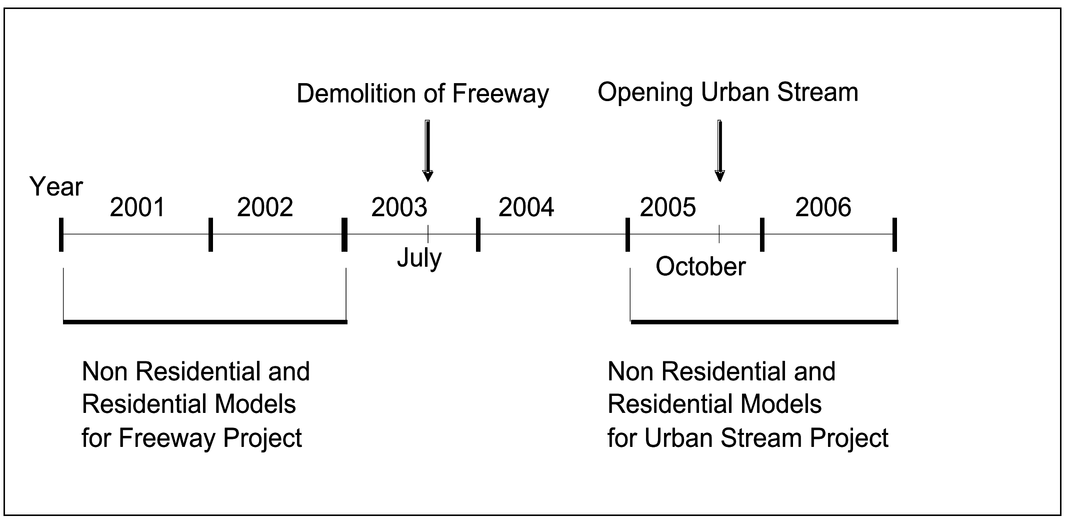


Figure 5 reveals the temporal nature of analysis that was carried out. During the period of study, there were three notable time periods: 2001-2002,when the CGC freeway was still in operations; 2003-2004, a transitional period when the freeway was demolished and the stream restoration/linear park construction began; and 2005-2006, presence of central Seoul's new urban amenity: the CGC stream and linear park. For purposes of examining the price effects of the freeway and its urban stream/linear park replacement, MLMs were estimated for two periods: 2001-2002 (freeway period) and 2005-2006 (urban stream/liner park period). The 2003-2004 transitional period was excluded because of the disruptive effects of the massive construction activities underway at that time.

Figure 5. Time Periods of Projects and Model Design



6. Descriptive Statistics

Table 1 presents descriptive statistics for non-residential parcels in 2001- 2002 (the freeway period) and 2005- 2006 (the urban stream/linear park period). A total of 6,483 and 7,235 land-parcel observations were available for these two periods, respectively. For variables related land attributes and use, specifically a parcel's shape, slope, and road accessibility, the ordinal scores were assigned by property assessors. Lower values are desirable– e.g., square parcels on flat slopes with superior road accessibility receive scores of 1.

For both time periods, the distribution of land uses among non-residential parcels was as follows: commercial-retail (65%), undeveloped land zoned for commercial-retail (9%), office (6%), mixed-use (19%), and undeveloped land zoned for mixed-use (1%). Table 1 also shows that employment densities tended to be higher than population densities in areas surrounding the sampled non-residential parcels. Further, residents in areas surrounding the surveyed non-residential parcels tended to be in the mid life-cycle stages (20 to 40 years of age).

For the residential parcels surveyed, there were 3,769 and 4,244 observations for the two time points (2001-2001 and 2005-2006, respectively). Table 2 shows the surveyed residential land parcels were primarily used for single family housing (77%), followed by multi-family housing (15%), non-developed or open land available for residential use (4%), row housing (2%), and condominiums (2%). For the residential parcels studied, surrounding population densities were higher than surrounding employment densities.

The two tables also shed light on proximity of various activities to the CGC corridor. Non-residential parcels tend to be closer to CGC than residential lands owing to the fact that the stream flows through the heart of Seoul where historically offices and retail shops had predominated. Similarly, non-residential parcels tend to be closer to City Hall (generally considered to be Seoul's 100% corner, or heart of the CBD), subway stations, and major roads. In terms of land-use composition, public expenditures, park land, and the ratio of parcels that are developed, areas surrounding the surveyed residential and non-residential parcels are quite similar. However, non-residential parcels tended to have larger shares of surrounding land devoted to retail activities and high rates of local taxes (on a per household basis).

Table 1. Descriptive Statistics for Non Residential Models

Variable	2001~2002 Obs	Mean	Std.Dev.	Min	Max	2005~2006 Obs	Mean	Std.Dev.	Min	Max
CPI-adjusted Land Price (Korea Won per Square Meter)	6,483	4,496,620	4,161,874	936,567	39,700,000	7,235	6,425,122	5,933,833	1,400,000	58,100,000
Distance to CGC Corridor										
Distance to Cheonggyecheon (straight ine distance,m)	6,483	1,069.2	975.0	20.5	5,2809	7,235	1,0782	978.1	20.5	5,280.9
dummy (distance ≤ 100)	6,483	0064	0.245	0000	1000	7,235	0.062	0241	0000	1000
dummy (100 < distance ≤ 200)	6,483	0076	0.265	0000	1000	7,235	0.073	0260	0000	1000
dummy (200 < distance ≤ 300)	6,483	0069	0.254	0000	1000	7,235	0.068	0252	0000	1000
dummy (300 < distance ≤ 400)	6,483	0067	0.249	0000	1000	7,235	0.065	0247	0000	1000
dummy (400 < distance ≤ 500)	6,483	0067	0.249	0000	1000	7,235	0.067	0251	0000	1000
Other Location Factors										
Distance to CBD: City Hal (s raightline distance,m)	6,483	3,360.9	2,347.7	130.4	8,9896	7,235	3,371.4	2,3468	130.4	8,989.6
Distance to Subway Stations (s raightline distance,m)	6,483	354.1	295.4	48	3,599.1	7,235	356.9	301.1	4.8	3,683.1
Distance to Arterial Roads (s raightline distance,m)	6,483	36.2	272	00	152.2	7,235	365	27.2	0.0	152.2
Land Attributes and Use										
Shape (1~8)**	6,483	3801	1.794	1000	8000	7,235	3.775	1.782	1000	8000
Slope (1~5)***	6,483	2039	0.219	1000	5000	7,235	2.035	0208	1000	5000
Road Accessibiity (1~12)****	6,483	5683	2.967	1000	11.000	7,235	5.765	2910	1000	11.000
Commercial (0/1)	6,483	0655	0.475	0000	1000	7,235	0.639	0.480	0000	1000
Commercial Raw Lands and Others (0/1)	6,483	0037	0.188	0000	1000	7,235	0.048	0213	0000	1000
Office (0 1)	6,483	0076	0.265	0000	1000	7,235	0.080	0271	0000	1000
Mixed-Use (0/1)	6,483	0215	0.411	0000	1000	7,235	0.212	0.409	0000	1000
Mixed-Use Raw Lands and Others (0 1)	6,483	0018	0.132	0000	1000	7,235	0.022	0.146	0000	1000
Neighborhood Economic and Demographic Attributes										
Popula ion Density (Persons per Gross Square Km)	6,483	16,1233	11,610.2	1,908.4	44,023.3	7,235	15,5166	11,557.1	1,354.7	42,253.3
Employment Density (Employee per Gross Square Km)	6,483	27,890.4	22,585.0	712.2	91,617.2	7,235	22,4845	18,050.8	638.6	77,221.2
Percentage of College Degree (%)	6,483	0238	0.067	0.100	0350	7,235	0.136	0034	0080	0265
Percentage of 20 to 40 years old (%)	6,483	0366	0.036	0285	0.451	7,235	0.331	0040	0275	0.440
Percenatge of 40 to 60 years old (%)	6,483	0282	0.035	0228	0343	7,235	0.274	0042	0229	0366
Percentage of more than 60 years old (%)	6,483	0.136	0.036	0076	0218	7,235	0.133	0047	0084	0242
Other Neighborhood Attributes										
Park Density Ratio (Park Area per Ward Area)	6,483	0221	0.150	0061	0.441	7,235	0.129	0.146	0008	0.445
Developable Land Ratio (Developable Land per Ward Area)	6,483	0673	0.138	0.477	0800	7,235	0.674	0.140	0.477	0820
Road Area Raio (Road Area per Ward Area)	6,483	0.154	0.048	0094	0207	7,235	0.159	0047	0096	0210
Retal Area Raio (Retail Area per Ward Area)	6,483	0.109	0.119	0006	0298	7,235	0.134	0.144	0012	0341
Percentage of Residential Permit per Total Permit (%)	6,483	0266	0.115	0052	0.478	7,235	0.157	0.114	0041	0.410
Percentage of Commercial Permit per Total Permit (%)	6,483	0557	0.175	0223	0.767	7,235	0.600	0207	0.142	0927

* Shape: Vaue for assessed shape of parcels
** Slope : Value for assessed slope of parcels
*** Road Accessibility: Value for assessed access bility to roads
(DetaI Description in Appendix)

Table 2.. Descriptive Statistics for Residential Models

	2001~2002					2005~2006				
Variable	**Obs**	**Mean**	**Std.Dev.**	**Min**	**Max**	**Obs**	**Mean**	**Std.Dev.**	**Min**	**Max**
CPI-adjusted Land Price (Korean Won per Square Meter)	3,769	1,218,846	282,184	75,863	2,699,516	4,244	1,858,086	437,631	210,000	5,600,000
Distance to Ramps or Pedestrian Entrances										
Network Distance to Freeway Ramps (m)	3,769	3,285.2	1,662.7	196.8	7,962.9					
Network Distance to Cheonggyecheon Pedestrian Entrances (m)						4,244	2,425.2	1,366.1	193.2	7,254.1
dummy (distance ≤ 500)	3,769	0.023	0.150	0.000	1.000	4,244	0.052	0.221	0.000	1.000
dummy (500 < distance ≤ 1,000)	3,769	0.136	0.343	0.000	1.000	4,244	0.178	0.382	0.000	1.000
dummy (1,000 < distance ≤ 1,500)	3,769	0.134	0.341	0.000	1.000	4,244	0.205	0.403	0.000	1.000
dummy (1,500 < distance ≤ 2,000)	3,769	0.125	0.331	0.000	1.000	4,244	0.194	0.396	0.000	1.000
dummy (2,000 < distance ≤ 2,500)	3,769	0.168	0.374	0.000	1.000	4,244	0.115	0.320	0.000	1.000
dummy (2,500 < distance ≤ 3,000)	3,769	0.107	0.310	0.000	1.000	4,244	0.068	0.251	0.000	1.000
Other Location Factors										
Distance to CBD: City Hall (straight line distance,m)	3,769	4,572.8	2,248.5	779.8	9,114.9	4,244	4,609.5	2,264.9	779.8	9,114.9
Distance to Subway Stations (straight line distance,m)	3,769	627.1	608.1	41.3	3,919.4	4,244	639.5	623.9	41.3	3,919.4
Distance to Arterial Roads (straight line distance,m)	3,769	47.5	33.3	0.0	253.6	4,244	47.2	33.0	0.1	253.6
Land Attributes, Type, and Neighborhood Attributes										
Shape (1~8)*	3,769	3.578	1.707	1.000	8.000	4,244	3.587	1.688	1.000	8.000
Slope (1~5)**	3,769	2.544	0.798	1.000	5.000	4,244	2.528	0.779	1.000	5.000
Road Accessibility (1~12)***	3,769	8.586	1.380	1.000	12.000	4,244	8.501	1.388	1.000	11.000
Single Family Housing (0/1)	3,769	0.814	0.389	0.000	1.000	4,244	0.765	0.424	0.000	1.000
Row Housing (0/1)	3,769	0.021	0.143	0.000	1.000	4,244	0.023	0.151	0.000	1.000
Multi Family Housing (0/1)	3,769	0.127	0.333	0.000	1.000	4,244	0.150	0.357	0.000	1.000
Condominium (0/1)	3,769	0.013	0.114	0.000	1.000	4,244	0.023	0.149	0.000	1.000
Raw Land in Residential (0/1)	3,769	0.012	0.110	0.000	1.000	4,244	0.014	0.118	0.000	1.000
Other Lands in Residential (0/1)	3,769	0.012	0.110	0.000	1.000	4,244	0.024	0.153	0.000	1.000
Population Density (Persons per Gross Square Km)	3,769	21,710.2	10,767.5	3,178.4	44,023.3	4,244	21,185.3	11,087.6	2,888.0	42,253.3
Employment Density (Employee per Gross Square Km)	3,769	11,338.9	12,334.1	712.2	77,971.7	4,244	12,112.3	10,813.8	638.6	71,210.0
Percentage of College Degree (%)	3,769	0.239	0.069	0.105	0.350	4,244	0.148	0.039	0.094	0.265
Percentage of 20 to 40 years old (%)	3,769	0.386	0.032	0.312	0.451	4,244	0.347	0.042	0.283	0.440
Percenatge of 40 to 60 years old (%)	3,769	0.260	0.020	0.228	0.340	4,244	0.260	0.028	0.229	0.366
Percentage of more than 60 years old (%)	3,769	0.114	0.021	0.076	0.196	4,244	0.119	0.030	0.084	0.242
Other Neighborhood Attributes										
Park Density Ratio (Park Area per Ward Area)	3,769	0.215	0.171	0.061	0.441	4,244	0.120	0.153	0.008	0.445
Developable Land Ratio (Developable Land per Ward Area)	3,769	0.645	0.144	0.477	0.800	4,244	0.648	0.148	0.477	0.820
Road Area Ratio (Road Area per Ward Area)	3,769	0.142	0.042	0.094	0.207	4,244	0.146	0.044	0.096	0.210
Retail Area Ratio (Retail Area per Ward Area)	3,769	0.059	0.095	0.006	0.298	4,244	0.072	0.115	0.012	0.341
Percentage of Residential Permit per Total Permit (%)	3,769	0.308	0.099	0.052	0.478	4,244	0.199	0.113	0.041	0.410
Percentage of Commercial Permit per Total Permit (%)	3,769	0.489	0.167	0.223	0.767	4,244	0.528	0.198	0.142	0.927
Local Tax per Households (Korean Won)	3,769	4,370,875	3,406,631	1,259,339	11,900,000	4,244	5,108,723	4,231,003	1,311,776	13,800,000

* Shape: Value for assessed shape of parcels

** Slope: Value for assessed slope of parcels

*** Road Accessibility: Value for assessed accessibility to roads

(Detail Description in Appendix)

7. Multilevel Linear Hedonic Models: Non Residential Parcels, 2001~2002 and 2005~2006

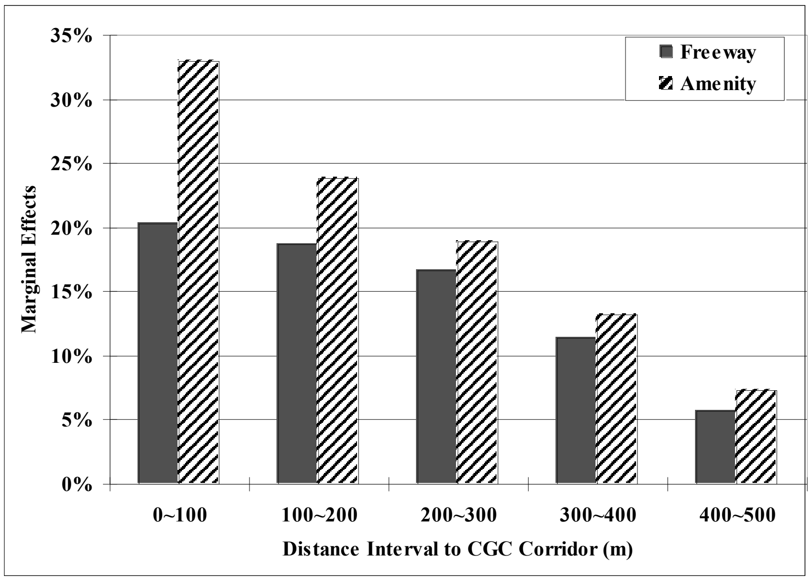
For modeling purposes, all of the variables shown in Table 1 were candidates for inclusion in multi-level hedonic price models. Predictor variables were retained if their coefficients were statistically significant and matched *a priori* expectations.

The MLM results for non-residential parcels are presented in Table 3. The intraclass correlations (ρ), representing the share of variation explained by the grouping structure (i.e., the wards) , were quite high, justifying the use of MLM.   Specifically, 57.8% and 60.2% of the variation of land price is explained by between-group variation among 182 and 185 districts over the two time periods respectively. In both models shown in Table 3, all predictor variables were statistically significant at the 5 percent probability level..

7.1 Effects of Distance to the CGC Corridor

The findings related to the core research question – the relative influences of proximity to the CGC freeway (in 2001-2002) and the CGC urban stream/linear park (in 2005-2006) – are revealed by the coefficients on the dummy variables for different straight-line distance intervals, in 100 meter bands (up to 500 meters). Lying in the 500 meters of the CGC corridor increased non-residential property values, although more for the linear-park amenity than the former freeway, for each distance ring. Controlling for other variables in the model, Figure 6 reveals the marginal distance effects of the urban stream/linear-park amenity versus the freeway for the five 100m bands. For non-residential uses, the marginal effects of the stream/linear-park amenity within 100 meters are 13% point higher than that of the freeway.   The marginal advantage of the stream/linear-park, however, erodes with distance from the corridor, but still exists ½ kilometer away.

Figure 6. Marginal Effects of Freeway and Amenity by Distance Intervals



7..2 Effects of Other Factors

The results in Table 3 reveal that other features of a site and surrounding neighborhood significantly influenced non-residential land prices. This subsection summarizes the hedonic price influences of the control variables used in the analysis.

<u>Other Location Factors</u>

In general, non-residential land prices fell with distance to Seoul's City Hall, the nearest subway station, and arterial roadways in both time periods. The eroding effects of distance to City Hall on land prices increased in more recent years.

Land Attributes and Land Use

In both time periods, high ordinal values assigned to a parcel's shape, slope, and road accessibility (denoting odd shapes, steep slopes, and poor road access) lowered non-residential land prices. In terms of the type of non-residential use, in the 2001-2002 period when the CGC freeway was in place, offices enjoyed a 6% land-price premium while mixed-use parcels were discounted by 25% (in comparison to the reference land use category, retail-commercial parcels). These effects were somewhat moderated during the 2005-2006 era of the stream/linear-park.

Neighborhood Economic and Demographic Attributes

In 2001-2002, higher population densities in the four wards traversed by the CGC freeway were associated with lower non-residential land prices while the opposite held for employment densities. Office, retail, and other non-residential parcels that are inter-mixed with similar activities tend to average higher prices because of agglomeration economies as well as greater opportunities for comparative shopping. The only neighborhood demographic variable with high enough statistical significance to appear in either model was the percentage of residents more than 60 years old during the 2005-2006 period. The results suggest that the presence of residential areas with older residents are associated with lower non-residential property prices.

Other Neighborhood Attributes

In general, non-residential property values declined as the amount of land devoted to parks and that was fully developed increased. The availability of developable land appears to lower non-residential land prices, however retail space and residential building activities tend to increase prices due to increased competition for land. This was so, however, only in the 2001-2002 freeway era.

Table 3. Multilevel Linear Hedonic Model for Predicting Non Residential Land Prices per Square Meter (☐)

	2001~2002			2005~2006		
Variable	**Coefficient**	**t**	**p**	**Coefficient**	**t**	**p**
Fixed Effects						
Distance to CGC Corridor						
dummy (1, if distance ≤ 100 , o herwise 0)	0 203	8.48	0 000	0.330	14 53	0 000
dummy (1, if 100 < distance ≤ 200 , o herwise 0)	0.187	8.79	0 000	0 238	11 88	0 000
dummy (1, if 200 < distance ≤ 300 , o herwise 0)	0.167	8.69	0 000	0.189	10 50	0 000
dummy (1, if 300 < distance ≤ 400 , o herwise 0)	0.114	6.31	0 000	0.133	7.76	0 000
dummy (1, if 400 < distance ≤ 500 , o herwise 0)	0 057	3.34	0 001	0 073	4 56	0 000
Other Location Factors						
ln(Distance to CBD: City Hall)	-0.469	-13 87	0 000	-0 520	-17.64	0 000
ln(Distance to Subway Stations)	-0.139	-19.39	0 000	-0.136	-20 23	0 000
ln(Distance to Arterial Roads)	-0 016	-4.63	0 000	-0 016	-4 82	0 000
Land Attributes and Use						
Shape (1~8)	-0 008	-3.99	0 000	-0 005	-2.45	0 014
Slope (1~5)	-0.131	-7.78	0 000	-0.146	-8 86	0 000
Road Accessibility (1~12)	-0 072	-53.31	0 000	-0 072	-55 50	0 000
Commercial Raw Lands and Others (0/1)	-0.149	-8.01	0 000	-0.177	-11.30	0 000
Office (0/1)	0 060	4 28	0 000	0 027	2.14	0 033
Mixed-Use (0/1)	-0 249	-24.15	0 000	-0 239	-24.43	0 000
Mixed-Use Raw Lands and O hers (0/1)	-0.332	-12.71	0 000	-0.332	-14.72	0 000
Neighborhood Economic and Demographic Attributes						
ln(Popula ion Density)	-0.134	-2.24	0 025			
ln(Employment Density)	0.105	3.46	0 001			
ln(Percentage of more han 60 years old)				-0.124	-2.30	0 021
Other Neighborhood Attributes						
ln(Park Density Ra io)	-0.695	-9.03	0 000	-0 024	-2 88	0 004
ln(Developable Land Ra io)	-2.157	-6.23	0 000			
ln(Retail Area Ra io)	0 265	10.62	0 000			
ln(Percentage of Residen ial Permit per Total Permit)	0 051	5 97	0 000			
Constant	18 591	27.92	0 000	25 553	21.10	0 000
Random Effects						
Sigma_u	0.305			0.321		
Sigma_e	0 261			0 261		
Rho	0 578			0.602		
Summary Statistics						
Number of Observa ions	6483			7235		
Number of Groups	182			185		

8. Multilevel Linear Hedonic Models: Residential Parcels, 2001~2002 and 2005~2006

Table 4 presents the multilevel hedonic price model results for residential parcels, for each of the two time periods.. The intraclass correlation (ρ) confirms that multi-level modeling is appropriate: 29.8% and 38.7% of the variation in land values is explained by between-group variation across the 109 and 107 districts for the 2001-2002 and 2005-2006 time periods, respectively.

8..1 Effects of Distance to Freeway Ramps or Pedestrian Entrances

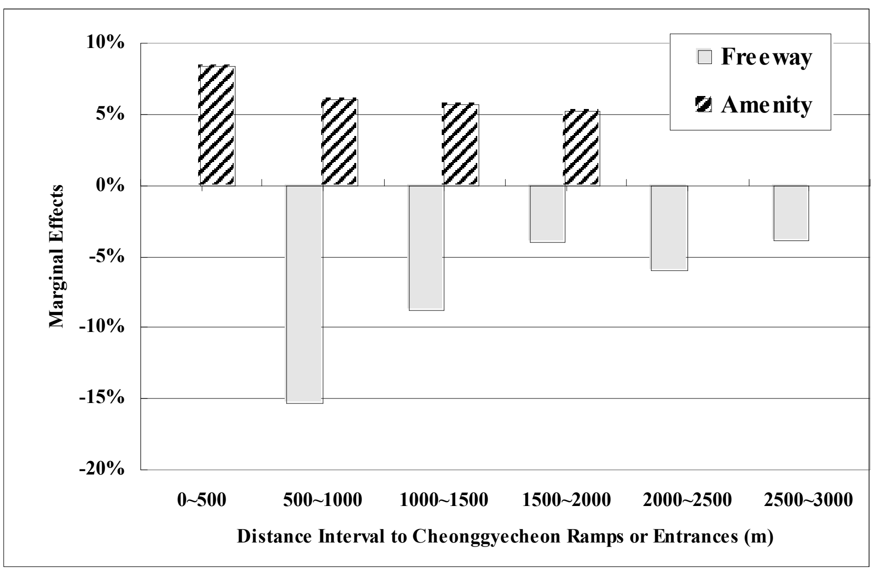
We found that the CGC freeway generally conferred accessibility benefits among residential properties surveyed throughout the 109 ward districts however the freeway's nuisance effect often detracted from land values within a ½ to 3 km buffer of the freeway. Consistent with expectations, we found that by 2005-2006, conversion to an urban stream/linear-park increased the value of nearby residential properties, particularly within ½ kilometers of a pedestrian entryway.

The elasticity coefficient on the "network distance" variable indicates that a doubling of distance to the freeway ramps was associated with a 15.1% decrease in residential property values in 2001-2002, all else being equal. The coefficients on the fixed-effect dummy variables, however, reveal that residential land values got discounted within a ½ to 3 km straight line distance of a freeway ramps– generally within earshot and eyeshot of the elevated structure, indicating visual blight and noise depressed values within this zone. We note that no discount was recorded for the 0 to ½ km buffer due to statistical insignificance within our sample for the 2001-2002 period. In general, most residential properties that were studied were located farther from both the freeway and urban stream/linear park than non-residential properties.

By 2005-2006 when the urban stream/linear-park had replaced the freeway, the slope coefficient of the variable measuring network distance to the access points (which was now the pedestrian entrances) was flatter than for the 2001-2002 period. All else being equal, a doubling of network distance to the pedestrian entrances was associated with a 5.4% decline in residential property values. However there was also a clear amenity benefit of being situated 2 km of the urban stream/linear-park – what might be considered a 5 to 10 minute walkshed. Based on the coefficients on the fixed-effect dummy variables, the greatest value-added was for residential properties within ½ km of a pedestrian entranceway; the smaller coefficients on the other dummies indicate this amenity-based premium declined as one got farther away, up to 2 km. We expect the premium was associated mainly with the benefit of having a nearby recreational outlet rather than a view since 77 percent of the residential parcels surveyed were low-rise single-family homes. For most, their view of the urban stream/linear-park is obstructed by high-rise office towers and apartment buildings.

Figure 7 summarize the results by plotting the network marginal effects of proximity to both the CGC freeway (in 2001-2002) and urban stream/linear-park (in 2005-2006). The plots, derived from coefficients on the distance to CGC ramps or pedestrian entrances, clearly show that the nuisance effects of proximity to the freeway and premium effects of proximity to the urban stream/linear-park eroded with distance, up to the 3 km mark. Thus the freeway was a significant dis-amenity to residential parcels that were the closest to it whereas the urban stream/linear-park was just as clearly an amenity.

Figure 7. Marginal Effects of Freeway and Amenity by Distance Intervals



8..2 Effects of Other Factors

Below, the influences of control variables used in the modeling hedonic price effects of residential properties are summarized.

Other Location Factors

Distance to Seoul City Hall and subway stations only had a significant eroding effect on residential property values in 2005-2006 – possibly in the latter case due to the loss of freeway capacity and thus a higher value placed on being near Seoul's subway and 100% corner (i.e., City Hall). Table 4 reveals that proximity to arterial roadways was also valued slightly more in the 2005-2006 post-freeway era.

Land Attributes, Type, and Neighborhood Attributes

Similar to the finding for non-residential properties, odd parcel shapes, steep slopes, and poorer road access were associated with lower residential land values, in both time periods. In terms of the type of residential property, Table 4 clearly shows that condominiums – a popular housing choice throughout Korea -- commanded the highest premium: 19.8% compared to single-family housing which served as the reference group. In 2001-2002, the model shows residential property values tended to be higher in settings with higher employment density and more highly educated residents. Higher employment densities increase residential values by exerting competitive pressures on bid rents and also because retail densities also rise which means closer proximity to consumer goods and services.

Other Neighborhood Attributes

Table 4 shows that during both time periods, residential property values were positively associated retail activities in the neighborhood (suggesting the benefits of mixed uses) but negatively associated with development intensities. A high density of nearby parks also generally had a depressing effect on residential property values. This could reflect peculiarities of downtown Seoul wherein housing near parks only appreciate in value when the parks are of significant size and substantially developed.   Lastly, the negative sign on the coefficient for the variable denoting local tax per household likely reflects the negative capitalization of tax burdens once factors like quality of nearby public infrastructure (e.g., proximity to subway) are accounted for.

Table 4. Multilevel Linear Hedonic Model for Predicting Residential Land Prices per Square Meter (□)

	2001~2002			2005~2006		
Variable	**Coefficient**	**t**	**p**	**Coefficient**	**t**	**p**
Fixed Effects						
Distance to Freeway Ramps or Pedestrian Entrances						
ln(Network Distance to Freeway Ramps or Pedestrian Entrances)	-0.151	-7 54	0 000	-0 054	-3 57	0 000
dummy (1, if distance ≤ 500 , o herwise 0)				0 083	2.35	0 019
dummy (1, if 5 00 < distance ≤ 1,0 00 , o herwise 0)	-0.154	-5 24	0 000	0 060	2.19	0 029
dummy (1, if 1,0 00 < distance ≤ 1,5 00 , o herwise 0)	-0 088	-3 51	0 000	0 057	2.34	0 019
dummy (1, if 1,5 00 < distance ≤ 2,000, otherwise 0)	-0 041	-1 83	0 068	0 052	2.37	0 018
dummy (1, if 2,000 < distance ≤ 2,5 00 , o herwise 0)	-0 059	-3 26	0 001			
dummy (1, if 2,500 < distance ≤ 3,0 00 , o herwise 0)	-0 039	-2 81	0 005			
Other Location Factors						
ln(Distance to CBD: City Hall)				-0.137	-4 98	0 000
ln(Distance to Subway Stations)				-0 027	-4 51	0 000
ln(Distance to Arterial Roads)	-0 010	-4 05	0 000	-0 014	-5.67	0 000
Land Attributes, Type, and Neighborhood Attributes						
Shape (1~8)	-0 010	-6.63	0 000	-0 007	-5 08	0 000
Slope (1~5)	-0 099	-25 92	0 000	-0 094	-23.52	0 000
Road Accessibility (1~12)	-0 054	-28 23	0 000	-0 053	-28.44	0 000
Row Housing (0/1)	0 033	1 97	0 049	0 040	2 57	0 010
Mul ifamily Housing (0/1)	0 023	2 94	0 003	0 015	2 05	0 040
Condominium (0/1)	0.198	8 96	0 000	0.198	11.57	0 000
Raw Land in Residen ial (0/1)	-0.695	-30.38	0 000	-0 573	-27.28	0 000
ln(Employment Density)	0 062	4 96	0 000			
ln(Percentage of College Degree)	0 208	4.45	0 000			
Other Neighborhood Attributes						
ln(Park Density Ra io)	-0 273	-3 51	0 000	-0 021	-3 5	0 000
ln(Developable Land Ra io)	-1.735	-6 59	0 000	-0 599	-3 2	0 001
ln(Retail Area Ra io)	0 213	13 24	0 000	0.123	3 84	0 000
ln(Percentage of Residen ial Permit per Total Permit)	0 033	2.47	0 014			
ln(Percentage of Commercial Permit per Total Permit)	0.106	5 08	0 000			
ln(Local Tax per Households ($))				-0.155	-3.68	0 000
Constant	17 094	9.62	0 000	18 913	22.6	0 000
Random Effects						
Sigma_u	0 091			0.115		
Sigma_e	0.140			0.145		
Rho	0 298			0.387		
Summary Statistics						
Number of Observa ions	3769			4244		
Number of Groups	109			107		

9. Conclusion

These empirical results support the core hypotheses of our research. In general, the CGC corridor conferred benefits mainly to offices, retail shops, and other non-residential uses when it was a freeway. However within a 500 meter buffer, non-residential properties were generally worth more when the freeway was replaced by an urban stream/linear-park. This could reflect a number of influences, such as the successful substitution of a massively expanded busway network for the lost freeway capacity and the presence of a major public amenity in influencing office locations (e.g., attraction of high-skilled white collar workers to location near an attractive recreational outlet). Similarly, retail land prices might have gone up near the urban stream/linear-park in anticipation of more high-salaried, professional class workers and residents being attracted to the area. While the statistical results do not exactly tell us why non-residential properties capitalized even greater benefits from an urban stream and linear park than a freeway, we believe these to be plausible explanations. Follow-up research using qualitative methods, including informant interviews, will be carried out to address this matter further.

The impacts of the freeway-to-amenity conversion on residential property values are unequivocal. Residences within an nuisance zone of the elevated freeway structure sold at a discount whereas a few years later when the urban stream/linear-park was in place, they sold at a premium. While proximity to freeway on-ramps was valued by residential properties, this benefit was offset by nuisance effects of noise, dust, fumes, and visual blight for residences within several kms of the structure.

Our research findings have clear policy implications as related to public investment and dis-investment. For one, replacing a freeway with a restored urban stream and nicely landscaped linear park clearly changed the spatial distribution of capitalized benefits and dis-benefits. As with most public resource allocation choices, there were winners and losers, however since the net marginal effects were highest following the freeway removal, we believe this massive change in public works in central Seoul resulted in winners far outnumbering losers.

Additionally, the magnitude of land-value impacts from the freeway and urban stream were sensitive to the location of land parcels. Offices, retail stores, and other non-residential activities were closest to the elevated freeway and generally enjoyed the enhanced regional accessibility benefits that were conferred. Most residences were situated well beyond ½ kilometer of the freeway and while they enjoyed some regional accessibility advantages, these were eclipsed by disamenities for parcels within an view-shed, noise-shed, and "odor"-shed of the elevated structure. By the time the urban stream/linear-park was in place, land-use conversions had occurred. Not only were nearby offices and retail shops commanding higher rents, but new residences in high-rise apartments were appearing, taking advantage of this public amenity. The spillover benefit of the urban stream and linear-park is revealed by a heat-island effect study that found ambient temperatures along the inner-city stream were 3.3^{O} to 5.9^{O} Centigrade lower than along a parallel road 4 to 7 blocks away (Seoul Development Institute, 2006)

In close, Seoul Korea's bold experiment with replacing a heavily-trafficked inner-city freeway with a restored stream and linear park has been an unqualified success based on land-market performance. Are these lessons transferable to other places? Perhaps. Ideally, research will be performed on other freeway-to-amenity conversions that have occurred or are now under way to probe the generalizability of our research findings. It is important to note that the Cheong Gye Cheon conversion has not been Seoul's only massive public-works transformation. At roughly the same time the freeway-to-stream conversion was taking place, Mayor Lee converted a massive 1.32 ha-sized roadway interchange near Seoul's City Hall to an oval inner-city park. Also, 74 linear kms of roadway space has been expropriated and given over to the city's massive expanded dedicated bus-lane network. As part of a larger urban experiment aimed at reinvigorating the city, the benefits conferred by the Cheong Gye Cheon conversion could reflect the influences of a larger urban renaissance that is now underway. Clearly, the dynamic transformation of Seoul's urban landscape in recent years calls for more research to enrich our collective understanding of the welfare implications of designing a city less for automobiles and more for people.

References

Anderson, S. T. and West, S. E. (2006) Open Space, Residential Property Values, and Spatial Context, Regional Science and Urban Economics, 36, pp. 773-789.

Asabere, P. K., Hachey, G., and Grubaugh, S. (1989) Architecture, Historic Zone, and the Value of Homes, Journal of Real Estate Finance and Economics, 2, pp. 181-195.

Aschauer, D. A. (1990) Highway Capacity and Economic Growth, Economic Perspectives, pp. 14-24.

Bhatta, S. D. and Drennan, M. P. (2003) The Economic Benefits of Public Investment in Transportation: A Review of Recent Literature, Journal of Planning Education and Research, 22, pp. 288-296.

Boarnet, M. (1997) Highways and Economic Productivity: Interpreting Recent Evidence, Journal of Planning Literature, 11(4), pp. 476-486.

Boarnet, M. (1998) Spillovers and the Locational Effects of Public Infrastructure, Journal of Regional Science, 38(3), pp. 381-400.

Boarnet, M. and Chalermpong, S. (2001) New Highways, House Prices, and Urban Development: A Case Study of Toll Roads in Orange County, CA, Housing Policy Debate, 12(3), pp. 575-605.

Boarnet, M. and Haughwout, A. F. (2000) Do Highways Matter? Evidence and Policy Implications of Highway's Influence on Metropolitan Development.. Washington, DC: Brookings Institution

Bolitzer, B. and Netusil, N. R. (2000) The Impact of Open Spaces on Property Values in Portland, Oregon, Journal of Environmental Management, 59, pp. 185-193.

CGC Restoration Project Headquarters (2004) CGC Restoration.. Seoul: Seoul Metropolitan Government.

Cheshire, P., and Sheppard, S. (1995) On the Price of Land and the Value of Amenities, Economica, 62, pp. 247-267.

Dehring, C. N. D. (2006) Housing Density and the Effect of Proximity to Public Open Space in Aberdeen, Scotland, Real Estate Economics, 34(4), pp. 553-566.

Dipasquale, D., and Wheaton, W. C. (1996) Urban Economics and Real Estate Markets.. Englewood Cliffs, NJ: Prentice Hall.

Espey, M. and Owusu-Edusei, K. (2001) Neighborhood Parks and Residential Property Values in Greenville, South Carolina, Journal of Agricultural and Applied Economics, 33(3), pp. 487-492.

Florida, R. (2002) The Rise of Creative Class, Jackson: Basic Books.

Frech III, H. E. and Lafferty, R. N. (1984) The Effect of the California Coastal Commission on Housing Prices, Journal of Urban Economics, 16, pp. 105-123.

Gillen, D. (1996) Transportation Infrastructure and Economic Development: A Review of Recent Literature, Logistics and Transportation Review, 32(1), pp. 39-62.

Giuliano, G. (2004) Land Use Impacts of Transportation Investments: Highway and Transit, in: S. Hanson and G. Giuliano (Ed.), The Geography of Urban Transportation, pp. 237-273. New York: Guilford Press..

Glaeser, E. L., Kolko, J., and Saiz, A. (2001) Consumer City, Journal of Economic Geography, 1, pp. 27-50.

Hamilton, L. C. (2006) Statistics with STATA. Belmont: Thomson Higher Education.

Kain, J. F. and Quigley, J. M. (1970) Measuring the Value of Housing Quality, Journal of the American Statistical Association, pp. 532-548.

Kohlhase, J. E. (1991) The Impact of Toxic Waste Sites on Housing Values, Journal of Urban Economics, 30, pp. 1-26.

Lutzenhiser, M. and Netusil, N. R. (2001) The Effect of Open Spaces on A Home's Sale Price, Contemporary Economic Policy, 19(3), pp. 291-298.

Ministry of Construction and Transportation, Publicly Announced Land Price data (2001 ~ 2006). Seoul, Korea.

National Statistical Office, Population and Housing Census, 2000 and 2005. Dae-jeon, Korea.

Polinsky, M. and Shavell, S. (1976) Amenities and Property Values in a Model of an Urban Area, Journal of Public Economics, 5, pp. 119-129.

Rabe-Hesketh, S. and Skrondal, A. (2005) Multilevel and Longitudinal Modeling Using Stata.. College Station , TX: STATA Press.

Rosen, S. (1974) Hedonic Prices and Implicit Markets: Product Differenciation in Pure Competition, Journal of Political Economy, 82(1), pp. 34-55.

Seoul Development Institute (2006) Study on Urban Structure and Form in CGC Project. Seoul, Korea.

Seoul Metropolitan Government (2003) CGC Restoration Project. Seoul, Korea.

Seoul Statistics Home Page, http://www.seoul.go.kr/v2007/publicinfo/statistics/data/4_02.html.

Sivitanidou, R. (1995) Urban Spatial Variation in Office-Commercial Rents: The Role of Spatial Amenities and Commercial Zoning, Journal of Urban Economics, 38, pp. 23-49.

Tajima, K. (2003) New Estimates of the Demand for Urban Green Space: Implication for Valuing the Environmental Benefits of Boston's Big Dig Project, Journal of Urban Affairs 25(5), pp. 641-655.

The Preservation Institute Home Page, http://www.preservenet.com/.

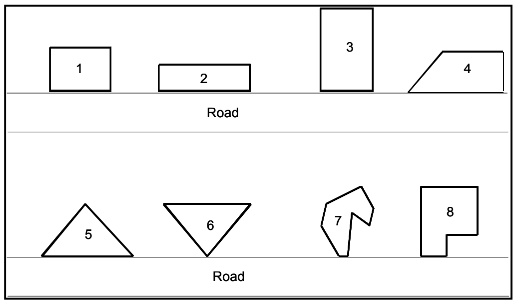
Vandell, K. D. and S.J. Lane (1989) The Economics of Architecture and Urban Design: Some Preliminary Findings, AREUEA Journal, 17, pp. 235-260.

Voith, R. (1993). Changing Capitalization of CBD-Oriented Transportation Systems- Evidence from Philadelphia, 1970-1988, Journal of Urban Economics, 33(3), pp. 361-376.

Woodridge, J. (2006) Introductory Econometrics.. Mason, OH: Thompson South Western.

Appendix : Description on Shape, Slope, and Road Accessibility Variables

1. Shape (Number means the value of assessed land shape)



2. Slope

Value	Description
1	Land remarkably lower than roads or nearby landscape
2	Flat land
3	Land with slope less than 15°
4	Land with slope more than 15°
5	Land remarkably higher than roads or nearby landscape

3. Road Accessibility

Value	Description
1	Land facing to more than 25meter-wide roads
2	Land facing to 8~12 meter-wide and more than 25meter-wide roads
3	Land facing to less than 8 meter-wide and more than 25meter-wide roads
4	Land facing to 12~25 meter-wide roads
5	Land facing to 12~25 meter-wide and other roads
6	Land facing to 8~12 meter-wide roads
7	Land facing to 8~12 meter-wide and other roads
8	Land facing to less than 8 meter-wide roads
9	Land facing to auto accessible roads
10	Land facing to small tractor accessible roads
11	Land facing to two small tractor accessible roads
12	Land without accessible roads