A Tale of Two Cities - How Transit Accessibility and the Financial Crisis Affected the Price of Commercial Properties in Taipei and Kaohsiung[1]

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1 BACKGROUND

The Real Estate Cycle Indicators[2] suggest that Taiwan's real estate market had been declined since the second quarter of 2007 and became in deep recession since the third quarter of 2008. On the other hand, the real estate market in Kaohsiung remains prosperous due to the fact that lots of transportation related infrastructure projects had been completed as shown in Figure 1. For example, Taiwan High Speed Rail was inaugurated in January 2007 and two mass transit lines of Kaohsiung Rapid Transit System[3] (KRTS) were completed in September 2008. Nevertheless, Kaohsiung Arena are scheduled to operate in July 2009 as the stadium of World Games 2009, and two transit related projects, i.e., a circular light rail transit line and the underground section of Taiwan Railways, are under construction and are planned to be completed in the next several years. With the improvement of transportation infrastructure and the provision of employment opportunities from these projects, the real estate market in Kaohsiung has been fueled and energized in the past few years.

On the other hand, with over 2 million daily trips by MRT and more than 4 daily million trips by the Taipei transit system, it is shown that MRT stations are very attractive to retailers, bankers, consultant executives, and commuters. In other words, we seek to explore the price premium for better transportation accessibility before and after the completion of major transportation projects. The results can be used to evaluate the effectiveness of transit-oriented development, a policy which is recently initiated by the city government.

To analyze the factors affecting property prices, we apply hedonic price method to estimate model parameters using the transition data of Kaohsiung metropolitan area[4] provided by the Ministry of the Interior. The variables of our models include attributes related to the property, the neighborhood, and the accessibility measured by the distances to transportation terminals. The functional forms of our models consist of linear, semi-log linear, log-linear, and Box-Cox transformation. By the comparison of hedonic functions of 2007 and 2008, we conclude that the decline of commercial property was approximately six percent in the third quarter and ten percent in the fourth quarter of 2008. On the other hand, a price premium of between eleven and thirty percent for property near KMRT stations was retained after the onset of the crisis. The conclusion is that the crisis did not affect the relative price premium for good transit accessibility, even though the price premium was smaller in absolute terms.

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[2] The indicators published by Architecture and Building Research Institute, Ministry of the Interior, consist of GDP, monetary supply, index of construction stocks, bank loans to property mortgage, and CPI.

[3] KRTS consists of two lines, i.e., Red Line and Orange Line, with the total length of 40.4 km and 36 stations. The system was constructed under the Build-Operate-Transfer (BOT) method. As of July 2008, the average daily ridership of the system is 108,957 passengers.

[4] The metropolitan area includes the majority of cities and townships in Kaohsiung County and part of Pintung County. The total population of Kaohsiung metropolitan area, as of 09/30/2008, is around 2,775,000.

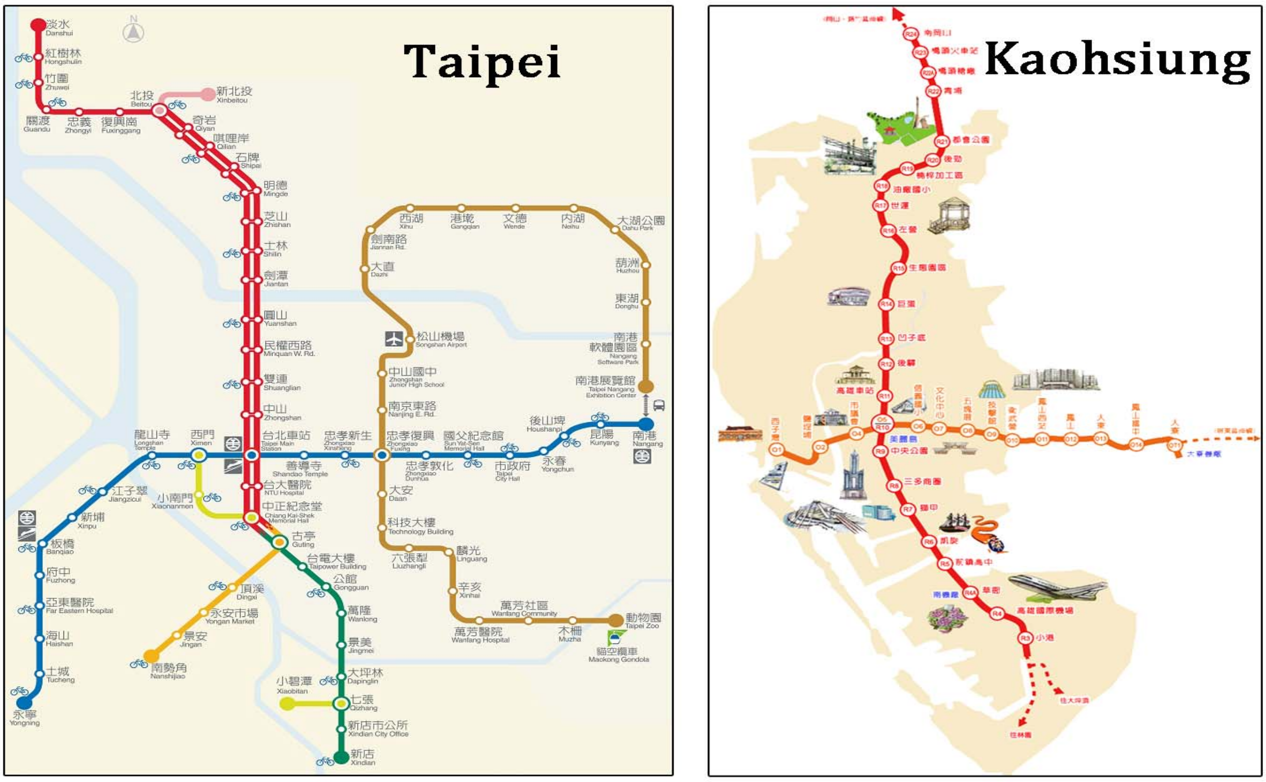

Figure 1: The Public Transport Network in Taipei and Kaohsiung Metropolitan Area

2 Hedonic prices

Hedonic price theory is associated with the introduction of the term in a paper by Sherwin Rosen (1974), using ideas that had already been introduced by a number of economists in the 1960s (see, for example, Lancaster 1966). Rosen uses a utility-maximizing approach to derive implicit attribute prices for multi-attribute goods under conditions of perfect competition, where each attribute has a unique implicit price in equilibrium. Perfect competition, however, rests on assumptions of perfect information, which is not normally approximated in markets for housing or other real estate markets.

Perfect competition is however not a necessary assumption for empirical hedonic price studies. Barzel (1989) approaches multi-attribute goods in a more dynamic way, by building on the insights of property rights theorists such as Demsetz (1967). Webster and Lai (2003) extend Barzel's theory to spatial economics in a way that explicitly takes dynamic processes and imperfect information into account. From such a dynamic standpoint, empirical hedonic price models do not produce stable estimates of equilibrium prices, but rather snapshots of transitional conditions. For example, a discovery of two centers with a metropolitan impact does not necessarily invalidate the common monocentric assumption; it could be a transitional stage where a declining and an emerging center both impact the willingness to pay of market participants for a finite time period – a reflection of asymmetric and imperfect information among buyers and sellers.

In general, hedonic price models aim at disentangling the attributes of a good from one another for the purpose of estimating implicit prices. In housing models, the price or rent is a function of various attributes, typically divided into structural and location attributes. Location attributes can be further subdivided into general accessibility and localized neighborhood effects.

Regression techniques make it possible to estimate the implicit price for each attribute. Linear models are usually avoided, since the assumption of constant marginal implicit prices is untenable unless there are constant returns to scale in production or costless repackaging of two or more bundles. The most common non-linear models include log-linear, semi-log, and Box-Cox-transformed functions[5]. The log-linear and semi-log functions are pre-specified functions, while Box-Cox functions uses an iterative procedure that maximizes the log-likelihood of the function within a pre-specified family of functions. Such maximization ensures a more desirable distribution of the error term than with less flexible estimation techniques.

In this study, we use the log-linear functional form, which is both compatible with the underlying economic theory and relatively simple. The log-linear function has the additional interpretive advantage that the estimated coefficients correspond to average attribute elasticities. All pre-specified functional forms – including the log-linear function – has the advantage of allowing direct comparisons of quantitative attribute effects across markets.

On the other hand, it is often advisable to compare the results of different functional forms in order to identify non-robust estimates. For this reason, we estimated semi-log functions for all regions as well as simple left-hand-side and simple both-side Box-Cox functions for two regions (Hsinchu and Tainan). The log-linear models exhibited higher coefficients of determination and

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[5] The simple-left-hand-side Box-Cox transformation is $X_1^{\lambda} = \beta_1 + \beta_2 X_2 + \ldots + \beta_i X_i + \ldots + \beta_k X_k$. The simple both-side Box-Cox transformation is $X_1^{\lambda} = \beta_1 + \beta_2 X_2^{\lambda} + \ldots + \beta_i X_i^{\lambda} + \ldots + \beta_k X_k^{\lambda}$; where $X_i^{\lambda} = (X_i^{\lambda} - 1) / \lambda$ for $\lambda \neq 0$ and $X_i^{\lambda} = \ln X_i$ for $\lambda_i = 0$.

closer-to-normal distributions of residuals than the corresponding semi-log functions in all cases, but the qualitative effects of the variables were remarkably robust[6], with the exception of HSR station accessibility in the Tainan region and the “height” variable in allbut one region. The Box-Cox functional forms for Hsinchu and Tainan yielded identical qualitative conclusions as the log-linear model. Indeed, the both-side model for Hsinchu converged with $\lambda = 0.01$, which is virtually identical with the log-linear model (defined as $\lambda = 0$)[7].

3 Transit Accessibility and House Prices

There are many studies of the effect of accessibility on housing development analyzing local transit networks. Among them, Cervero (1994) found that for Bay Area cities served by BART, residents living near rail stations were around five times as likely to commute by rail transit as the average resident-worker in the same city. He concluded that the strongest predictors of whether station-area residents commuted by rail were whether their destinations were near rail stations and whether they could park for free at their destinations. Moreover, neighborhood density and proximity of housing to stations were also related to rail travel. He also suggested that if transit-based housing is to reap significant mobility and environmental benefits, it must be accompanied by transit-based employment growth and programs that pass on true costs to motorists and parkers. There are many hedonic studies of the effect of accessibility on housing prices related to local transit networks. Armstrong and Rodriguez (2006) analyze a slightly more extensive rail network than in most hedonic studies. They estimated accessibility benefits of rail services in eastern Massachusetts, including multimodal accessibility to commuter rail stations and distance from the rail right-of-way.

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[6] The main attribute effects tend to be similar across functional forms, while many of the less important attributes tend to produce different quantitative and qualitative conclusions depending on the choice of functional form and the specification of independent variables (see Butler, 1982). Our results indicate that among the statistically significant effects that were identified using the log-linear model, the only questionable qualitative result is the HSR station accessibility effect in the Tainan region.

[7] For Tainan, the corresponding $\lambda = .168$. For both Hsinchu and Tainan, the simple-left-hand-side model was associated with lower log likelihood than the simple both-side model. The semi-log function is a special case of the simple left-hand-side model.

The results were inconclusive, except that proximity to commuter rail right-of-way produced a significant negative effect on property values, which probably reflects negative externalities such as noise.

Bowes and Ihlanfeldt (2001) suggest that railroad station accessibility should affect property values since such access reduces commuting costs. This should help attract retail activity from localities further away from stations, other things being equal. Possibly countering these positive effects are negative externalities such as noise and better access for criminals. Their results - from Georgia in the United States - suggest that stations that are located sufficiently far away from the urban core tend to attract new residential development.

The most comprehensive studies of rail networks have been conducted in the Netherlands in a number of theoretical and empirical studies by Debrezion, Pels, and Rietveld (for example 2006a; 2006b). Unlike other authors, they have adopted a multi-regional perspective that extends to the Netherlands as a whole. Debrezion et al. (2006a) use a hedonic pricing model to analyze the impact of the railroad network on house prices in the Netherlands. They use several access variables, including station accessibility, train service frequency and track proximity. Among other findings, they estimated that housing in close proximity to railroad stations command market prices that are about 25 percent more expensive than equivalent housing at a distance of 15 kilometers or more. A problem with their approach is that they analyzed the Netherlands as a whole rather than just the Randstad conurbation; the use of several spatially segmented markets in the same hedonic price function is associated with biased estimates of attribute effects (Palmquist 1991).

Studies of the regional enlargement of the Stockholm region in Sweden show that the radius of the price-distance gradient increased as a result of improved rail accessibility. Residential property prices in Uppsala could be partly explained by their time distance from downtown Stockholm after the introduction of a frequent 45-minute commuter train service with discounted fares for daily commuters (Andersson and Andersson, 2008).

With sufficiently good information flows, improved accessibility will be capitalized in land values in conjunction with the initial investment decision. The normal case is however imperfectly informed markets, due to uncertainties regarding the credibility of decisions as well as future impacts of investments on the economy as a whole. The overall effect is therefore likely to be gradually incorporated into house prices, with distinct price effects that correspond to the sequence of relevant events: station location decisions; the commencement of construction; the opening of the line; and the cumulative experience from consuming transportation services. The first three effects should have been fully incorporated in the land value observations that we analyze in this paper, while the service experience component may have been capitalized in land values to a limited extent.

Yu and Wong (2005) studied such a temporal sequence in their analysis of the land price effects from a proposed tunnel project in Hong Kong. Their results show that expectations of improved accessibility had been capitalized in house prices to a substantial extent well before the completion of the tunnel. They suggest that such expectation effects may enable governments to fund infrastructure investments by selling land in areas with contingent accessibility benefits.

A related topic is the spatial structure of infrastructural impacts. This is particularly relevant in the present context, since some of Taiwan's high-speed rail stations are in remote suburban locations. Sasaki, Ohashi, and Ando (1997) argue that market activity will not lead to a spatial dispersion of economic activities when an extensive network is implemented. They point out that the stock effect of existing lines favors previously developed regions, implying that new lines in remote regions improves the accessibility of central regions as well.

Sasaki et al. (ibid.) do however not take the possible spatial differentiation of transaction costs into account. If such cost heterogeneity is included, it is still possible that the reinforcement of pre-existing agglomeration economies does not materialize. For example, a property developer with substantial land holdings around stations may indeed bring about spatial dispersion, since unified land ownership is associated with low transaction costs. The transaction cost savings may therefore offset the sunk costs that in the past caused agglomeration economies, as long as long-established areas have more dispersed land ownership.

4 Descriptions of the Data and Estimation Results

The observations on transaction prices and structural characteristics were obtained from the Department of Land Administration of the central government, and cover all 2,137 and 2,490 residential property sales and 393 and 381 commercial property sales that were recorded in the metropolitan areas in 2007 and 2008, respectively. All the sale prices were adjusted to 2006 constant dollars. The education data are for 2004 and were obtained from the Ministry of Finance. The neighborhoods correspond to districts in the core cities and to townships in the rest of the metropolitan areas. A suggested income variable was unfortunately unavailable for districts, but the correlation between average income and the percentage of residents with at least two years of college education is very high in districts and suburban townships, so the education variable is in effect also a proxy for income. The distance measurements are proxies for house-specific access to the MRT and HSR station, the Kaohsiung Internal Airport, the city center, and major shopping halls, respectively. The distance data correspond to the shortest route for motor vehicles according to a popular GIS program that covers the entire road network of Taiwan; *PaPaGo R12*.

The neighborhood attributes “commercial zone” and “residential zone” refer to Taiwanese zoning regulations, which are more flexible than in many other jurisdictions. Taiwan’s cities have retained a mixed-use character since “residential zones” allow commercial use on the first and second floors of apartment houses and townhouses. “Commercial zones” allow for some residential use on higher floors. For example, downtown residential zones are often used for high-rise apartment blocks with high-value commercial use such as banks and luxury retailing on the first two floors. Moreover, land use regulations tend to be somewhat haphazardly enforced compared with European or North American cities (Bernstein, 2007).

The functional forms of the hedonic models include: 1) Semi-log; 2) Inverse semi-log; 3) Double-log; and 4) Box-Cox transformation, as shown below.

1. Semi-log

$$\ln P = \alpha_0 + \sum_{i=1}^{m} \beta_{im} Z_{im} + \sum_{i=1}^{n} \beta_{in} D_{in} + \varepsilon_i \qquad (4.1)$$

2. Inverse semi-log

$$P = \alpha_0 + \ln \sum_{i=1}^{m} \beta_{im} Z_{im} + \sum_{i=1}^{n} \beta_{in} D_{in} + \varepsilon_i \qquad (4.2)$$

3. Double-log

$$\ln P = \alpha_0 + \ln \sum_{i=1}^{m} \beta_{im} Z_{im} + \sum_{i=1}^{n} \beta_{in} D_{in} + \varepsilon_i \qquad (4.3)$$

Where,
P: housing price,
Z: explanatory variables,
D: dummy variables,
β: coefficients,
α: constant term,
ε: random error.

4. Box-Cox

$$Y(\lambda_2) = X(\lambda_1)\beta + \varepsilon = \beta_1 X_1 \lambda_1 + \beta_2 X_2 + \ldots\ldots + \beta_p X_p + \varepsilon,\ \varepsilon \sim N(0, \sigma^2 I) \qquad (4.4)$$

The hedonic analysis makes use of sales prices rather than rents, which accounts for most transactions involving residential property. In addition, sales prices reflect expectations of future developments, and should therefore - unlike rents - reflect potential long-term future benefits of new or planned infrastructure investments. Table 2 is a list of all variables which specifies measurement units as well as the abbreviations that are used in estimation. Table 3 gives the means and standard deviations of the original untransformed variables. Table 4 shows the estimation results of the log-linear functions for residential and commercial property while Table 5 gives the estimation results of the Box-Cox transformation with significant parameters (we choose the absolute t value greater than 1 as the level of significance). Meanwhile, Table 4 excludes all quarter-specific constant in the 2007 apartment model due to the fact that there were only two transaction records for the first three quarters while Table 5 excludes all apartment models because Box-Cox approach did not provide robust estimations of model parameters. For the remaining significant variables, Table 4 and 5 also show that all the structural, neighborhood and accessibility measures are with the correct signs. And the data of 2008 provides better goodness-of-fit for both the residential and commercial models.

We also learn that all the ups and downs of housing prices as predicted by the quarter-specific constants are quite consistent with Kaohsiung Housing Index as shown in Figure 2. But the percentages of changes in property transition prices are small in comparison to the Housing and Land Value Indices. In other words, it is fair to address the statement that the global financial crisis only affects the local market in a minor way.

Another interesting finding is that the distance to HSR station has a positive effect for commercial properties in the 2007 model, which is the only positive HSR coefficient in our study, but it becomes a negative effect in the 2008 model. There are quite a few reasons to explain the contradiction. First, HSR station become more accessible after the MRT lines was completed in 2008. Second, the station is not attractive for commercial activities in 2007 due to the fact that it is also in the vicinity of a highly polluted industrial center, but the major facility of the industry is scheduled to be relocated within few years. And the last reason is that a major shopping hall is scheduled to be built adjacent to the station in the near future.

Nevertheless, the distance to Kaohsiung main train station exhibits very significant negative effect on commercial properties in the 2007 model while insignificant positive effect in the 2008 model. The contradictory may rise from the fact that the benefit of accessibility improvement provided by MRT for the main train station is overshadowed by the inconvenience of a newly constructed underground railway project which will not be completed within five years.

It is no surprise that the hedonic price model exhibits significant effects of transit accessibility on property prices. In fact, it is the second most significant factors in the category of accessibility attributes. For residential properties, the elasticity of distance to CBD is about 13% to 29%, while the elasticity of distance to a MRT station ranges from 3% to 7%. As for commercial properties, the elasticity of distance to CBD is between 11% and 13% while the elasticity of distance to a MRT station ranges from 9% to 11%.

Although global financial crisis has minor effects on the local housing market, as suggested by the Housing Value Index and our hedonic price model, it is important to learn that properties around MRT stations remain very appealing to buyers in the local housing market. Therefore, it is fair to address that the global crisis has not yet jeopardize the prospect of transit oriented development in Kaohsiung.

Additionally, Tables 6, 7 and 8 show that the distance-to-MRT-station effects are nearly doubled for properties beyond 1 km or 1.6 km compared with properties within 1 km or 1.6 km. And the dummy variable of within 500 meters to MRT station does not have significant effect on property prices. This is somewhat tricky with the facts shown in Table 5. Perhaps the effect of KMRT on property prices at the current stage has yet to be verified due to low patronage of the transit system. The prospective of KMRT, however, would be dependent on the future patronage brought by new TOD projects.

On the other hand, Table 9 and Table 10 show that the distance-to-MRT-station effects are more than tripled for properties within 1 km compared with properties beyond 1 km. However, the dummy variable of within 500 meters to MRT station does not have significant effect on property prices. This is consistent with the facts that Taipei MRT network covers the majority area of Taipei City with high patronage. The prospective of Taipei MRT, is much better than KMRT due to the successes of patronage brought by several new TOD projects.

5 Final Remarks

According to the above, we find that the average transaction price of shops per square meter in Taipei is about 250% more than the prices in Kaohsiung. The prices of shops near Taipei MRT stations is nearly tripled compared to the prices of shops far away from MRT stations, and the prices of shops near Kaohsiung MRT stations is about 30% higher than the prices of shops far away from

MRT stations. We also find that the distance to CBD effects on Taipei shop prices is about 6 times larger than on Kaohsiung shop prices Global financial crisis has notable effect on shop prices in Taipei but has only moderate impact on the prices in Kaohsiung - although not statistically significant. In future, we will try to investigate rental markets for shops, offices and residential flats, and try to collect asking price data for all types of properties

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Table 1 List of variables with units of measurement and abbreviations

Variable	Unit of measurement	Abbreviation
Housing Transaction Price	Million TWD	Price
Age of House	Year	Age
Lot Size	$100m^2$	Lot
Floor area	$100m^2$	Area
Floor number	Number	Floor
Percentage of Ownership	%	Owner
Percentage of Residents with College Education	%	Edu
Distance to the Kaohsiung Main Station	Km	TR
Distance to the Nearest MRT Station	Km	MRT
Distance to the HSR Zuoying Station	Km	HSR
Distance to the Kaohsiung International Airport	Km	KIA
Distance to Taipei Song Shan Airport	km	TSA
Street frontage lot or not	Dummy	Corner, Strfrt
Zone	Dummy	Com, Res
Distance to the Sanduo Shopping District for Kaohsiung data, to Taipei 101 for Taipei data	Km	CBD
Distance to local CBD Takashimaya Dept. Store	km	LCBD1
Road Width	M	RW
Distance to the Nearest Shopping Mall	Km	Shop
Distance to the nearest MRT station within 500m	Dummy	MRT 500m
1st quarter of 2007	Dummy	1st 07
2nd quarter of 2007	Dummy	2nd 07
3rd quarter of 2007	Dummy	3rd 07
4th quarter of 2007	Dummy	4th 07
1st quarter of 2008	Dummy	1st 08
2nd quarter of 2008	Dummy	2nd 08
3rd quarter of 2008	Dummy	3rd 08
4th quarter of 2008	Dummy	4th 08

Note: the breakdown of observations in 8 consecutive quarters for Kaohsiung data are as follows: 584, 485, 486, 501, 474, 590, 516, 460 for the townhouse sample; 1, 1, 0, 79, 83, 116, 120, 131 for the apartment sample; and 139, 90, 94, 70, 89, 119, 78, 95 for the shop sample, respectively.

Table 3: Descriptive Statistics of Kaohsiung Housing Data

Type	Townhouse				Apartment				Shop			
Variable	Min	Max	Mean	Std.	Min	Max	Mean	Std.	Min	Max	Mean	Std.
						2007						
Price	0.39	18.06	4.79	2.83	0.62	9.37	3.00	1.97	0.88	23.50	7.39	3.76
Age	0.01	50.00	18.90	14.42	0.25	42.58	14.90	11.33	0.17	57.92	19.85	14.74
Lot	0.21	2.32	0.82	0.29	0.05	11.21	0.42	1.27	0.30	2.53	0.88	0.33
Area	0.10	4.26	1.54	0.67	0.24	3.03	1.10	0.46	0.52	5.06	1.99	0.79
Owner	57.79	92.83	86.06	7.57	57.79	92.83	83.69	11.44	57.79	92.83	87.04	6.19
Edu	9.44	39.90	28.39	6.23	13.88	39.90	30.34	4.98	13.88	39.90	28.92	6.15
TR	0.50	54.10	10.19	8.47	1.00	18.40	6.35	3.93	0.50	47.70	9.83	8.73
MRT	0.01	43.10	4.00	5.57	0.32	4.60	1.57	1.03	0.28	36.90	4.09	5.90
HSR	0.90	50.50	13.59	8.87	2.00	25.20	9.19	5.81	1.90	44.10	13.53	9.10
KIA	0.87	61.60	14.09	9.24	1.20	21.50	11.13	4.91	1.20	55.20	13.16	8.85
RW	2.00	45.00	15.74	7.58	5.00	60.00	19.65	11.72	6.00	46.00	19.04	8.42
Strfrt	0.00	1.00	0.48	0.50	0.00	1.00	0.69	0.46	0.00	1.00	0.90	0.30
Corner	0.00	1.00	0.00	0.07	0.00	1.00	0.12	0.33	0.00	1.00	0.02	0.13
Com	0.00	1.00	0.15	0.35	0.00	1.00	0.37	0.49	0.00	1.00	0.33	0.47
Res	0.00	1.00	0.82	0.39	0.00	1.00	0.63	0.49	0.00	1.00	0.67	0.47
CBD	0.30	56.40	10.24	8.58	0.60	16.60	6.67	3.71	0.70	50.10	9.71	8.68
Shop	0.06	41.40	4.74	5.58	0.28	14.00	3.04	2.44	0.06	35.00	4.89	6.14
						2008						
Price	0.71	17.16	4.83	2.74	0.62	10.72	2.92	1.63	1.24	28.17	8.39	4.61
Age	0.17	47.75	17.78	13.81	0.25	39.50	15.79	10.21	0.17	52.00	18.79	14.84
Lot	0.17	3.97	0.85	0.35	0.04	0.63	0.21	0.10	0.20	3.69	0.92	0.41
Area	0.16	4.26	1.60	0.67	0.24	2.59	1.13	0.40	0.40	6.00	2.12	0.92
Owner	76.67	94.14	89.11	2.44	76.67	94.14	89.24	4.17	83.65	94.14	88.77	2.70
Edu	14.61	40.90	28.01	3.87	24.09	40.90	32.43	4.26	14.61	40.90	28.97	4.43
TR	0.54	57.90	12.03	8.21	0.36	16.70	5.97	3.67	0.95	43.30	10.36	8.69
MRT	0.01	47.10	4.31	5.45	0.03	5.20	1.50	0.94	0.19	32.50	4.32	6.32
HSR	0.60	48.90	13.88	7.35	0.80	19.50	8.51	4.73	1.50	40.10	13.27	7.99
KIA	0.85	64.40	14.93	9.75	0.79	23.90	11.46	5.95	0.65	49.90	13.60	9.81
RW	2.00	45.00	15.51	7.54	2.00	50.00	19.47	9.32	4.00	40.00	18.55	7.89
Strfrt	0.00	1.00	0.45	0.50	0.00	1.00	0.67	0.47	0.00	1.00	0.94	0.24
Corner	0.00	1.00	0.01	0.07	0.00	1.00	0.12	0.33	0.00	1.00	0.03	0.17
Com	0.00	1.00	0.08	0.28	0.00	1.00	0.35	0.48	0.00	1.00	0.30	0.46
Res	0.00	1.00	0.86	0.34	0.00	1.00	0.65	0.48	0.00	1.00	0.68	0.47
CBD	0.51	60.30	11.97	8.59	0.20	19.10	6.50	4.02	0.30	45.80	10.27	9.00
Shop	0.02	45.20	5.43	5.57	0.01	7.50	2.57	1.77	0.07	30.60	5.12	6.24

Table 4: Descriptive Statistics of Taipei 2008 Housing Data

Type	Townhouse				Apartment				Shop			
Variable	Min	Max	Mean	Std.	Min	Max	Mean	Std.	Min	Max	Mean	Std.
Price	235	4868	2078	1112	30	20500	1058	835.9	560.0	8166	4363	5378
Age	1.92	45	35.41	10.71	0.17	45.83	22.32	11.23	29.00	40.08	34.54	7.83
Lot	32	290.9	95.9	58.42	0.04	1783	26.80	46.31	9.10	118.5	63.80	77.36
Area	55.26	385.8	189.8	91.34	18.36	1939	103.1	66.04	32.22	289.5	160.9	181.9
Edu	37.23	59.39	45.50	6.70	37.23	64.18	50.40	7.31	57.24	57.24	57.24	0.00
TR	0.879	12.8	5.70	3.90	0.41	15.1	6.66	3.46	0.721	1.1	0.911	0.268
MRT	0.359	2.8	1.13	0.58	0.01	12.1	1.55	1.54	0.317	0.542	0.43	0.159
TSA	2.5	13.8	7.60	3.01	0.51	15.8	6.67	3.06	5.8	6.2	6	0.28
RW	8	47	19.40	10.13	4	100	21.53	13.15	9	75	42	46.67
CBD	2.9	18.2	10.03	4.14	0.6	20.3	7.52	4.14	6.30	7.70	7.00	0.98
LCBD1	1.2	18	8.06	4.17	0.284	20.2	9.85	4.56	8.70	9.70	9.20	0.71

Table 5: Box-Cox-transformed Hedonic Price Functions of Kaohsiung Housing Data

Model	Townhouse		Shop	
Variable\Statistics	Coefficient	t-value	Coefficient	t-value
		2007		
Constant	1.27	3.50**	-0.27	-0.42
Age	-0.07	-13.24**	-0.08	-6.28**
Lot	0.64	13.45**	0.88	5.51**
Area	0.66	19.81**	0.58	6.63**
Owner	-0.10	-2.71**		
Edu	0.17	4.99**	0.20	2.05**
TR	-0.02	-0.71	-0.20	-3.52**
MRT	-0.05	-4.18**	-0.13	-3.70**
HSR	0.03	1.74	0.32	8.48**
KIA	0.10	6.82**	0.23	6.32**
RW	0.06	5.34**	0.12	4.79**
Strfrt	0.27	12.01**	0.38	3.77**
Corner	0.36	2.74**	0.42	1.96**
Com	0.42	7.15**	0.27	3.69**
Res	0.29	6.00**		
CBD	-0.13	-5.98**	-0.13	-2.66**
Shop	-0.06	-5.57**	-0.04	-1.37
1^{st} 07	-0.33	-12.00**	-0.47	-5.50**
2^{nd} 07	0.05	2.17**		
3^{rd} 07	0.03	1.39		
LAMDA	0.22	7.29**	0.29	4.11**
No. of Sample	2056		393	
Log Likelihood	-3207.3		-780.93	
R^2	0.761		0.726	
		2008		
Constant	-4.25	-3.61**	0.67	1.09
Age	-0.11	-21.02**	-0.07	-6.82**
Lot	0.51	14.91**	0.66	7.27**
Area	0.68	24.77**	0.51	8.58**
Owner	0.71	4.02**		
Edu	0.34	6.04**	0.15	1.04
TR	-0.05	-1.71	0.15	2.81**
MRT	-0.07	-8.39**	-0.14	-4.84**
HSR	-0.01	-0.79	0.01	0.20
KIA	0.09	6.29**	0.16	4.85**
RW	0.02	2.17**	0.15	4.50**
Strfrt	0.15	8.75**	0.28	2.94**
Corner	0.27	2.78**	0.42	2.93**
Com	0.36	7.86**	0.21	4.65**
Res	0.30	8.66**		
CBD	-0.11	-3.74**	-0.19	-4.60**
Shop	-0.06	-6.52**	-0.16	-7.06**
1^{st} 08			0.06	1.59
2^{nd} 08				
3^{rd} 08	-0.01	-0.48		
LAMDA	0.16	6.28**	0.12	2.12**
No. of Sample	2040		381	
Log Likelihood	-3067.4		-804.35	
R^2	0.857		0.767	

Table 6 Kaohsiung Townhouse Prices and Distance to MRT

variable	Distance to MRT Station within 1 km		Distance to MRT Station beyond 1 km		Distance to MRT Station within 1.6 km		Distance to MRT Station beyond 1.6 km	
	coefficient	t value	coefficient	t value	coefficient	t value	coefficient	t value
Constant	2.0672	7.9623	1.8905	18.8689	2.2736	13.4956	1.7326	15.1537
RW	-0.0006	-0.0262	0.0427	3.4129	0.0040	0.2428	0.0457	3.1091
Age	-0.0800	-6.2984	-0.0981	-19.5465	-0.0923	-10.8359	-0.0970	-17.5477
Floor	0.0577	0.7582	0.0804	2.4826	0.0082	0.1472	0.0997	2.8310
Lot	0.5216	9.4770	0.3572	16.2434	0.4779	11.5297	0.3603	15.3231
Area	0.5491	9.6487	0.6340	23.5970	0.5612	13.2906	0.6486	21.7529
TR	-0.0776	-3.4937	0.0002	0.0078	-0.0595	-3.1587	-0.0104	-0.2802
CBD	-0.1960	-7.5414	-0.1429	-5.2168	-0.1771	-8.4660	-0.1575	-3.9290
MRT	-0.0377	-1.9255	-0.0844	-8.2516	-0.0439	-3.1567	-0.0820	-6.3795
HSR	-0.1974	-6.5897	-0.0705	-3.5847	-0.2007	-9.3591	-0.0368	-1.5910
KIA	0.0963	3.6016	0.0515	3.5975	0.0837	5.0509	0.0544	2.7267
SHOP	0.0143	0.7071	-0.0697	-8.6896	0.0098	0.6675	-0.0738	-8.5787
2nd 08	0.0236	0.7156	0.0312	2.0162	-0.0098	-0.4103	0.0490	2.8485
3rd 08	0.0763	2.2153	0.0201	1.2630	0.0238	0.9637	0.0318	1.7920
4th 08	0.0625	1.5374	-0.0148	-0.9124	0.0009	0.0301	-0.0070	-0.3931
R^2	0.8578		0.8395		0.8626		0.8342	
Corrected R^2	0.8529		0.8382		0.8598		0.8325	
No.	418		1709		705		1422	

Table 7 Shop Prices and Distance to MRT

variable	Distance to MRT Station within 1 km		Distance to MRT Station beyond 1 km		Distance to MRT Station within 1.6 km		Distance to MRT Station beyond 1.6 km	
	coefficient	t value	coefficient	t value	coefficient	t value	coefficient	t value
Constant	2.4864	3.7185	1.5756	5.8907	1.8887	4.2636	1.5752	5.3323
RW	0.2172	2.4206	0.1569	3.9043	0.2634	4.5189	0.1284	2.8740
Age	-0.0890	-2.3535	-0.0498	-4.0731	-0.0737	-3.5816	-0.0453	-3.2324
Floor	-0.1502	-0.5646	0.0169	0.1654	0.0466	0.2947	0.0809	0.6983
Lot	0.4536	2.2381	0.5059	7.0837	0.7077	6.0603	0.4542	5.7651
Area	0.5002	2.6354	0.4933	5.7707	0.2893	2.2531	0.5080	5.4870
TR	0.0004	0.0052	0.1174	1.7111	-0.0039	-0.0612	0.1356	1.5055
CBD	-0.1083	-2.1470	-0.2230	-3.2800	-0.1630	-3.9719	-0.2822	-2.8678
MRT	-0.0881	-1.1066	-0.1105	-2.8641	-0.1164	-2.3527	-0.0922	-2.1437
HSR	-0.1178	-1.0378	-0.0219	-0.4240	-0.0599	-0.7149	-0.0073	-0.1185
KIA	0.0362	0.4605	0.1587	3.7874	0.0677	1.1117	0.2283	3.7710
SHOP	-0.2423	-3.0457	-0.1238	-5.3317	-0.1291	-2.7701	-0.1326	-5.2163
2^{nd} 08	-0.0002	-0.0019	-0.0703	-1.5518	-0.0423	-0.6335	-0.0633	-1.2334
3^{rd} 08	-0.0278	-0.2799	0.0351	0.7075	-0.0100	-0.1444	0.0220	0.3943
4^{th} 08	-0.0555	-0.5703	-0.0558	-1.1619	-0.0805	-1.1526	-0.0456	-0.8539
R^2	0.8304		0.7514		0.8345		0.7231	
Corrected R^2	0.7964		0.7395		0.8160		0.7068	
No.	85		308		140		253	

Table 8 Taipei Townhouse / Shop Prices and Distance to MRT (with distance dummy)

variable	Townhouses				Shops			
	Distance to MRT Station within 1 km		Distance to MRT Station within 1.6 km		Distance to MRT Station within 1 km		Distance to MRT Station within 1.6 km	
	coefficient	t value	coefficient	t value	coefficient	t value	coefficient	t value
Constant	2.0652	7.9482	2.2738	13.4909	2.4480	3.5887	1.8871	4.2418
RW	-0.0008	-0.0330	0.0037	0.2248	0.2196	2.4242	0.2635	4.5025
Age	-0.0796	-6.2526	-0.0919	-10.7698	-0.0865	-2.2361	-0.0733	-3.5126
Floor	0.0559	0.7338	0.0069	0.1232	-0.1509	-0.5639	0.0464	0.2919
Lot	0.5195	9.4164	0.4763	11.4680	0.4583	2.2421	0.7069	6.0220
Area	0.5511	9.6614	0.5627	13.2988	0.5010	2.6226	0.2900	2.2483
TR	-0.0780	-3.5083	-0.0598	-3.1731	0.0014	0.0166	-0.0038	-0.0595
CBD	-0.1950	-7.4756	-0.1765	-8.4208	-0.1082	-2.1297	-0.1635	-3.9545
MRT	-0.0263	-0.9798	-0.0346	-1.7087	-0.0444	-0.2951	-0.1076	-1.3676
HSR	-0.1976	-6.5879	-0.2014	-9.3749	-0.1179	-1.0320	-0.0603	-0.7160
KIA	0.0962	3.5973	0.0832	5.0186	0.0384	0.4835	0.0679	1.1096
SHOP	0.0145	0.7164	0.0099	0.6693	-0.2403	-2.9939	-0.1285	-2.7339
2nd 08	0.0229	0.6914	-0.0103	-0.4290	0.0017	-0.0173	-0.0426	-0.6351
3rd 08	0.0769	2.2301	0.0241	0.9730	-0.0251	-0.2508	-0.0096	-0.1376
4th 08	0.0629	1.5474	0.0011	0.0381	-0.0571	-0.5825	-0.0807	-1.1499
MRT 500m	0.0237	0.6242	0.0216	0.6311	0.0453	0.3429	0.0139	0.1442
R^2	0.8580		0.8627		0.8306		0.8346	
Corrected R^2	0.8527		0.8597		0.7938		0.8146	
No.	418		705		85		140	

Table 9 Taipei Apartment Prices and Distance to MRT

variable	Distance to MRT Station within 1 km		Distance to MRT Station beyond 1 km		Distance to MRT Station within 1.6 km		Distance to MRT Station beyond 1.6 km	
	coefficient	t value	coefficient	t value	coefficient	t value	coefficient	t value
Constant	0.8703	2.6175	-0.0320	-0.0917	0.5412	2.0710	1.5125	2.5061
RW	0.0328	1.8118	0.0574	3.7188	0.0329	2.3789	0.0886	3.9273
Age	-0.1055	-10.3062	-0.0860	-8.6180	-0.1030	-12.1844	-0.0666	-5.1084
Floor	0.0301	0.9100	0.1278	4.6246	0.0426	1.5804	0.1638	4.8388
Lot	0.1135	4.1798	0.1599	6.4969	0.1306	5.8402	0.1512	4.7227
Area	0.9199	27.5136	0.8727	28.2587	0.8981	32.6627	0.8992	21.9334
Edu	0.6887	9.1962	0.7432	9.2997	0.7345	12.5509	0.1726	1.1518
TR	-0.0852	-4.6992	-0.0490	-2.2733	-0.0916	-6.3437	0.2034	4.2358
CBD	-0.2488	-8.9835	-0.1721	-7.9505	-0.2194	-11.5350	-0.1060	-2.4203
MRT	-0.0559	-3.7641	-0.0169	-0.8739	-0.0514	-4.4705	-0.0843	-2.7399
TSA	-0.0202	-0.7238	-0.0099	-0.4527	-0.0105	-0.5099	-0.1411	-3.9883
LCBD1	-0.2403	-10.9318	-0.1527	-11.8771	-0.1990	-13.8822	-0.1381	-7.1198
2nd 08	-0.0158	-0.4820	0.0334	1.0564	0.0072	0.2846	-0.0019	-0.0327
3rd 08	0.0042	0.1279	0.0463	1.4786	0.0323	1.2760	0.0140	0.2455
4th 08	-0.0142	-0.4221	0.0118	0.3798	0.0031	0.1199	-0.0005	-0.0082
R^2	0.7927		0.8100		0.8036		0.8001	
Corrected R^2	0.7897		0.8074		0.8017		0.7949	
No.	976		1011		1434		553	

Table 10 Taipei Apartment Prices and Distance to MRT (*with distance dummy*)

variable	Apartments			
	Distance to MRT Station within 1 km		Distance to MRT Station within 1.6 km	
	coefficient	t value	coefficient	t value
Constant	0.8703	2.6158	0.5402	2.0666
RW	0.0327	1.8056	0.0328	2.3640
Age	-0.1055	-10.2965	-0.1030	-12.1747
Floor	0.0304	0.9162	0.0430	1.5935
Lot	0.1137	4.1818	0.1310	5.8523
Area	0.9197	27.4720	0.8977	32.6206
Edu	0.6888	9.1930	0.7348	12.5520
TR	-0.0854	-4.7002	-0.0921	-6.3598
CBD	-0.2487	-8.9735	-0.2193	-11.5245
MRT	-0.0532	-2.5304	-0.0454	-2.6745
TSA	-0.0203	-0.7275	-0.0106	-0.5148
LCBD1	-0.2403	-10.9257	-0.1990	-13.8761
2^{nd} 08	-0.0160	-0.4877	0.0070	0.2774
3^{rd} 08	0.0041	0.1239	0.0323	1.2749
4^{th} 08	-0.0142	-0.4202	0.0033	0.1275
MRT 500m	0.0056	0.1847	0.0136	0.4787
R^2	0.7927		0.8036	
Corrected R^2	0.7897		0.8015	
No.	976		1434	