EMPIRICAL ANALYSIS ON CORRELATION BETWEEN HOUSING PRICES AND EDUCATIONAL PERFORMANCE: A CASE OF DAEGU IN KOREA

By

KIM, Yoonsan

THESIS

Submitted to
KDI School of Public Policy and Management
in partial fulfillment of the requirements
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ABSTRACT

EMPIRICAL ANALYSIS ON CORRELATION BETWEEN HOUSING PRICES AND EDUCATIONAL PERFORMANCE: A CASE OF DAEGU IN KOREA

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The purpose of the study is to analyze the correlation between hosing prices and educational performance, and to specifically interpret the correlation as a nationwide matter. This study, therefore, focuses on Daegu Metropolitan City, a region excluding the Seoul Metropolitan Area where precedent researches were made already. Meanwhile, this study employed *the hedonic pricing model* being widely used in related academic and practical fields. With that model, two research hypotheses are developed as follows: first, the educational performance in this city influences the condominium prices linearly or nonlinearly; second, the influence changes by lapse of time. To clarify the influence in depth, multifarious analyses are attempted so that Chapter 4 provides a variety of analyses composed of an OLS regression, a time-series analysis, a dummy-variable regression and a panel data analysis. Through these analyses, several key findings are obtained as in the following: 1) the price of a condominium of which the lot size is thirty pyeongs (one hundred square meters) goes up by approximately *KRW 13.6 million* as of 2009 in terms of the statistic-economics, when an adjacent high school has one more student admitted into the Seoul National University; 2) the magnitude of the influence has increased by *average 18.5 percent per annum* for five years from 2005 to 2009; 3) the condominium price and the educational performance holds a nonlinear correlation so that, if a student who gains the admission into the Seoul National University belongs to a high school which sends more than

seven students to the top-class university, the condominium price gets almost doubled; 4) lastly, through the panel data analysis, this study identifies the facts that the influence of unobservable omitted variables is not critical and the most decisive factor by which determines the value of residential real estate in Daegu Metropolitan city is the educational performance.

Dedicated to My Beloved Wife and Daughter

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Last but not least, I requite my lovely wife for her affection she has shown hitherto. Commuting from Daegu, in which I reside, to the school in Seoul, it ought to be a time-, cost-, and energy-consuming work for me and for my spouse as well. Nonetheless, she stood by and waited for me reticently to get my study completed, even, sometimes, rendering me a practical hand to arrange bundles of data.

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CHAPTER.1 INTRODUCTION

1.1 Introduction to Educational Fever and Real Estate

The importance of education, as a socio-economic factor, has always been one of the controversial social issues worldwide. In the case of the Korean, they much emphasize the role and importance of education so that the competition such as desire to be admitted into top-class universities becomes overheated. Such overheated competition in South Korea (hereafter Korea) is popularly denominated as *educational fever*. The Korean educational fever is so high as to be acknowledged widely throughout the world. High educational fever in Korea can be explained as a driving force of economic development and as to contribute to the elevation of international status of Korea (Choi 2008).

The educational fever in Korea, whereas, also induces negative influences, not only positive ones, on the Korean society such as the rise of land value biased toward particular zones. The reason the term, educational fever, is being popularly used in negative ways is that even normal people empathize with education reality as a problem (Oh 2002) so that realistic educational fever is a direct interest in instrumental value of education to obtain the money, the prestige and the power (Song et al. 1999). Moreover, educational fever in Korea is the phenomenon of correlations among education-related activity, cultural knowledge by which leads such activity and socio-structural context as socio-economic reality (Kim 1990). That is to say, education significantly affects this society and even this country in a variety of fields and ways in the respect of economy.

Furthermore, a research survey shows an interesting result that education has a deep relationship with local economy. Following the survey, people regard local economy as to affect the education significantly and as the first priority to enhance academic ability (Kim 2008). This survey result signifies the fact that economy elements such as real estate cannot

stand alone without taking other factors such as education into account considerably and thereby these two factors, occasionally, need to be addressed at the same time[1].

Meanwhile, as perceived by the case of recent global financial crisis resulted from subprime mortgage, real estate accounts for a great part of local economy worldwide. This argument becomes more persuasive when it comes to residential real estate. The significance of residential real estate and housing market in Korea is evidenced by the fact that real estate regulations and countermeasures were announced or revised approximately eighty-four times by the Korean government to make the housing market stable from the year 1967. Even, under current Lee's presidency, housing market regulations were revised thirty-four times[2].

These efforts by the Korean government to make the house price stable usually targeted the Seoul Metropolitan Area where house price fluctuated all the time. Gangnam area, specifically, in Seoul is famous for the highest house price and educational fever in Korea. Moreover, speculation-ridden areas in other metropolitan cities such as Daegu, Busan, Incheon, Gwangju and Ulsan were also targeted. The relation, thus, between house prices and educational performance was necessarily examined. People in Korea, specifically whose children are in middle or high school, put the first priority on education when purchasing a house. Table 1.1 below shows this tendency well.

Table 1.1: the First Consideration When Purchasing House (in %)

		Pleasant Environ-ment	Education condition	Trans-portation	Develop-ment Feasibility	Living Amenity	Distance To Relatives	Etc.	None
Total		24.4	21.6	18.3	14.6	12.5	2.5	3.2	2.9
Age of House Buyer	Under 30	17.8	***28.4***	16.2	17.8	11.2	4.6	2.5	1.5
	40s	19.0	***35.4***	14.1	15.1	10.2	1.8	2.1	2.3
	50s	31.6	8.4	20.9	16.7	14.1	1.1	3.0	4.2
	Over 60	34.0	0.7	26.8	5.9	17.6	3.9	7.2	3.9

Source: the Survey on Actual Condition of Housing Finance (the Kookmin Bank 2009)

[1] Approximately seventy percent of the respondents answered positively to the question asking whether regional economy affects education significantly.

[2] Source: Influence of Real Estate Policy on Construction Industry (Kim et al. 2005), Housing and Real Estate Policy (Lee, 2007)

Furthermore, "Educational environment is a crucial criterion to decide the dwelling when it comes to the Korean parents world-best concerning educational fever," we are advised (Sim et al. 2009). Following the book, Gangnam, Yangcheon and Nowon districts in Seoul are well-known for high educational fever and house prices. In addition to those districts, Bundang district in Seongnam City, Juyeop-dong in Ilsan City, the Pyungchon zone in Anyang City, Donchun-dong in Incheon Metropolitan City, newly rising Haeundae district in Busan Metropolitan City, the Dunsan zone in Daejeon Metropolitan City, Bongsun-dong of a new town in Gwangju Metropolitan City, Nam-gu district in Ulsan Metropolitan City and Suseong district in Daegu Metropolitan City are also famous for high educational fever by which incurs a house price rise. Those districts and zones are denominated as *education-specialized zones*. The house price in such education-specialized zones has practically been or risen higher than other districts and zones in the same city so that several researches were made to clarify this phenomenon. Most of those researches, however, unfortunately focus on the problem of educational fever in the Seoul Metropolitan Area, despite real estate problems are not confined to only that area. Additional researches, therefore, on this phenomenon is necessary to interpret the matter as nationwide one, as the book above addressed.

1.2 Purpose of the Study and Hypothesis Development

The purpose of the study is to empirically analyze the correlation between housing prices and educational performance and to specifically interpret the correlation as a nationwide matter. This study, therefore, focuses on a region excluding the Seoul Metropolitan Area where previous researches, revealing the relation in this area, were already made and thereby this study targets Daegu Metropolitan City. This is from taking notice of a news account[3] mentioning that Suseong district in Daegu Metropolitan City is already well-

[3] Source: http://biz.heraldm.com/common/Detail.jsp?newsMLId=20090416000290

known for a prestigious high-school district in this region, that is, the district is regarded as eighth-high-school district[4] of Seoul (the *Herald Business* 2010). Moreover, Chung (2000), in his research focused on Daegu Metropolitan City, argues that, as income level or the number of family member is getting higher or greater, the tendency to put emphasis on education circumstance is getting higher in the respect of residential location preference. This research implies the problem of educational fever and real estate is also prevalent in Daegu Metropolitan City.

According to the purpose, this study attempted to provide a theoretical background for appropriate nationwide policies on real estate by empirically analyzing the correlation between housing prices and educational performance in that city. In doing so, this study attempted to make four analyses: 1) the correlation between housing prices, specifically the prices of condominium apartments, and educational performance; 2) the change of the correlation during time period from 2005 to 2009; 3) the nonlinear effect of educational fever; 4) and the influence of unobservable omitted variables on the correlation.

To analyze the influence empirically, this study targeted sixty condominium apartment complexes (hereafter condominiums), unfortunately excluding one condominium in Dalseong-gun district of which the past price data were not possible to obtain, nearby sixty high schools of which more than one student admitted into the *Seoul National University* (hereafter the Seoul University) from 2005 to 2009. Accordingly, the average prices per square meter of each condominium were chosen for the dependent variable. There are several compelling evidences that condominiums were selected. First, the price rise of condominiums is greater than that of private residences etc. Second, Rho and Kang (2009, 4) argues that the premium of land for condominiums was highest in residential real estate, compared to private residences. Besides, occupants in condominiums showed the highest education level in

[4] Eighth-high-school district in Seoul Metropolis is famous for high admission rate to top-class universities in Korea and for the nation-highest house price.

profile of housing consumer per residential type (Kim 2005). The price of condominiums is, therefore, said to be the most effective variable representing residential real estate.

On the other hand, among explanatory variables, the number of student admitted into the Seoul University was used for an education factor. The reason this variable is taken as an education factor is that the Seoul University is regarded as the top university in Korea so that this university definitely represents the desire to be admitted into top-class universities. This is strongly evidenced by the fact that the Seoul University ranked fiftieth in 2008 and in 2010 and forty-seventh in 2009[5] amongst the universities in the world. Not only that, following the ARWU[6], this university occupied the rank between 152th and 200th in 2008 and in 2009 and between 101th and 150th in 2010. It goes without saying that the Seoul University ranked the top in Korea. The other variable for educational fever, meanwhile, is the admission rate to four-year-course colleges.

Nevertheless, the number of private institute, a kind of input variable used in some precedent researches, was not included in this study as an education factor, because school inputs such as per-pupil spending had no apparent impact on student achievement and were therefore inappropriate as measures of school quality (Chiodo et al. 2010; Hanushek 1986, 1997). Jung (2006) also maintains that the proportion of private institutes did not affect the price of condominiums, and therefore this study employed two bundles of output-characterized data as educational variables.

Other explanatory variables, moreover, anticipated to influence the price of condominiums were also employed to properly analyze the influence. First, some variables for living conditions were employed: the number of subway station and the number of bus run in the vicinity of condominiums were for transportation factors; the number of city park

[5] This is annually announced by QS (Quacquarelli Symonds) in The Times in The London. Source: http://www. topuniversities.com

[6] The ARWU (Academic Ranking of World Universities) is a grand-scale Chinese project conducted by the Shanghai Jaotung University. Source: http://www.arwu.org

and department store and large discount store nearby condominiums were for neighborhood factor. Second, to reflect inner conditions of each condominium as well, two discrete variables of each condominium, the number of household in each condominium and the age of each condominium were used. Given that, nonetheless, not only this study pursued external effects but also regional factors were more crucial than individual factors of condominiums in determining their prices (Eom et al. 2006), traditional discrete variables of condominiums such as the number of room, the lot size and etc. were not employed and only two discrete variables were used restrictively. They were well elucidated in detail in Subchapter 4.1.

Among those variables, unfortunately, time series data of two explanatory variables, the admission rate to four-year-course colleges and the number of bus run, were hardly obtained at all. In the case of the data for the rate of four-year-course colleges, only those of the year 2009 were officially announced and therefore obtained. In the case of the data for the number of bus run, in the mean time, only those of the year 2009 were also employed, because there was no way to collect past data and verify their reliability. Accordingly, two explanatory variables were used at equal value in the time series analysis on the change of the influence on real estate. To analyze such variables, this study employed *the hedonic pricing model* being widely used in related academic and practical fields. With that model, two research hypotheses are developed as follows: 1) the educational factor influences the prices of condominiums linearly or nonlinearly; 2) the influence changes with a five-year time series analysis of 2005 to 2009.

For the analysis on the research hypotheses, this study is composed of five chapters. In Chapter 2, a brief explanation on the hedonic pricing model, literature review and opinions are provided first. The overview, then, of districts in Daegu Metropolitan City is included in Chapter 3 and thereafter two research hypotheses are analyzed in Chapter 4 with the hedonic

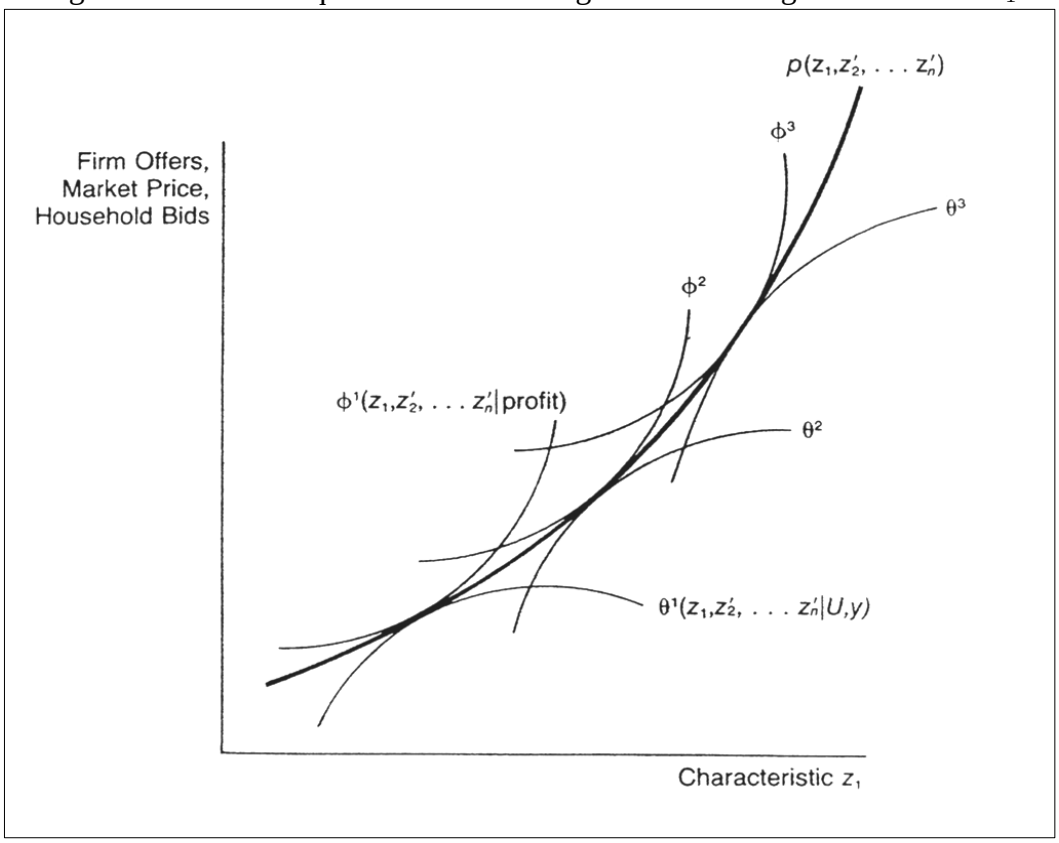
pricing model by four empirical analyses: the *ordinary least squares* (hereafter OLS) regression, the *time series analysis* on the basis of the coefficient comparison, the *dummy-variable regression* and the *panel data analysis*. After these analyses, the analytical remarks based on them are developed. Lastly, in Chapter 5, this study is concluded with discussion and the limitation of the study.

CHAPTER.2 HEDONIC PRICING MODEL

2.1 Summary of the Hedonic Pricing Model

The term, *hedonic*, originated from the ancient Greek hedonistic philosophies by which formed the foundation of utilitarianism (Lee 2008; DiPasquale et. al 1996) and the term, *the hedonic price*, is called as the implicit price or the characteristic price. Because housing is a heterogeneous commodity, its price is determined by characteristics the housing itself contains. The background of this theory is well illustrated in Figure 2.1.

Figure 2.1: Market Equilibrium of Heterogeneous Housing Characteristic z_1



Source: Fallis (1985), p. 80.

Understanding the equilibrium of a housing market becomes far more complicated, when housing is regarded as a heterogeneous commodity, because a housing market has implicit characteristics of its own; where, (z_1, z'_2, … z'_n) is a bundle of characteristics. In Figure 2.1 above, a $p(\mathbf{z})$ function means an equilibrium condition at which the quantity

supplied is equal to the quantity demanded. On the one hand, equation (2.1) is a *bid function* for demand side so that it implies willingness to pay of a household. These bid functions are illustrated tangentially on the lower side of the $p(\mathbf{z})$ function. On the other hand, equation (2.2) is an *offer function* for supply side so that it indicates what price a firm is willing to offer. The bid functions are depicted also tangentially on the upper side of the $p(\mathbf{z})$ function. (Fallis, 1985)

$\theta(\mathrm{z}_1, \mathrm{z}_2, \ldots\ \mathrm{z}_n \,|\, U, y)$ .... (2.1)

Where U is the utility of a household; y is the income of a household.

$\emptyset(\mathrm{z}_1, \mathrm{z}_2, \ldots\ \mathrm{z}_n \,|\, \text{profit})$ .... (2.2)

Therefore, when a bid function of a household and a offer function of a firm converge on a point of a $p(\mathbf{z})$ function, an equilibrium condition or price is determined. The equilibrium price of a $p(\mathbf{z})$ function, thereby, is the hedonic price. On this theoretical background, the hedonic price is estimated by regressing the dependent variable of a price and the explanatory variables of characteristics. This theory can be simply described in the form of functions. A simple equation (2.3) and a linear function of equation (2.4) explain the hedonic pricing model. The hedonic pricing model can have several forms according to modeling. In this paper, considering the purpose is not to analyze the accurate price but to basically analyze the influence of educational variables on the price of condominium, the linear-function form of equation (2.4) was used for the relation analysis once in Subchapter 4.2 and 4.3, although Lee (2008) argued that each hedonic pricing model has its own pros and cons in its usage and therefore more consideration is necessary when choosing a model.

$P = h(S, N, L)$ .... (2.3)

Where P is a price; S, N, L are discrete characteristics; and $h(\ )$ implies regression.

$p(\boldsymbol{z}) = \beta_0 + \beta_1 z_1 + \beta_2 z_2 + \ldots + \beta_n z_n$ .... (2.4)

Where $p(\mathbf{z})$ is the hedonic price as a dependent variable; z_1, z_2, ... z_n are explanatory

or independent variables representing each characteristic; and β_1, β_2, ... β_n are coefficients of z_1, z_2, ... z_n or regression parameters being estimated.

The hedonic pricing model or the hedonic price equation, meanwhile, is widely used in real estate analyses in numerous ways. A brief explanation on its use is following: estimation of the value of real estate, evaluation of the environment of real estate, creation of a price index by comparing housing costs among different cities, and etc.

2.2 Literature Review

A lot of foreign and local studies have attempted to clarify the relation between education and real estate in many ways, with employing diverse models and variables by which represent their conditions, and with targeting various regions in accordance with their purpose. This study explored such a variety of theories that uphold or were partially skeptical about the relation between education and real estate by reviewing precedent researches such as dissertations, books, academic journals, working papers and newspapers relevant to the topic of this study.

Precedent researches concerning the relation between education and real estate have studied various issues such as the worth of neighborhood school, the relation of educational outcomes and house values, the impact of school characteristics on house prices, in more detail, the measures of school quality that value housing market, the student quality related to real estate prices, the relation of admission rate into top-class university and condominium prices and etc. domestically and abroad. During reviewing those precedent researches, the fact that educational environment indeed affected real estate in the respect of not only the price but also the rent came to be perceived. In this study, those findings from precedent researches were introduced first with foreign cases and then with domestic ones.

2.2.1 Foreign Literature

Not only domestically in Korea but also abroad, many efforts to clarify the relation between education and real estate were made in the form of theses, journals and etc. Those precedent researches revealed how and which educational factors affected real estate.

First, a research maintains that individuals, when purchasing houses, do appear to consider the current test performance of students in the local school rather than the extent to which a community's schools contribute to a cohort's test performance. His study estimated the impact of school characteristics on house values such as per-pupil expenditures, test scores, the racial composition of the local schools and etc. with the hedonic analysis as its model. Its geography was based on district- and school-level in Chicago in the U.S. and a two-year time data of 1987 and 1991 were used. More interesting findings from this research is the necessity of including measures of neighborhood quality in addition to the school characteristics just to prevent the coefficient estimates for the school characteristics from being biased (Thomas and Zabel 1997).

David (1999), meanwhile, maintains that parents do not choose schooling based on which school districts are best able to improve students' academic achievement; instead, they appear to choose school systems based on peer group effects, valuing the type of children who attend the school district. His study was to clarify which measures of school quality value a housing market in the major metropolitan areas of the state of Ohio in the U.S. In his study, more extensive samples such as proficiency tests, expenditure per pupil and the pupil/teacher ratio, consistently capitalized into housing prices, were employed. Both traditional hedonic house price estimation and a hedonic corrected for spatial autocorrelation were used for the models. Through the result, David suggests not employing value-added measures such as the graduation rate, teacher experience levels and teacher education levels, because they are not consistently positively related to housing prices.

Furthermore, Wong and others (2008) argue that the intake quality of a university program has a strongly positive correlation with the performance of the real estate market. They elaborated to analyze twenty-year time series data collected from Hong Kong. Eventually they suggest reducing the volatility of intake quality of programs to program providers who wish to admit high-caliber students.

Following another supporting research, disrupting neighborhood schools reduces house value by nine point nine percent, *ceteris paribus.* … Instituting transportation services increase house values by two point six percent, all else being equal. … This neighborhood schools effect had an equivalent impact on house values of a fully capitalized forty-seven point five percent increase in property taxes (William 2000). This research was performed geographically based on Shaker Heights, Ohio in 1987 with the hedonic analysis.

On the other hand, the proficiency test score was found as the most consistently valued measure of school quality. It was positive and significant when entered alone or with per pupil expenditures for full sample and all metropolitan area samples (David et al. 2005). An increase in test score by one standard deviation raised house prices by seven point one percent, other things being equal. This working paper calculated the value, added by tracking the achievement of a cohort of students over time from fourth to ninth grade, and the house price hedonics was used as its analysis model.

Chiodo et al. (2010) and Hanushek (1986, 1997) argue, interestingly, that school inputs such as per-pupil spending have no apparent impact on student achievement and are therefore inappropriate as measures of school quality, though various studies in the traditional hedonic analysis have used so-called input-based measures of education quality. Chiodo, meanwhile, compared pure hedonic pricing model, linear boundary fixed effects model and nonlinear boundary fixed effects model to distinguish each result. In his study, he reveals that houses associated with higher-quality schools command a much higher price premium.

Meanwhile, given that the hedonic price is an implicit price determined by the characteristics of housing, this study needs to inevitably include as many characteristics as possible in the analyses to lessen the effect of unobservable omitted variables. Moreover, in the respect of the characteristics of education factors, it is advised to employ output-characterized ones. This is, when parents decide to move just for the children's education, they generally take the school performances, output-characterized factors not input-characterized ones, into account. In other words, when it comes to education factors, the value of real estate is decided by apparent school performances not by inputted educational quality, because such input-characterized value-added measures cannot stand for accurate school performances.

Therefore, to employ appropriate variables and thereafter analyze such effect of unobservable omitted variables and to lessen the influence biased to a particular variable, two output-characterized education factors are employed and the panel data analysis is conducted in Chapter 4.

2.2.2 Domestic Literature

Not surprisingly, many domestic precedent researches also supported the positive relation between education and real estate. A research, however, showed a skeptical opinion on the relation and, regretfully, those domestic researches focused on the case of the capital area, the Seoul Metropolitan Area, so that those researches were hardly accepted as to represent a nationwide phenomenon.

Kang and Choi (2002) attempted to identify the price and supply characteristics of condominiums in Daegu Metropolitan City. According to their study, education is perceived as a determinant of residential environment and therefore they analyze whether education facilities affect the price of condominiums. The result is that education facilities, except

middle schools, do not affect the price.

However, the study above used the fact as its educational variable that whether elementary, middle and high schools and colleges are located in the targeted area or not. Unfortunately, because those variables seemingly do not represent the educational performance in Daegu Metropolitan City, a considerate choice for such variables is necessary.

Jung (2006), on the other hand, champions that educational variables such as the admission rate into the Seoul University and four-year-course colleges, the rate of private institutes and eighth-high-school district affect condominium prices in accordance with the analysis result geographically based on Seoul Metropolis. His study used the hierarchical linear model for the analysis after comparing with the hedonic model. Variables for the analysis were grouped into two categories of discrete variables of condominiums and regional variables. His study, otherwise, interestingly identifies that any educational variables do not affect the price of condominiums, when it targets only one area of Gangbuk.

Park and Kim (2006), meanwhile, argue that the educational policy can stabilize the rent market of condominium in Gangnam district. But it has some limitation in stabilizing the condominium transaction market, which indicates that the housing policy or the interest-rate policy should be mobilized. Their research addressed the aftereffect of an educational policy[7], not the effect of education on real estate. They identified their hypotheses with comparisons and questionnaire survey.

Moreover, Eom and others (2006) maintain that the average condominium prices in region A is sixty-four percent higher than in region B, if region A has twice as good education system as region B. The hedonic pricing model was employed for empirical analysis also targeting Seoul Metropolis. They used various regional characteristics as well as individual characteristics of condominiums. Eventually their study revealed that regional characteristics

[7] 2·17 Educational Policy: The purpose is to curtail private educational spending and thereby to normalize the public education.

are more important than individual ones in determining condominium prices and then made a policy suggestion: The government should improve the educational environments of undervalued regions in order to curb speculative bubble in overvalued regions.

As advised by the research above, the regional characteristics surrounding a condominium are more effective than internal discrete characteristics of a condominium to explain the hedonic pricing model. This is attributed to a characteristic of housing, a *segmented market*. Because the location is a decisive factor of determining the value of real estate, the location and its environment is said to represent the segmented characteristics of real estate. In this sense, this study employs six external variables and only two internal variables are used restrictedly.

Another study, in the mean time, supports the positive relation between education and real estate. The qualities of high schools influenced the price of nearby condominiums, despite the size effect turned out to be quite small. In addition, when education system changed from sorting to mixing in some areas of Korea, the real estate price near the high-quality high school had risen. This therefore means that the quality of education has an influence on real estate prices (Kim et al. 2007). Their study used the multiple regression on the geographical basis of Bundang district in The Seongnam City and The Ilsan City.

Kim and Lee (2007), nonetheless, argue that rapid increase in condominium prices do not stem from education factors, and lack in information on education performances can distort market participants' decision, although they argue that changes in condominium prices affect the adjacent area. This research, also targeting Seoul Metropolis and adjacent new cities, used the spatial autoregressive regression and employed some variables as in the following: the rate of increase in condominium prices for a dependent variable, the number of private institute for a educational input variable, the rate of increase in admission rate into the Seoul University for a educational output variable, the demography, jobs to employed

residence ratio and the number of worker in markets.

However, the variable, the number of private institute, is an input variable so that it can hardly represent the quality of education. A precedent research, besides, warns us of no apparent impact on student achievement and school quality of such input-based variables. Thomas (1996), on the other hand, emphasizes the necessity to include measures of neighborhood quality in addition to the school characteristics just to prevent the coefficient estimates for the school characteristics from being biased. Therefore, the results of their study remained concern over deciding variables.

Meanwhile, Kim and Jung (2010) studied the fitness between traditional hedonic model and spatial econometrics model rarely targeting the case of regional real estate of Busan Metropolitan City. However, this research just compared the fitness of the two analysis models so that any lessons about the relation between education and real estate were not obtained except for the fact that their study did not focus on Seoul Metropolis.

Lastly, following a news article[8], the result of an analysis on the correlation between the score of college scholastic ability test based on five-year time series data and condominium prices in Seoul Metropolis identifies that the influence of the score on the prices has declined by forty percent. This phenomenon is seemingly attributed to the rise of the number of foreign language high school and special-purpose high school so that high-rank students moved from their dwellings (*the Chosun Ilbo* 2011). This article implies the necessity to analyze also the change and tendency of the influence as well as the influence.

A lot of foreign and local studies reviewed above attempt to identify the relation between education and real estate, and thereby many measures, analysis models and regions are employed or targeted. Therefore, precedent researches remain several implications or lessons on the topic.

[8] Source: http://news.chosun.com/site/data/html_dir/2011/05/16/2011051600186.html

Summarizing the precedent researches and then enumerating lessons from them, they could be articulated as follows: 1) a research should pay significant consideration on selecting and employing data; 2) applying diverse types of models to empirical analyses is meaningful, because this can clarify the influence of the educational performance on real estate accurately; 3) and in the case of domestic study, additional analyses regarding this topic as a nationwide phenomenon should be performed to implicate appropriate policies.

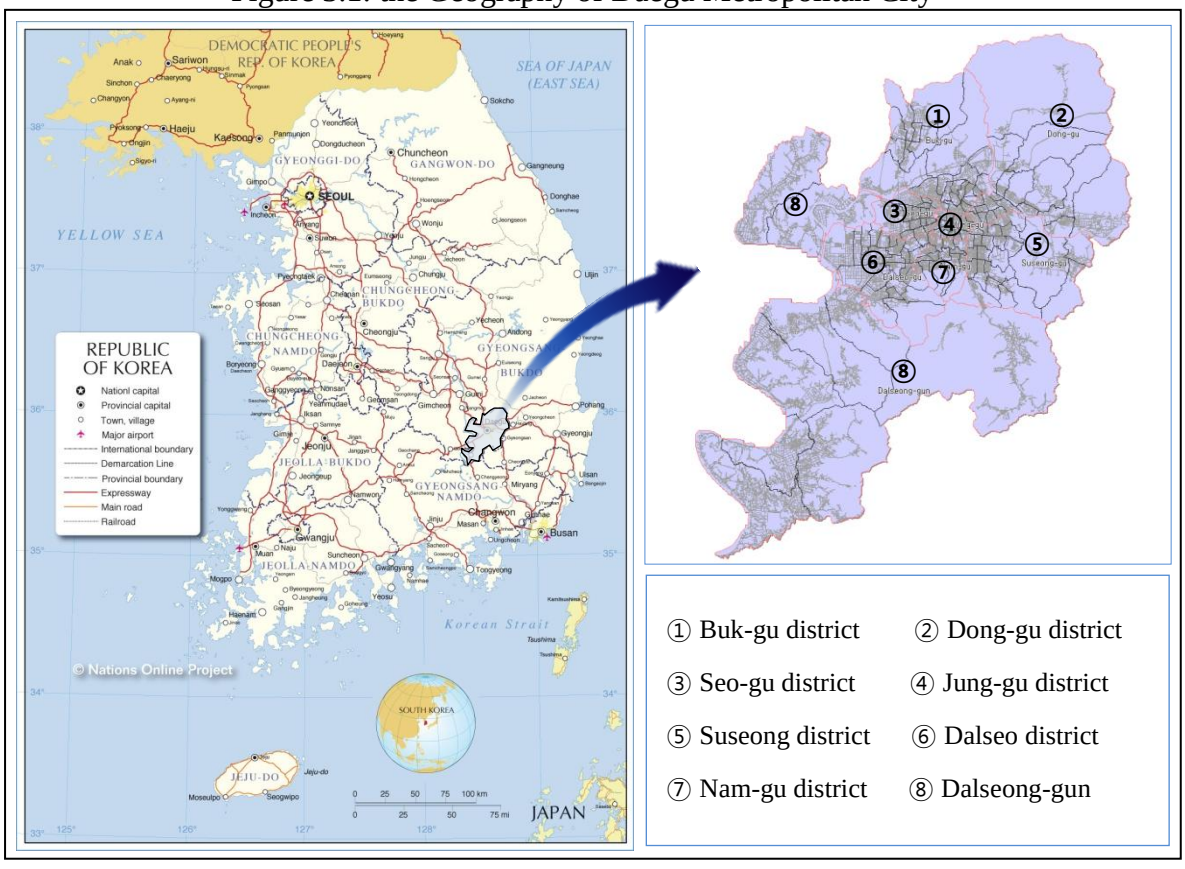
This study, therefore, reflected those lessons to make more rational analyses: First, this study endeavored to employ proper variables. To prevent the coefficient estimates for the school characteristics from being biased and to use more crucial factors in determining condominium prices, diverse types of variables representing inner conditions and outer circumstances of each condominium were appropriately used in this study. Second, for the analysis on the effect of unobservable omitted variables, various analysis techniques were employed to analyze the correlation between housing prices and educational performance properly. Third, because almost all of the domestic researches geographically targeted Seoul Metropolis, this study made an attempt to analyze the case of other region except the capital area and thereby this study also attempted to lay the foundation stone of nationwide analyses on the relationship between education and real estate. Therefore, this study first researches the case of Daegu Metropolitan City.

CHAPTER.3 OVERVIEW OF DISTRICTS IN DAEGU

3.1 Introduction to Daegu Metropolitan City in Korea

Daegu Metropolitan City is located in south-eastern part of Korea. GRDP (Gross Regional Domestics Product) of this city was KRW 32,714 billion at the current prices as of 2008, with holding the proportion of three point two percent of total GRDP in this country, following Seoul, Busan, Incheon and Ulsan in order. Introducing recent socio-economic situation[9] of this city, several factors related to the topic can be introduced: the area of this city is 884.07㎢; population stood at 2,509,187 with 906,470 households as of late 2009; eight districts as shown in Figure 3.1 below.

Figure 3.1: the Geography of Daegu Metropolitan City[10]



[9] Source: the Statistics of Daegu Metropolitan City Hole (http://english.daegu.go.kr/cms/cms.asp?Menu=28), the KOSIS (the Korean Statistical Information Service; http://www.kosis.kr/index/index.jsp)

[10] Source: the One World - Nation Online (http://www.nationsonline.org/oneworld/index.html), the Daegu Life Geographic Service (http://gis.go.kr/multi/index.jsp)

As one of the five largest cities in Korea, 798.47㎢ of total 884.07㎢ area, approximately ninety percent is used for urban area and the rest 85.6㎢ is designated as for rural area. In detail, residential area of 118.99㎢ occupies approximately thirteen percent to total area. Among dwelling patterns, fifty point eight percent of total households in Daegu Metropolitan City was residing in condominiums. Table 3.1 shows the dwelling patterns of this city in 2009.

Table 3.1: the Dwelling Patterns in Daegu Metropolitan City (in household)

	Total	Apartment House				Detached Houses	Non-residential Building
		Semi Total	Condo-miniums	Multiplex Houses	Row Houses		
Number of House	871,127	496,005	442,291	45,983	7,731	363,345	11,777
Composition Ratio (%)	100	56.9	***50.8***	5.2	0.9	41.7	1.4

Source: the Hosing Statistics Almanac of Daegu Metropolitan City, Year 2010

The diffusion ratio of house was 104.4 percent as of December 31, 2009, because the number of house exceeded that of households. The designation of speculation-ridden area in Daegu Metropolitan City, meanwhile, was all lifted as of December 3, 2007, according to the policy revision of current government. Consequently, only three districts in Seoul Metropolis are still designated as speculation-ridden area in Korea. Once, however, all districts in this city were designated as speculation-ridden areas and Suseong district was the last district of which the designation of speculation-ridden area was lifted.

On the other hand, the number of the high school was 91 as of December 31, 2009 and the high-school district in Daegu Metropolitan City is divided into two groups. The first high-school district contains a part of Dalseong-gun, Jung-gu, Dong-gu, Buk-gu and Suseong districts. The other districts belong to the second high-school district. Following Table 3.2, ninety-one high schools were established and are being managed in this city. Dalseo district had the greatest number of public or private high school, followed by Suseong district and Buk-gu district.

Table 3.2: the Number of High School in Daegu Metropolitan City

Districts	Total	Public High School			Private High School		
		Semi Total	Normal	Specialty[11]	Semi Total	Normal	Specialty
Total	91	42	33	9	49	38	11
Jung-gu	5	2	2	-	3	2	1
Dong-gu	10	3	1	2	7	5	2
Seo-gu	5	4	3	1	1	1	-
Nam-gu	8	1	1	-	7	4	3
Buk-gu	15	7	7	-	8	8	-
Suseong district	17	7	6	1	10	8	2
Dalseo district	23	14	10	4	9	7	2
Dalseong-gun	8	4	3	1	4	3	1

Source: the Internet Homepage of the Office of Education of Daegu (http://www.dge.go.kr)

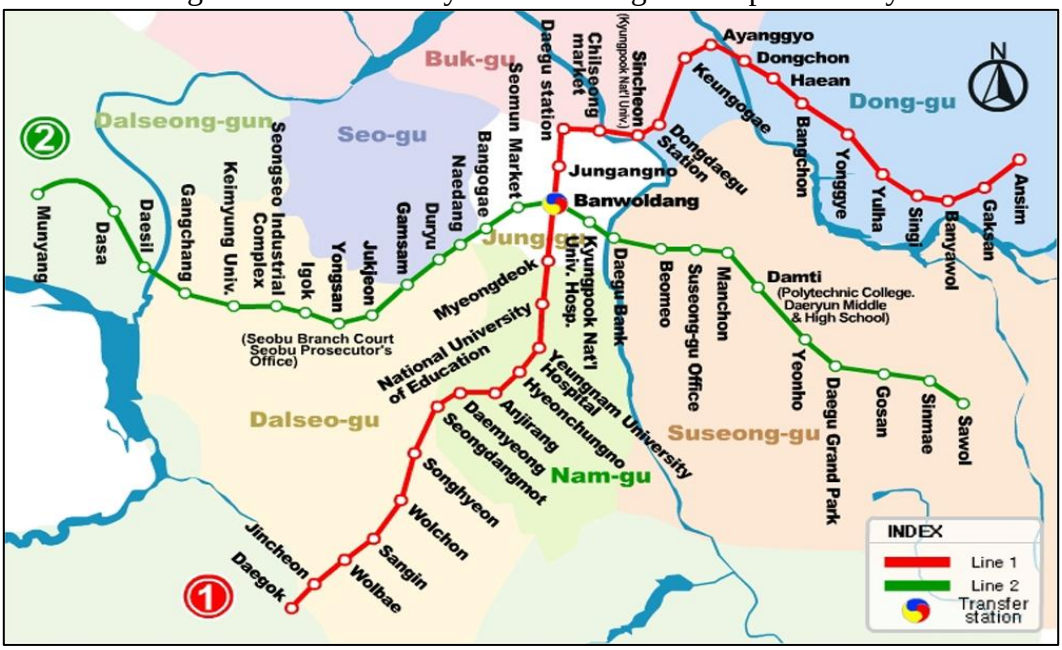
Out of these ninety-one high schools in this city, only sixty-one had sent more than one student to the Seoul University from 2005 to 2009. Among those districts, 465 out of total 966 students admitted to the top-class university in Korea during that time period came from Suseong district, occupying forty-eight percent. Detailed discussion on this academic achievement of high schools is made later in Subchapter 3.2.

Public transportation system, meanwhile, in Daegu Metropolitan City consists of three elements at large: the bus, the subway and the taxi. Among three public transportations, the Daegu citizens highly depend on buses, because only two subway lines are available and the third subway line is under construction. As described in Figure 3.2, the subway line one and two does not run the whole gamut of Daegu Metropolitan City. In the case of the bus, whereas, ninety-bus lines are on service: three rapid lines, two belt lines, fifty-eight trunk lines and twenty-seven branch lines[12]. These buses transport the Daegu citizens stopping at important facilities from district to district so that the bus, unlikely to Seoul Metropolis, is the major means of transportation in this city.

[11] Specialty high schools: technical high schools, commercial high schools, arts high schools and agricultural high schools

[12] Source: the Daegu Metropolitan City Bus Route Guide (http://businfo.daegu.go.kr)

Figure 3.2: the Subway Lines in Daegu Metropolitan City



Source: the Daegu Metropolitan Transit Corporation (http://www.dtro.or.kr)

Furthermore, other factors representing neighborhood condition of a condominium were shown in Table 3.3. The number of city park in Daegu Metropolitan City was 712 with the area of 18,363,000 m^2 and six department stores and seventeen discount stores were on service, occupying total-305,125 m^2 area, as of December 31, 2009. As shown in Table 3.3, Dalseo district turned out to have the greatest number of city park and discount store etc. among eight districts.

Table 3.3: the Number of City Park, Department Store and Discount Store in Daegu

Districts	Number of City Park	Number of Store		
		Semi Total	Department Store	Discount Store
Total	712	23	6	17
Jung-gu	-	3	3	0
Dong-gu	134	2	-	2
Seo-gu	27	2	-	2
Nam-gu	24	1	-	1
Buk-gu	110	6	1	5
Suseong district	117	3	1	2
Dalseo district	169	6	1	5
Dalseong-gun	131	-	-	-

Source: the Daegu Statistical Information (http://www.daegu.go.kr/Statistics/)

The socio-economic status of Daegu Metropolitan City related to the topic has been overviewed in brief. In following subchapters, more specific explanation on such factors, by which represent variables for empirical analyses, and comparisons between districts are made just to help in understanding characteristics of each district.

3.2 Overview of High Schools in Each District

The most crucial factor or variable in this study is said to be the educational performance and, as discussed earlier in Chapter 1 and 2, the number of student who gained admission into the Seoul University and the admission rate to four-year-course colleges were selected as the variable after reviewing precedent researches. These two were used as important explanatory variables in the hedonic model and thereby took a great role in clarifying the hypotheses.

Revisiting, meanwhile, the status of high schools in Daegu Metropolitan City, ninety-one high schools are allocated to each district in response to the education policy of two high-school districts; the first high-school district is for the eastern region and the second one is for the western in this city. Among these districts, Suseong is already well-known for a prestigious high-school district in Daegu Metropolitan City as previously noted. Following news articles[13], sixty-one high schools sent more than one student to the Seoul University during time period of 2005 to 2009 and thirteen high schools out of the sixty-one belonged to Suseong district. More specifically, 465 students out of total 966 successful candidates were from Suseong district at the rate of forty-eight percent, followed by Dalseo and Buk-gu districts. These academic achievements are well explained in Table 3.4 and the number of student admitted into the Seoul University from 2005 to 2009 of sixty-one high schools is minutely tabulated in Appendix 1.

[13] Source: the Dong-A Ilbo (http://news.donga.com/3/all/20090212/8695313/1, http://www.donga.com/news/d_story/society/university/seouluni_enter.html)

Table 3.4: the Number of Student Admitted into the Seoul University from 2005 to 2009 in Each District

District	(%)	Total	Yr 2009	Yr 2008	Yr 2007	Yr 2006	Yr 2005
Total	100	966	141	183	214	210	218
Buk-gu	12	119	22	29	16	23	29
Dong-gu	3	25	5	5	3	4	8
Seo-gu	4	37	5	5	10	6	11
Jung-gu	3	33	4	7	6	12	4
Suseong	***48***	***465***	64	77	114	103	107
Dalseo	20	197	30	43	49	38	37
Nam-gu	9	83	11	14	14	23	21
Dalseong-gun	1	7	-	3	2	1	1

On the other hand, the admission rate to four-year-course colleges of sixty-one high schools assumed a different aspect compared to the case of the Seoul University. Following a public announcement[14] of educational authorities, unlikely to the fact above that high schools in Suseong district sent more students to the Seoul University per annum, admission rate to four-year-course colleges of each district appeared to be relatively analogous to each other. Table 3.5 below shows their situations briefly. In the table, Nam-gu district took the highest rate with sixty-four point seven percent, followed by Suseong district still holding foremost position. Admission rate to four-year-course colleges, meanwhile, of sixty-one high schools are tabulated in Appendix 2 in detail.

Table 3.5: the Average Admission Rate to Four-year-course Colleges of Each District

	Average	Buk-gu	Dong-gu	Seo-gu	Jung-gu	Suseong	Dalseo	Nam-gu	Dalseong-gun
Admission Rate	57.7	55.8	58.8	50.6	***46.1***	64.7	59.7	***65.2***	60.9

Source: http://www.schoolinfo.go.kr/index.jsp

According to those two facts of educational achievement, the general status of high school education in Daegu Metropolitan City can be considered as follows. First, almost

[14] The Korean education authorities provide educational information on from elementary schools to high ones on the internet managed by the institute, the Korea Education & Research Information Service (KERIS).

more than a half of the students enter four-year-course colleges after their graduation. Besides, not only deviation in the admission rate is not wide much, but also Dalseong-gun and Nam-gu districts, in which the prices of condominiums are low, show high admission rate to four-year-course colleges. This signifies that entering a college after graduating a high school is a general tendency nowadays and this fact, seemingly, will not represent a regional characteristic any more. Second, in the case of the number of student who obtained admission to the Seoul University, it showed a regional difference to a great extent. An overwhelming concentration of a socio-economic factor such as the number above, generally speaking, induces secondary social problems. For example, as precedent researches discussed, overheated educational circumstance takes a great part in aggravating perverted prices of real estate in Gangnam district of Seoul Metropolis. Likewise, Suseong district in Daegu Metropolitan City shows such concentration and thereby considerate analysis and measures are preliminarily required to prevent the secondary social problems.

Given that, meanwhile, those two variables, the number of successful candidate into the Seoul University and the admission rate to four-year-course colleges, hold different positions, this phenomenon implies meaningful situations that the relation between education and real estate confront. On the one hand, this would imply that not all high schools, of which lots of students admitted to the Seoul University, sent their students to four-year-course colleges in large numbers, and on the other hand, these two different educational factors would work differently as variables when the analyses are in progress. Therefore, analysis results on the relation between education and real estate with those two factors are anticipated as to come out in different directions: one would have significant impact on the relationship; while the other would not. This analysis results are empirically described with the hedonic pricing model later in Chapter. 4.

3.3 Comparison of Districts in Daegu

3.3.1 Condominium apartments

In this subchapter, to comprehend characteristics of each district relevant to the hypotheses of this study, the status of condominium apartments, public transportation systems and neighborhood conditions was elucidated more specifically. Such being the case, the status of condominium apartment was surveyed first. As mentioned earlier in Subchapter 3.1, the dwelling pattern of condominiums in Daegu Metropolitan City occupied fifty point eight percent of total households, and the status of households residing in condominiums per districts, as of late 2009, were surveyed as shown in Table 3.6. Following the table, when it comes to the number of household, Dalseo district recorded the greatest number, amongst those districts, followed by Suseong and Buk-gu districts sequentially.

Table 3.6: the Status of Condominium Apartment in Daegu

	Total	Jung-gu	Dong-gu	Seo-gu	Nam-gu	Buk-gu	Suseong	Dalseo	Dalseong -gun
Number of Complex	1,538	77	301	117	61	263	308	330	81
Number of Building	5,495	147	922	311	178	1,045	1,124	1,365	403
Number of Household	442,291	9,750	53,929	15,085	12,273	***90,455***	***94,179***	***130,344***	36,276

Source: the Hosing Statistics Almanac of Daegu Metropolitan City, the Year 2010

Furthermore, not only the number of household, but the price of condominiums in three districts, Suseong, Dalseo and Buk-gu, also showed the highest value. Referring to the price data of sixty condominiums, obtained from the Budongsan114 for hedonic analysis later, the price of the most expensive condominium, among sixty, was *KRW* 1,300 *million* as of late 2009. The average price per square meter of this 290-square-meter condominium was KRW 4,310 thousand by which also ranked the top. Not only that, other condominiums in Suseong district also showed high prices compared to those in other districts. These average prices per square meter of sixty condominiums were well arranged in Appendix 5.

Figure 3.3: the Price Change of the Most Expensive Condominiums in Each District from 2005 to 2009

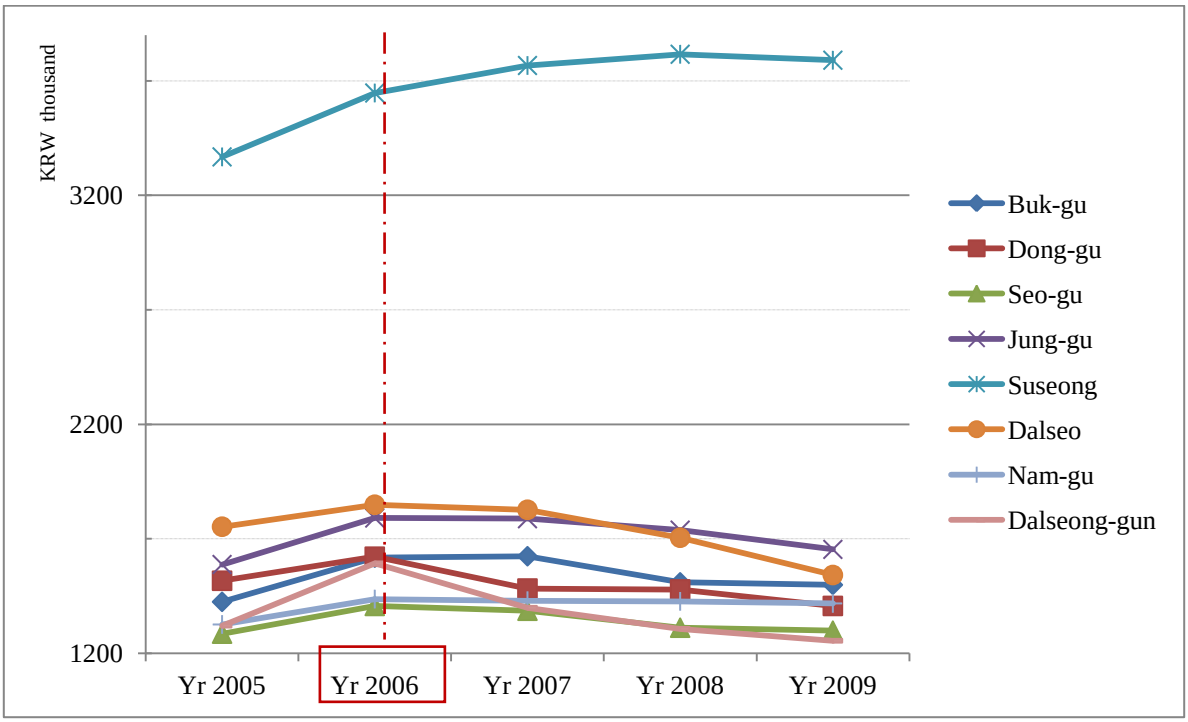


Figure 3.3 above describes the price change of the most expensive condominiums extracted from each district among sixty condominiums during 2005 to 2009. Interestingly, the condominium prices, except the one from Suseong district, had fallen from the year 2006 after slightly rising. This implies two symptoms that the condominium prices of Daegu Metropolitan City were also affected by the *global financial crisis* resulted from subprime mortgage in the U.S. and the condominium from Suseong district, uniquely, did not show the same phenomenon. In addition to that unique phenomenon, the price of the most expensive condominium from Suseong district among sixty was prominently higher than the others. Indeed, it can be said that Suseong district portrays analogous symptoms to that of Gangnam in Seoul Metropolis.

On the other hand, the condominiums in Jung-gu district, in which *the City Hole* and *the downtown* of this city are located, were generally more aged than those of other districts. This attributes to the fact that Jung-gu district, as a central area of this city, was first developed in the past. Relatively, less aged condominiums were located in Suseong, Dalseo

and Buk-gu districts so that this status was deemed to also influence the condominium prices surveyed to some extent. Furthermore, the famous brands of condominium apartments have been constructed currently and are being built recently in Suseong and Dalseo districts. These good-brand condominiums were disregarded in this study because of their less-than-five-year age. In the contrast to that, the number of household in each condominium did not show a certain pattern in accordance with district conditions so that this factor, seemingly, was anticipated less affect the analysis results. The detailed information on the two variables, the age and the number of household, of each condominium is explained in Appendix 4.

3.3.2 Transportation

As noted in Subchapter 3.1, the major means of public transportation in Daegu Metropolitan City is the bus unlikely to the subway in Seoul Metropolis, largely because of still inefficient lines and networks of the subway; the subway line one and two are on service and the third line is under construction. When examining the status of bus runs in this city, the number of bus run was concentrated on Jung-gu district the downtown. This status is tabulated in Appendix 6 in detail. Because Jung-gu district is the central area of this city, much of population moves in and out of this district and thereby it seems that the main public transportation converges to Jung-gu district. Moreover, another interesting fact was detected when the status of bus runs was surveyed. Quite a number of bus lines were designed to stop at the bus stops nearby high schools and consequentially this bus-line design helped students go to school and back home conveniently. Nonetheless, this status of bus runs in this city did not go along with that of the condominium prices. While the number of bus run converged to Jun-gu district, the condominium prices of Suseong district were higher than those of other districts. This relationship between the number of bus run and the condominium prices is explored later in Chapter 4.

Two subway lines, meanwhile, in Daegu Metropolitan City run from south to north and from east to west connecting a district to other districts. Two subway lines intersect each other at Jung-gu district, analogous to the bus runs, and subway stations also converge to this district which the downtown is located in. As the subway line one and two pass only through Dalseo, Jung-gu and Dong-gu districts and Dalseo, Nam-gu, Jung-gu and Suseong districts respectively, Buk-gu, Seo-gu and Dalseong-gun districts do not have the privilege. Following Appendix 7, the number of subway station nearby sixty condominiums, only one subway station was allocated to nearby a condominium in Buk-gu, Seo-gu and Dalseong-gun districts. The subway line one is on service from the year 1998 and the line two has been operating from the year 2005. In the meantime, the definite relationship between the condominium prices and the number of subway station was not detected just at a glance.

3.3.3 Other living conditions

In this study, two variables were occupied to represent living conditions: the number of city park and of department store and large discount store. Revisiting the status of city parks in each district in Table 3.3, the district in which the number of city park was greatest was Dalseo with 169 city parks followed by Dalseong-gun with 131 city parks and Dong-gu with 134 city parks, as of late 2009. Seo-gu, Nam-gu and Jung-gu otherwise held lower positions with twenty-seven, twenty-four and zero city parks respectively. Nevertheless, regarding that a great number of small-size city parks has been built in and outside condominiums for inhabitants' better living environment so that a prospective condominium buyer takes such small-size city parks for granted, this study focused on middle-size city parks of which the area is more than 10,000 square meters and thereafter researched the fact how much these city parks influenced the condominium prices in Daegu Metropolitan City. Among sixty city parks in Appendix 8, six city parks were established nearby a condominium in Dalseo district,

and otherwise eighteen condominiums out of sixty did not have any city park nearby their territory, as of late 2009. More than one city parks, meanwhile, provided convenience to the adjacent condominium residents, located all around in each district. The relationship between the condominium price and the number of middle-size city park is clarified later in Chapter 4.

Table 3.7: the Number of Department Store and Large Discount Store in Each District

Districts	Total	Homeplus	E-mart	Lotte mart	Dpt. Store
Total	23	8	8	1	6
Jung-gu	3	-	-	-	3
Dong-gu	3	1	1	1	-
Seo-gu	2	1	1	-	-
Nam-gu	1	1	-	-	-
Buk-gu	***4***	2	1	-	1
Suseong district	***4***	1	2	-	1
Dalseo district	***6***	2	3	-	1
Dalseong-gun	-	-	-	-	-

In addition to city parks, the number of department store and large discount store was also employed as a variable representing the living conditions. Table 3.7 above shows the status of the stores nearby the sixty condominiums in each district. In this study, because many small- and middle-size discount stores are being operated nearby condominiums so that these stores are regarded as to less affect prospective home buyers' purchasing decisions, large discount stores were employed as the factor. In Jung-gu district where the downtown is located, three department stores were on service with no large discount store and, in Dalseo district, five large discount stores and a department store provided service to their customer ranking the top position amongst districts in this city. The analysis on the relation between two variables, the condominium prices and the number of department store and large discount store, is made later on with the hedonic pricing model.

CHAPTER.4 EMPIRICAL ANALYSIS ON CORRELATION BETWEEN HOUSING PRICES AND EDUCATIONAL PERFORMANCE: A CASE OF DAEGU IN KOREA

Recalling the fact that educational fever in Korea induces not only positive effects but also negative ones, such as the rise of land value biased toward particular zones across the nation, on the Korean society, an economy element such as real estate cannot stand alone without taking other factors such as educational fever etc into consideration. In addition, as the precedent domestic researches, by which reveal such negative effects of educational fever on the economy, only focused on the Seoul Metropolitan Area to date, the analyses interpreting the negative effects of educational fever as a nationwide matter are required.

Accordingly, this study attempted to clarify the fact how such educational factors in Daegu Metropolitan City influenced the prices of condominiums, with the hedonic pricing model, by employing a variety of empirical analysis techniques as follows: 1) the correlation between the average prices per square meter of condominiums, the dependent variable, and other factors, the explanatory variables, as of the year 2009, was explored basically by the OLS regression; 2) besides, this study conducted a five-year time-series analysis based on the time period from 2005 to 2009; 3) and then the dummy-variable regression allowed us to analyze the nonlinear effect of educational performance; 4) lastly, through the panel data analysis, the influence of unobservable omitted variables and the modeling appropriateness of the variables employed in this study were tested.

For those four empirical analysis techniques, this study employed total nine variables of which the composition is one dependent variable and eight explanatory variables. Amongst eight explanatory variables, two variables represent internal discrete characteristics of the targeted condominium complexes and the rest of them are for the external environment of these condominiums.

4.1 Variables for Analysis with Hedonic Pricing Model

Before elucidating the variables, revisiting the equation 2.4, a linear function for the hedonic pricing model is shown as below.

$$p(\boldsymbol{z}) = \beta_0 + \beta_1 z_1 + \beta_2 z_2 + \ldots + \beta_n z_n \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.. \quad (2.4)$$

Where $p(\mathbf{z})$ is the hedonic price as a dependent variable; z_1, z_2, ... z_n are explanatory or independent variables representing each characteristic; and β_1, β_2, ... β_n are coefficients of z_1, z_2, ... z_n or regression parameters being estimated.

In this subchapter, a bundle of more detailed information on these variables is provided one by one and, before doing that, all nine variables for various analysis techniques are tabulated as below.

Table 4.1: the Variables for Empirical Analyses

<table>
<tr><th>Dependent Variable</th><th colspan="3">Explanatory Variables</th></tr>
<tr><td rowspan="8">The average price per square meter of each condominium</td><td>The number of households in each condominium</td><td colspan="2" rowspan="2">Internal-discrete variables of each condominium</td></tr>
<tr><td>The age of each condominium apartment complex</td></tr>
<tr><td>The number of student admitted into the Seoul University</td><td rowspan="2">Education factors</td><td rowspan="6">External-environmental variables</td></tr>
<tr><td>The admission rate to four-year-course colleges</td></tr>
<tr><td>The number of subway station nearby each condominium</td><td rowspan="2">Transportation factors</td></tr>
<tr><td>The number of bus run in the vicinity of each condominium</td></tr>
<tr><td>The number of city park in the vicinity of each condominium</td><td rowspan="2">Factors for living conditions</td></tr>
<tr><td>The number of department store and large discount store nearby each condominium</td></tr>
</table>

4.1.1 Dependent Variable

To decide the dependent variable, representing the hedonic price, $p(\mathbf{z})$, *the average prices (in KRW thousand) per square meter* of sixty condominium apartment complexes in the vicinity of sixty high schools of which more than one student gained admission to the

Seoul University were examined first. In doing so, the condominium apartment complexes aged more than five years as of 2009 were targeted so that the condominiums currently built were not included. Those sixty condominiums were surveyed based on the website, the Daegu Life Geographic Service[15], managed municipally by Daegu Metropolitan Office. With the geographic information of the sixty condominiums, the data for the prices of each condominium from 2005 to 2009 were obtained from the website, the Budongsan114[16], one of the largest real estate information companies in Korea and thereafter the average prices per square meter of sixty condominiums were arranged by processing the data. During this process, as noted previously, the price data of one condominium, located in Dalseong-gun district in which an agriculture-industrial complex was founded on so that condominiums were barely found out, was not obtained, because a bundle of the data for the transacted price of the condominium was not sought in any way. Only the price data of sixty condominium apartment complexes, thus, were employed and processed for the hedonic pricing model as the dependent variable (see Appendix 5). Meanwhile, by numbering in the way of from 1-1 to 8 (district number)-2 (high school or condominium apartment complex number), each high school and condominium apartment complex were processed to be discerned with ease.

Table 4.2: the Number of Condominium Apartment Complex Selected in Each District

District (Number)	Total	Buk-gu (1)	Don-gu (2)	Seo-gu (3)	Jung-gu (4)	Suseong (5)	Dalseo (6)	Nam-gu (7)	Dalseong-gun (8)
The Number	60	11	5	4	5	13	15	5	2

The table above explains the number of condominium apartment complex selected in each district as variables and thereby the numbers means the fact that, for example, eleven high schools in Buk-gu district sent more than one student to the Seoul University during time period from 2005 to 2009.

[15] the Daegu Life Geographic Service (http://gis.go.kr/multi/main/main.jsp?user_menu_id=1&user_lan_id=1&user_lan_suffix=en)

[16] the Budongsan114 (http://www.r114.co.kr/z/apt/asyse/show_pass_open_guide.asp?only=0&m_=37&g_=&solkind=1&pgtype=)

4.1.2 Explanatory variable (1): discrete factors of condominiums

As noted in Subchapter 1.2, based on the rationale from literature review, this study employed discrete factors of condominiums restrictively. Thus, two discrete factors were taken into consideration; the number of household in each sixty condominium and their age were arranged and then processed to fit them to the late analysis techniques (see Appendix 4). Two bundles of the data were gained also from the website, the Budongsan114, and thereafter the age of a condominium was calculated by subtracting the year building completed from every December from 2005 to 2009.

In the case of the number of household in each condominium, they had ranged from 102 to 1,521 amongst sixty ones, not showing a certain pattern according to districts. Put another way, the number of household varied in each district so that small-, middle- and large-sized condominium apartment complexes were uniformly constructed and offering shelter to their habitants. Because this explanatory variable provided the fixed value in spite of time elapse, the number of household in each condominium was applied to the analyses as a fixed value.

Moreover, the age of each condominium apartment complex also indicated the analogous status in accordance with districts, that is, the condominiums currently built and old ones coexisted in each district. Among sixty condominiums, the one constructed most recently was five point three years old and the most aged one was 31.5 years old, as of late 2009.

4.1.3 Explanatory variable (2): educational factors

To reflect well the educational fever in Daegu Metropolitan City, this study used two output-characterized variables: the first one is the number of student admitted to the Seoul University of sixty high schools; as discussed previously, one high school, which sent

four students to the Seoul University during 2005 to 2009 out of sixty-one, was not included because of the absence of the price data of the condominium; the second one is the admission rate to four-year-course colleges of sixty high schools. The first variable is to identify the educational fever for a top-class university in this city and its influence and the second one is to explore whether the plain educational fever affected residential real estate, specifically the prices of condominiums.

When it comes to the first variable, revisiting Table 3.2 and 3.4, thirteen high schools out of total seventeen in Suseong districts sent total 117 students to the Seoul University, occupying the top position. The status of other districts is tabulated as below in Table 4.3. According to the table, it can be said that the high schools in Suseong district showed the best performance in its educational achievement indeed. A cluster of data for the educational achievement, from the newspaper website[17] of the Dong A Ilbo, was arranged and then processed to be applied to the hedonic pricing model (see Appendix 1).

Table 4.3: the Number of High School of which More than One Student Admitted to the Seoul University in Each District

	Total	Buk-gu	Don-gu	Seo-gu	Jung-gu	Suseong	Dalseo	Nam-gu	Dalseong-gun
The Number #1	966	119	25	37	33	***465***	197	83	7
The Number #2	61	11	5	4	5	***13***	15	5	3
The Number #3	91	15	10	5	5	17	23	8	8
(2)÷(3) (%)	67.0	73.3	50.0	80.0	100.0	***76.5***	65.2	62.5	37.5

Where the number #1 is for students who obtained admission into the Seoul University in each district during the time period of 2005 to 2009; the number #2 is for high schools of which one more than one student got admission into the Seoul University in each district during the same time period; and the number #3 is for total high schools in each district.

[17] http://news.donga.com/3/all/20090212/8695313/1
http://www.donga.com/news/d_story/society/university/seouluni_enter.html

In the mean time, the another variable as an educational factor, the admission rate to four-year-course colleges of sixty high schools, was obtained from the website[18] managed by the Korea Education and Research Information Service (KERIS), as mentioned in Subchapter 3.2. This educational information service, unfortunately, started as of the year 2009 so that only one bundle of data for the year 2009 was obtained. Not only that, there was no way to gain the data for the years from 2005 to 2008 and thereby this study was compelled to apply the same value of the admission rate to four-year-course colleges to a time series analysis. Following Table 3.5, meanwhile, high schools in Nam-gu district recorded the highest admission rate among eight districts and this data indicated that the second variable did not go along with the first one as an educational factor (see Appendix 2).

4.1.4 Explanatory variable (3): transportation factors

This study employed two variables as public transportation factors. The subway and the bus are those variables. In the case of the subway, the number of subway station existing nearby condominiums was employed for the first transportation variable and this was from taking notice of a common idea, saying people prefer the condominium located at adjacent area to a subway station. Therefore, all subway stations, within a radius of approximately six-hundred meters of the sixty condominiums, were surveyed based on the website, the Daegu Life Geographic Service. Amongst those sixty condominiums, accurately half of them, thirty condominiums did not have any subway station within ten minutes on foot; the criterion, a radius of approximately six-hundred meters, attributed to the fact that a human being can walk four kilometers for an hour on average so that it takes ten minutes around for people to walk approximately six-hundred meters (see Appendix 7).

Meanwhile, this study endeavored to arrange and process the second transportation

[18] http://www.schoolinfo.go.kr/index.jsp

variable, the number of bus run. This variable was also surveyed on the basis of the website, the Daegu Life Geographic Service, and all bus stops in the vicinity of the sixty condominiums were examined and then a cluster of data was processed as follows: first, this study examined all bus stops within a radius of approximately six-hundred meters of the sixty condominiums and then obtained all bus numbers stop at each stop; second, the intervals of all bus runs were observed from the website, the Daegu Metropolitan City Bus Information, and then the number of bus run was calculated. The way of the calculation is following: Assuming that buses run for fifteen hours a day from seven a.m. to ten p.m., fifteen hours multiplied by sixty minutes equals nine hundreds minutes. Then, dividing the nine hundreds minutes by the interval (in minutes) of each bus, the number of bus run per day can be obtained; third, by totaling up the number of each bus run at a bus stop, the total number of bus run at a bus stop can be gained; lastly, again by adding up the total number of bus run at bus stops in the vicinity of the condominium, the number of bus run for the late empirical analyses was completed eventually. On the other hand, the buses examined in this study ran and stopped at stops from 301 to 2,279 times a day (see Appendix 6).

4.1.5 Explanatory variable (4): factors for living conditions

When it comes to variables for living conditions, two factors were taken into account. The first one is city parks and the other is large stores such as department and discount stores. These two factors are generally referred to as living convenience when moving to other area. In the case of city parks, regarding the recent trend in Daegu Metropolitan City that small-size city parks were built in and adjacently outside residences, this study took city parks of which the area were larger than 10,000 square meters, middle-sized ones, into account. This was just to explore whether middle-size city parks influenced the home buyers' purchasing decisions. Among the sixty condominiums, approximately one

third of condominiums had no middle-size city parks in the vicinity of them and, on the contrary, one condominium had six middle-size city parks. Meanwhile, all middle-size city parks also within ten minutes on foot, a radius of approximately six-hundred meters, from each condominium were counted on the basis of the website, the Daegu Life Geographic Service (see Appendix 8).

Furthermore, the number of department store and large discount store was also employed as a variable for living conditions. This was from taking notice of the fact that multipurpose buildings, to which condominiums and large stores were allocated at the same time, were recently being constructed and people had a preference for such buildings. Four different brands of department stores and four different ones of large discount stores, totally eight brands, were selected and processed as to be an explanatory variable. Meanwhile, unlikely to the cases of subway stations, bus stops and city parks, eight different brands of department stores and large discount stores within a radius of approximately one kilometer from each condominium were all counted also based on the website, the Daegu Life Geographic Service (see Appendix 9). That is because, when going shopping, people usually go such large stores by car and therefore the range people move around gets wider.

4.2 Analysis on Correlation between Housing Prices and Educational Performance

With those variables, this study endeavored to clarify the fact how much educational performance influenced the housing prices in Daegu Metropolitan City. To identify the influence well, as mentioned previously, the hedonic pricing model, specifically the *OLS regression* for its methodology, was used and bundles of data for these analyses were collected, processed and elucidated up to now. On the other hand, the influence of the explanatory variables on the dependent variable, the condominium prices, was first analyzed in this subchapter with the data of the year 2009 and the time series analysis from 2005 to

2009 is provided in the next subchapter. Accordingly, for the OLS regression, the data for statistical program, SPSS, were arranged first and thereafter inputted under the conditions of Table 4. 4.

Table 4.4: the Data Conditions for the SPSS Program

Variable	Title Denominated	Characteristic of Data
The average price per square meter of each condominium apartment complex	Price	Adjusted value for time series
The number of household in each condominium apartment complex	Household	Unchangeable value
The age of each condominium apartment complex	Age	Adjusted value for time series
The number of student admitted to the Seoul University of each high school	Seoul	Adjusted value for time series
The admission rate to four-year-course colleges of each high school	College	Fixed Value
The number of bus run at bus stops nearby each condominium apartment complex	Bus	Fixed Value
The number of subway station nearby each condominium apartment complex	Subway	Adjusted value for time series
The number of city park nearby each condominium apartment complex	Park	Adjusted value for time series
The number of city park nearby each condominium apartment complex	Store	Adjusted value for time series

With the data conditions above, the result of the OLS regression by which indicated the fact how much educational performance influenced the prices of condominiums in Daegu Metropolitan City was obtained as following Table 4.5 and 4.6.

Table 4.5: the Summary Statistics for the Year 2009

Variables	Mean	Std. Dev.	Observations
Price	1,394.55	490.142	N = 60, respectively
Household	648.117	406.596	
Age	15.042	6.702	
Seoul	2.350	2.550	
College	58.510	11.425	
Bus	1,062.000	416.592	
Subway	0.617	0.691	
Park	1.067	1.071	
Store	0.783	0.739	

Table 4.6: the Result of OLS Regression Analysis for the Year 2009 (1)

Variable	Coefficient	t-statistic	P-value
Constant	1,167.81**	3.607	0.001
Household	0.075	0.620	0.583
Age	-13.681*	-1.843	0.071
Seoul	123.952**	5.972	0.000
College	1.548	0.345	0.731
Bus	0.040	0.292	0.771
Subway	72.971	0.915	0.365
Park	-24.813	-0.543	0.589
Store	-75.592	-1.208	0.233

- *N: 60*
- *R-squared*: 0.562
- * Significant at 10 percent level, ** Significant at 5 percent level

As the coefficient value in Table 4.6 shows, only one variable, Seoul, turns out to be statistically significant at five percent level. Accordingly, this study endeavored to explore the bilateral relation between the dependent variable, the condominium price, and only one significant variable, Seoul, so that the regression result was obtained as in the table below.

Table 4.7: the Result of OLS Regression Analysis for the Year 2009 (2)

Variable	Coefficient	t-statistic	P-value
Constant	1,075.611**	17.434	0.000
Seoul	135.719**	7.594	0.000

- *N:* 60
- *R-squared*: 0.499
- *Adj. R-squared*: 0.490
- VIF (Variance Inflation Factor) of Seoul: 1.000
- Std. Deviation of Std. Residual: 0.991
- ** Significant at 5 percent level

Meanwhile, the result of the OLS regression for the year 2009 can be deciphered as follows: 1) among explanatory variables, only the number of student admitted to the Seoul University of each high school (Seoul) is statistically significant, as the significance probability is less than 0.05 (the significance level); 2) as the coefficient of multiple determination (R^2) shows the value of 0.499, approximately 49.9 percent of the variation in the average price per square meter is explained by the number of student admitted to the Seoul University so that this model is statistically significant; 3) in the case of the collinearity

diagnostics, as the VIF (Variance Inflation Factor) is less than seven, 1.000, the significant variable of Seoul has changed under the condition of statistically significance in response to the price; 4) following the result of residual statistics, as the plots in the scatterplot are scattered randomly (not illustrated in this study) and the standard deviation of standardized residual is 0.991, additional explanatory variables are not necessary any longer; 5) lastly, following the value of B (Unstandardized Coefficient), the regression equation, that is, the hedonic price equation for the year 2009, is depicted statistically in Equation 4.1.

$$p(\boldsymbol{z}) = 1{,}075.611 + 135.719\, z_1 \quad \text{(4.1)}$$

Where $p(\mathbf{z})$ is the hedonic price of a condominium in Daegu Metropolitan City as a dependent variable; z_1 is the number of student admitted to the Seoul University as an explanatory variable.

Therefore, the result of the OLS regression for the year 2009 clarifies the fact that, indeed, the educational performance, specifically the number of student admitted into the Seoul University, influenced the housing prices, specifically the prices of condominiums. Not only that, using the Equation 4.1, this study can also identify the fact how much the number of successful candidate to the Seoul University affected the prices of condominiums in the respect of the statistic-economics.

For example, in the Equation 4.1, regarding that "z_1" is the number of student admitted to the Seoul University and "p(z)" is the average price per square meter of condominiums, when a high school in the vicinity of a condominium has one more student admitted to the Seoul University, the price of the condominium rises by KRW 135.719 thousand per square meter. Converting, the area unit, square meter to pyeong[19], the price rise of the condominium is KRW 447.873 thousand per pyeong. That is to say, when it comes to a condominium of which the area is *thirty pyeongs*, almost equals to one hundred square meters,

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[19] Pyeong is the Korean traditional unit for measuring the area, lot sizes of real estate, and the value of 1pyeong is equal to 3.3 square meters.

whenever a high school send one more student to the Seoul University, the price of the condominium goes up by approximately *KRW 13.6 million* in terms of the statistic-economics. On the other hand, another educational variable, the admission rate to four-year-course college turns out not to affect the condominium prices in this OLS regression.

4.3 Time Series Analysis on Change of the Influence

As clarified in the previous subchapter, the educational performance influenced the housing prices, specifically the condominium prices, in Daegu Metropolitan City by the degree of approximately *KRW 13.6 million* per thirty-pyeong condominium in terms of the statistic-economics. In this subchapter, then, how much the influence changed in response to time elapse from 2005 to 2009 was explored.

To explore the change of the influence, four more additional bundles of data for the years from 2005 to 2008 were employed and the details of each datum were identical to that of the data for the year 2009. Moreover, the same program, SPSS, for the multiple regression was applied to the hedonic price analyses. Table 4.8 and 4.9 below show the summary statistics and the results of the OLS regressions respectively.

Table 4.8: the Summary Statistics for the Year from 2005 to 2008

Variable	2005		2006		2007		2008		Obser-vations
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	
Price	1,407.58	490.155	1,509.73	524.502	1,495.57	519.459	1,451.42	518.867	N = 60, respectively
Household	648.117	406.596	648.117	406.596	648.117	406.596	648.117	406.596	
Age	11.040	6.703	12.042	6.702	13.042	6.702	14.042	6.702	
Seoul	3.617	3.805	3.483	4.272	3.550	4.151	3.050	2.819	
College	58.510	11.425	58.510	11.425	58.510	11.425	58.510	11.425	
Bus	1,062.00	416.591	1,062.00	416.591	1,062.00	416.591	1,062.00	416.591	
Subway	0.283	0.585	0.617	0.691	0.617	0.691	0.617	0.691	
Park	1.050	1.080	1.050	1.080	1.050	1.080	1.050	1.080	
Store	0.683	0.651	0.717	0.691	0.783	0.739	0.783	0.739	

Table 4.9: the Results of OLS Regressions for the Year from 2005 to 2008 (1)

Variable	2005		2006		2007		2008	
	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic
Constant	1,004.69**	3.154	1,035.81**	2.933	1,071.94**	3.267	982.16**	2.766
Household	0.088	0.712	0.140	1.035	0.055	0.439	0.143	1.053
Age	-19.348**	-2.265	-10.296	-1.179	-7.472	-0.979	-10.196	-1.186
Seoul	76.885**	5.199	76.114**	5.415	91.768**	6.801	118.37**	5.341
College	1.521	0.332	4.434	0.925	2.916	0.648	2.329	0.469
Bus	0.154	1.310	0.003	0.022	0.014	0.097	0.118	0.785
Subway	28.899	0.332	64.937	0.735	3.435	0.042	2.473	0.028
Park	33.960	0.728	-9.008	-0.179	-69.101	-1.474	-71.303	-1.397
Store	-22.103	-0.288	-72.053	-0.970	57.551	0.848	-37.325	-0.534
**Significant at 5 percent level	▫ *N*: 60 ▫ *R-squared*: 0.535 ▫ *Adj. R*^{2}: 0.462		▫ *N*: 60 ▫ *R-squared*: 0.525 ▫ *Adj. R*^{2}: 0.450		▫ *N*: 60 ▫ *R-squared*: 0.585 ▫ *Adj. R*^{2}: 0.520		▫ *N*: 60 ▫ *R-squared*: 0.520 ▫ *Adj. R*^{2}: 0.444	

Like the result for the year 2009, as the coefficient value in the table above shows, Seoul turns out to be statistically significant at five percent level for all the years while Age is significant only once for the year 2005. This study, thus, endeavored to explore the relation only between the dependent variable and two significant variables again and thereby obtained the OLS regression results as below.

Table 4.10: the Results of OLS Regressions for the Year from 2005 to 2008 (2)

Variable	2005		2006		2007		2008	
	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic
Constant	1,330.44**	12.258	1,215.63**	18.940	1,166.78**	19.428	1,070.01**	14.583
Seoul	78.002**	6.312	84.432**	7.215	92.615**	8.383	125.033**	7.050
Age	-18.568**	-2.647	-	-	-	-	-	-
**Significant at 5 percent level	▫ *N*: 60 ▫ *R-squared*: 0.509 ▫ *Adj. R*^{2}: 0.492 ▫ VIF of Seoul: 1.07 ▫ Std. Deviation of Std. Residual: 0.983		▫ *N*: 60 ▫ *R-squared*: 0.473 ▫ *Adj. R*^{2}: 0.464 ▫ VIF of Seoul: 1.00 ▫ Std. Deviation of Std. Residual: 0.991		▫ *N*: 60 ▫ *R-squared*: 0.548 ▫ *Adj. R*^{2}: 0.540 ▫ VIF of Seoul: 1.00 ▫ Std. Deviation of Std. Residual: 0.991		▫ *N*: 60 ▫ *R-squared*: 0.461 ▫ *Adj. R*^{2}: 0.452 ▫ VIF of Seoul: 1.00 ▫ Std. Deviation of Std. Residual: 0.991	

Deciphering the results of OLS regressions: first, the variable, the number of student admitted to the Seoul University (Seoul), is also included in all cases, as the value of t-statistic is greater than 1.96, while in the year 2005 one more variable, the age of each condominium (Age), is contained; second, those models are all statistically significant, because all coefficients of multiple determination (R^2) show the value of from 0.452 to 0.540;

third, the value of all VIFs (Variance Inflation Factors) are almost 1.00, less than seven, so that the significant variable of Seoul has changed under the condition of statistically significant in response to the price change, when the collinearity test is conducted; fourth, following the result of residual statistics, as the plots in all scatterplot diagrams are scattered randomly (not illustrated in this study) and the standard deviation of standardized residual are 0.983 or 0.991, no more additional explanatory variables are necessary.

On the other hand, the value of B (unstandardized coefficient), by which indicates the magnitude of the influence of the educational performance on the condominium prices, has changed. Illustrating the magnitude of each annual influence with equations before pursuing time series analysis, each annual hedonic price equation contains different "B" value and the constant as follows; Equation 4.2 for the year 2005, Equation 4.3 for 2006, Equation 4.4 for 2007, Equation 4.5 for 2008 and, as illustrated previously, Equation 4.1 for 2009.

$$p(\boldsymbol{z}) = 1{,}330.44 + 78.002\, z_1 - 18.568\, z_2 \quad \text{(4.2)}$$

$$p(\boldsymbol{z}) = 1{,}215.63 + 84.432\, z_1 \quad \text{(4.3)}$$

$$p(\boldsymbol{z}) = 1{,}166.78 + 92.615\, z_1 \quad \text{(4.4)}$$

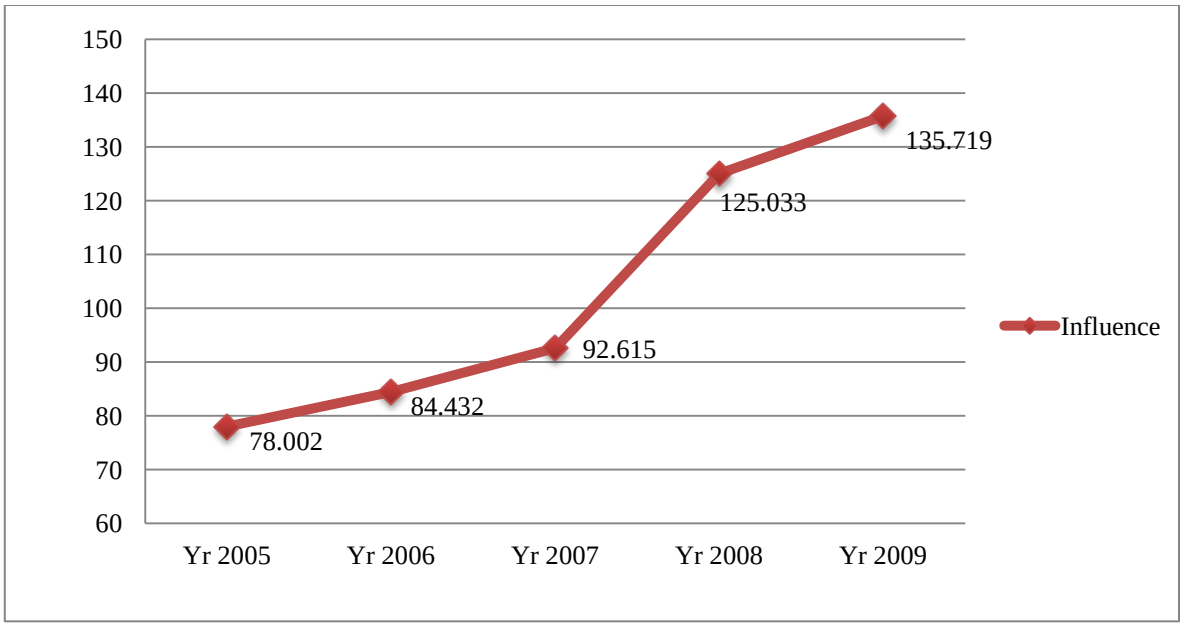
$$p(\boldsymbol{z}) = 1{,}070.01 + 125.033\, z_1 \quad \text{(4.5)}$$

$$p(\boldsymbol{z}) = 1{,}075.61 + 135.719\, z_1 \quad \text{(4.1)}$$

Where $p(\mathbf{z})$ is the hedonic price of condominiums in Daegu Metropolitan City as a dependent variable; z_1 is the number of student admitted to the Seoul University as an explanatory variable; z_2 is the age of a condominium also as an explanatory variable.

Following the hedonic price equations above, the influence of the number of student admitted to the Seoul University, a statistically significant explanatory variable, on the average price per square meter of the condominium, the dependent variable, has changed, because unstandardized coefficient (B) in each equation shows different values. The change of the influence can be depicted with a diagram as shown in Figure 4.1.

Figure 4.1: the Change of Correlation between Housing Prices and Educational Performance from 2005 to 2009



The line in the diagram above, meanwhile, shows a little bit steep rise in response to time elapse. On average, the influence of the number of student admitted to the Seoul University in a high school on the average price per square meter of a condominium in Daegu Metropolitan City has risen by the degree of approximately 18.5 percent per annum from 2005 to 2009. The steepest rise occurs in the time period from 2007 to 2008 by thirty-five percent. This diagram indicates the fact that, in terms of the statistic-economics, when a high school send one more student to the Seoul University, the price of an adjacent condominium goes up by approximately *KRW 7.8 million* in the year 2005. On the contrary, the price of the condominium rise by approximately *KRW 13.6 million* in the year 2009, if the lot size of the condominium is thirty pyeongs (approximately one hundred square meters).

In other words, the magnitude of the influence of the educational performance in Daegu Metropolitan City on housing prices has risen by average 18.5 percent per annum for the past five years from 2005 to 2009 statistically. This result differs from the case of Seoul Metropolis; as discussed in Subchapter 2.2, a newspaper article[20] announced that the

[20] Source: the Chosun Ilbo (http://news.chosun.com/site/data/html_dir/2011/05/16/2011051600186.html)

influence of the score of CSAT (college scholastic ability test) on the condominium prices has currently declined by forty percent.

On the other hand, another explanatory variable representing the internal status of a discrete condominium, the age of the condominiums, is once included as a statistically significant one only in the analysis of the year 2005 and thereafter this variable turns out not to be significant any longer from the year 2006.

4.4 Analysis on Nonlinear Effect of Educational Performance

In previous Subchapter 4.2 and 4.3, this study explored and clarified the fact that educational performance in Daegu Metropolitan City influenced the condominium prices. The influence, nevertheless, was statistically analyzed by the OLS regression, thus it can be said that only the *linear correlation* between the educational performance and the condominium prices was identified. Therefore, as the influence of the educational performance was verified to affect the price of condominiums in Daegu, a further regression analysis was performed to clarify how the influence changed in accordance with the level of the number of student admitted to the Seoul University. Put another way, through the analysis on the *nonlinear relationship*, this study attempted to verify the *education premium* on the condominium prices.

For this analysis, the *dummy-variable regression* was employed as its methodology and thereby this study researched how the correlation changed within the statistically significant variable, Seoul. Specifically, by using only the Seoul variable and then examining how much the condominium prices increased when the number of student admitted to the Seoul University also increased, the nonlinear effect of the educational performance was explored as follows.

Table 4.11: the Mean Value of the Variable, Seoul

Year	Seoul		Observation
	Mean	Standard Deviation	
2005	3.62	3.805	60
2006	3.48	4.272	60
2007	3.55	4.151	60
2008	3.05	2.819	60
2009	2.35	2.550	60

Note: The unit of mean value is person.

Table 4.11 shows the mean value of the Seoul variable. From those values, the average mean value of Seoul for a five-year time period is deduced so that a high school in this city sent around three students, on average, to the Seoul University per annum.

Therefore, this study classified the mean value of Seoul into three groups; less than three persons (almost same as the average value, 3.21), from four to six persons (almost doubled value of the average) and more than seven persons. Such being the case, in conducting the empirical analysis, the three groups were converted to *the indicator variables or dummy variables* by being coded as in Table 4.12.

Table 4.12: Coding Dummy Variables

	D_1Seoul	D_2Seoul
1st Group: less than 3 persons	0	0
2nd Group: 4 ~ 6 persons	1	0
3rd Group: More than 7 persons	0	1

Note: The 1st group is the *reference group* in the dummy-variable regression.

Following the classification and coding above, empirical analyses result for time period of 2005 to 2009 were obtained one by one, by regressing these dummy variables and the dependent variable. The summary statistics and the regression results for each year are shown in Table 4.13 and 4.14 respectively.

Table 4.13: the Summary Statistics of Dummy-variable Regression

Year	Constant		D1Seoul		D2Seoul		Observation
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	
2005	1,407.58	490.15	0.167	0.376	0.217	0.415	N=60, respectively
2006	1,509.73	524.50	0.167	0.376	0.150	0.360	
2007	1,495.57	519.46	0.150	0.360	0.183	0.390	
2008	1,415.42	518.87	0.200	0.404	0.117	0.324	
2009	1,394.55	490.14	0.117	0.324	0.067	0.252	

Table 4.14: the Results of Dummy-variable Regression (1)

Year	Constant		D1Seoul		D2Seoul		R^2
	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic	
2005	1,225.68**	20.778	20.824	0.163	823.555**	7.119	0.482
2006	1,322.22**	21.934	203.68	1.496	1,023.78**	7.205	0.477
2007	1,300.28**	22.140	124.73	0.910	963.180**	7.617	0.506
2008	1,295.56**	19.707	207.52	1.502	980.153**	5.694	0.364
2009	1,286.55**	25.153	147.74	1.021	1,361.45**	7.312	0.484

Note: ** Significant at 5% level

Following the results, as the values of t-statistic of D1Seoul in each year are less than 1.96, D1Seoul is said to be statistically insignificant. Therefore, this study conducted the regression analysis again, under different conditions; excluding statistically insignificant dummy variable of D1Seoul. The analysis result is shown in the table below.

Table 4.15: the Results of Dummy-variable Regression (2)

Year	Constant		D2Seoul		R^2	Variance Inflation Factor (VIF)[21]
	Coefficient	t-statistic	Coefficient	t-statistic		
2005	1,230.11**	23.702	819.124**	7.347	0.482	1.000
2006	1,362.84**	24.937	983.843**	6.976	0.456	1.000
2007	1,323.18**	24.974	940.271**	7.599	0.499	1.000
2008	1,342.55**	22.972	933.167**	5.454	0.339	1.000
2009	1,305.02**	27.266	1,342.98**	7.245	0.475	1.000

Note: ** Significant at 5% level

With the regression results and the basic form of the hedonic price in Equation 4.6, the hedonic price ($p(z)$) equation for each year could be drawn out as below.

$$p(z) = \beta_0 + \beta_1 D_1 + \beta_2 D_2 \quad \text{..... (4.6)}$$

$$p(z) = 1{,}230.11 + 819.124\ D_2\text{Seoul} \quad \text{..... (4.7)}$$

$$p(z) = 1{,}362.84 + 983.843\ D_2\text{Seoul} \quad \text{..... (4.8)}$$

$$p(z) = 1{,}323.18 + 940.271\ D_2\text{Seoul} \quad \text{..... (4.9)}$$

$$p(z) = 1{,}342.55 + 933.167\ D_2\text{Seoul} \quad \text{..... (4.10)}$$

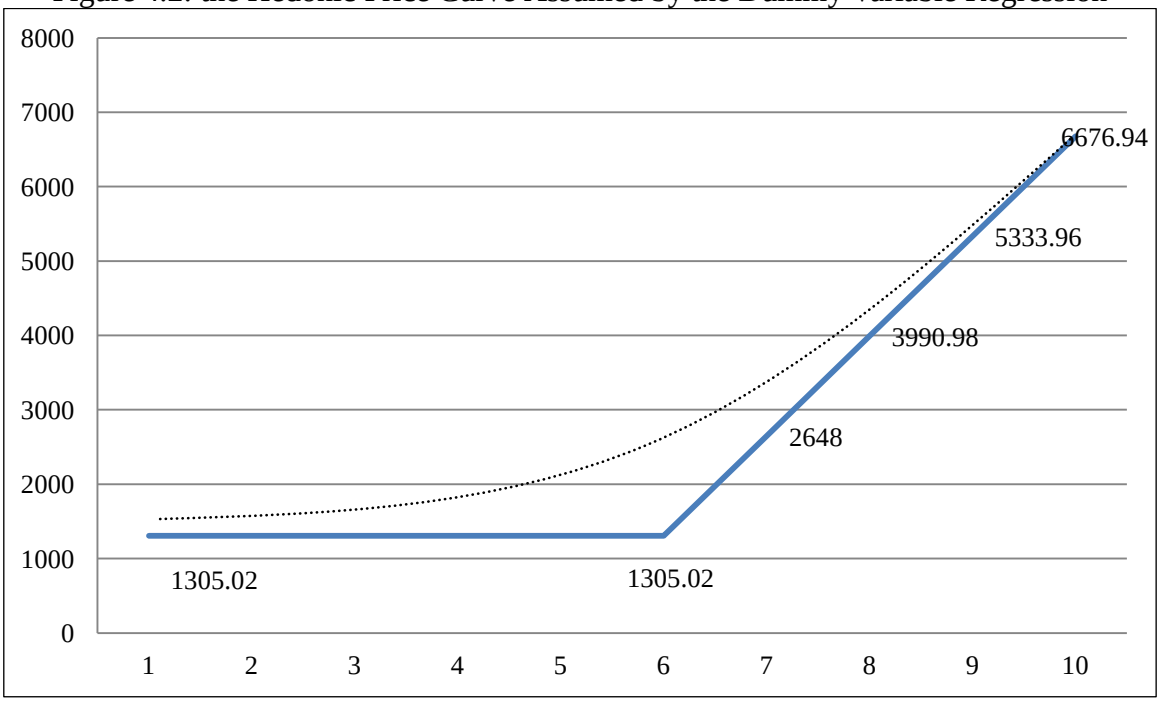
$$p(z) = 1{,}305.02 + 1{,}342.98\ D_2\text{Seoul} \quad \text{..... (4.11)}$$

[21] In the case of the collinearity diagnostics, as the VIF is less than seven, 1.000, the variable of Seoul is said to change under the statistically significant condition in response to the price.

Equation 4.7 is the hedonic price equation for the year 2005, Equation 4.8 is for the year 2006 and Equation 4.11 is for the year 2009 sequentially. When observing these equations, the coefficients of the dummy variables change irregularly and therefore it can be said that the influence of the third group in which a high school sends more than seven students to the Seoul University does not have a certain change pattern. Otherwise, this study could confirm the existence of so-called the *education premium* on real estate in Daegu Metropolitan City by the hedonic price equations of the dummy-variable regression.

Out of those equations, drawing a diagram for the equation of the year 2009, the nonlinear effect of the educational performance is assumed as in Figure 4.2.

Figure 4.2: the Hedonic Price Curve Assumed by the Dummy-variable Regression



Where the value of Y-axis represents the hedonic price; the value of X-axis is the number of student who gained the admission into the Seoul University; the dotted line is the assumption of the nonlinear relationship between Y-axis value and X-axis value.

Deciphering the equations and the figure above, meanwhile, when a high school in Daegu has one more student admitted into the Seoul University and if the student belongs to the third group; the high school has more than seven students who obtained the admission to

the Seoul University, the hedonic price of the adjacent condominium goes up by *KRW 1,343 million per thirty pyeongs* (one hundred square meters), statistically. On the contrary, if the student does not belong to the third group, the price of adjacent condominium is statistically *KRW 130.5 million per thirty pyeongs*, as of 2009.

Therefore, this analysis result eventually implies two facts: first, the educational performance in this city influences the condominium prices with different magnitude in accordance with the number of successful candidates, that is, the nonlinear correlation between the condominium prices and the educational performance exists as the education premium; second, if a student admitted into the Seoul University belongs to the third group in which the high school has more than seven successful candidates per annum, the magnitude of the influence, the condominium prices, gets almost doubled. And most of the high schools in the Suseong district are included in the third group.

4.5 Panel Data Analysis on the Correlation

To enhance the profundity of this study and thereby to realistically understand the influence of educational performance on housing prices in Daegu Metropolitan City, this study conducted the *panel data analysis*, an *econometric* one. More specifically, as the panel data, also known as *cross-sectional time-series* or *longitudinal* data, is a dataset identifying how the entities behave in an analysis model across time, this study endeavored to control for *unobservable omitted variables* and their *individual heterogeneity* with the panel data analysis.

Choi (2008) maintained that the most substantial reason to conduct the panel data analysis is necessarily to draw out the optimal modeling result by econometrically addressing these unobservable omitted variables properly. That is to say, in an empirical analysis, as the analysis model in which individual characteristics of diverse variables are reflected is

required, it is inevitable to statistically take uncontrolled variables into account (Choi 2008; Hausman and Taylor 1981). In this sense, the panel data analysis is deemed to be the most ideal analysis model in empirical analyses.

Moreover, Baltagi (2008, 6) and Haiso (2003) tell us, "several benefits from using panel data are in the following: 1) As time-series and cross-section studies not controlling the heterogeneity run the risk of obtaining biased results, the panel data analysis is necessary to control for *individual heterogeneity*; 2) Panel data give *more informative data, more variability, less collinearity among the variables, more degrees of freedom and more efficiency*; 3) Panel data are better able to study the *dynamics of adjustment*. That is, the panel data analysis helps a study in detecting a multitude of changes hidden in relatively stable cross-sectional distributions; 4) Panel data are better able to *identify and measure effects that are simply not detectable in pure cross-section or pure time-series data*; 5) Panel data models allow us to *construct and test more complicated behavioral models than purely cross-section or time-series data*; 6) *Biases resulting from aggregation over firms or individuals may be reduced or eliminated*, and etc."

As noted previously in Chapter 2, meanwhile, the hedonic price is conceptually a characteristic price or an implicit price so that a hedonic price model should take as many relevant variables as possible into account to better reflect characteristics of a real estate. By doing so, a model can reduce the risk of the effect by unobservable variables and thereby can control the price biased to a particular variable. In other words, an optimal hedonic price model for a real estate can be derived from counting and then reflecting as many variables deemed to represent the characteristics of the real estate and to influence the hedonic price as possible. In this context, the panel data analysis seems to provide a fine solution, alternative or methodology for the hedonic pricing model.

This study, therefore, attempted to better control the effect of unobservable omitted

variables on the condominium prices and thereby to obtain a more econometrically effective analysis model with the panel data analysis.

4.5.1 Fundamentals of the panel data analysis

When the panel data analysis is employed in a study, it is basically categorized into two technical models: The *fixed-effects model* and the *random-effects model* are generally referred to as typical models[22]. The fundamentals of these two models can be described in the form of an equation as follows.

$$y_{it} = (\alpha + u_{it}) + \beta_i X_{it} + \varepsilon_{it} \quad \cdots\cdots (4.12)$$

Where y_{it} is the dependent variable of entity *i* at time *t*, the hedonic price in this study; β_i represents the coefficient for one independent variable X_{it}; and ε_{it} is the error term; the term (α+u_{it}) differs in response to the models.

On the one hand, if it is the fixed-effects model, the term (α+u_{it}) is regarded as a *parameter to be estimated*, on the other hand, if it is the random-effects model, the term is regarded as a *random variable*. This is the decisive difference of the two technical models in its notion. That is to say, as the fixed-effects model assumes that: first, the term (α+u_{it}), a parameter, for each panel entity is different from each other and fixed, while β_i, the coefficient for one explanatory variable, is identical to all panel entities in which the individual characteristics of its own are contained; second, those characteristics are time-invariant and unique to the entities so that they should not be correlated with other characteristics, the fixed-effects model, consequently, explores the relationship between explanatory variables and a dependent variable within an entity.

In the mean time, the random-effects model has different assumptions, when compared to the fixed-effects one, as follows: first, the variations across entities are random

[22] In addition to two models, between-effects model, first-difference model, dynamic panel model and etc. are used for panel data analyses.

and uncorrelated with the explanatory variables so that u_{it} in this model represents a between-entity error, while ε_{it} is a within-entity error; second, the error term is not correlated with the explanatory variables of which the characteristic is time-invariant. The random-effects model, thus, is employed if the differences across entities seem to influence the dependent variable.

Such being the case, as explained just above, a study should decide more effective model between the two technical ones, while analyzing a panel data. The model decision, fortunately, between the fixed-effects model and the random-effects model can be made simply by running the *Hausman test*. The null hypothesis, H_0, and antihypothesis of this test are described in Equation 4.13 and 4.14 respectively.

$$H_0: cov\ (X_{it}, u_{it}) = 0 \quad \ldots\ldots (4.13)$$

$$H_1: cov\ (X_{it}, u_{it}) \neq 0 \quad \ldots\ldots (4.14)$$

This basically tests the correlation between the explanatory variables, X_{it}, and the errors, u_{it}. In doing so, if the null hypothesis is accepted so that the explanatory variables are correlated with the errors, the random-effects model is consequently more efficient as an analysis model.

4.5.2 Panel data analysis on the influence

To conduct the econometric analysis of panel data on the influence of educational performance on the condominium prices in this city, bundles of data were first rearranged to fit themselves to the analysis as shown in Table 4.16.

In the panel data of the table below, each entity is allocated to the first row from the left, then the dependent variable and the explanatory variables occupy the second row and from the third row to the right respectively. Besides, the entities are placed in each line from the top, in chronological order, entity by entity.

Table 4.16: the Data Form of the Panel Data Analysis

Complex	Year	Price	Household	Age	Seoul	College	Bus	Subway	Park	Store
1	2005	859	892	12	3	56.8	301	0	2	1
1	2006	931	892	13	2	56.8	301	0	2	1
1	2007	935	892	14	1	56.8	301	0	2	1
1	2008	908	892	15	3	56.8	301	0	2	1
1	2009	917	892	16	0	56.8	301	0	2	1
2	2005	1,088	720	10.1	2	58.6	599	0	1	1
...	...	...	...	...	...	...	...	...	...	...
2	2009	1,117	720	14.1	3	58.6	599	0	1	1
...	...	...	...	...	...	...	...	...	...	...

After the panel data were arranged as above, and following the purpose of the panel data analysis of this study, several models and tests were performed with the analysis program *STATA 10.1* to better control the effect of unobservable omitted variables on the condominium prices and thereby to obtain a more econometrically effective analysis model as in the following: 1) this study basically examined summary statistics such as mean values and standard deviations of the variables; 2) to clarify a change in the coefficient of the variables in accordance with analysis models, the *pooled OLS regression* was conducted first; 3) and then the variables were regressed by the fixed-effects model; 4) after that, this study regressed them by the random-effects model; 5) as noted previously, and to decide a more effective model, the Hausman test was employed; 6) by the result of the *Breusch-Pagan Lagrangian Multiplier Test*[23], the model, more appropriate to analyze the panel data, between the pooled OLS regression and the random-effects model was tested. Accordingly, this study examined the summary statistics of the panel data first and the result is shown in Table 4.17.

Table 4.17: the Summary Statistics of the Panel Data

Variables	Mean	Std. Dev.	Observations
Price	1451.77	507.5182	N = 300 (n = 60, T = 5), respectively
Household	648.1167	403.8671	
Age	13.04133	6.8062	
Seoul	3.21	3.596621	
College	58.51	11.34864	
Bus	1062	413.7957	
Subway	0.55	0.679981	
Park	1.053333	1.071283	
Store	0.75	0.708878	

[23] A basic hypothesis of the pooled OLS is "H_0: $var(u_i)=\sigma_u^2=0$"; the variance of an error term should not change according to panel entities and over time. If this test rejects H_0, the RE model becomes a more effective one.

After examining the summary statistics, the first analysis for the panel data, the pooled OLS regression, was employed just to clarify the influence of each variable.

Table 4.18: the Result of the Pooled OLS Regression

Variable	Coefficient	t-statistic	P-value
Household	0.09277*	1.67	0.097
Age	-12.4153**	-3.67	0.000
Seoul	85.5082**	12.73	0.000
College	3.47606*	1.72	0.086
Bus	0.06601	1.11	0.266
Subway	44.4301	1.28	0.202
Park	-24.5518	-1.18	0.239
Store	-31.4965	-1.04	0.299
Constant	1030.63**	7.07	0.000

- *N: 300*
- *R-squared*: 0.5105
- *Adj. R-squared*: 0.4971
- * Significant at 10 percent level, ** Significant at 5 percent level

Following the pooled OLS result, two variables, Age and Seoul, and the constant turn out to be statistically significant. This analysis result is analogous to that of the year 2005 in Subchapter 4.3. The analysis for 2005, whereas, was done by the OLS regression.

The table below shows the result of the second regression analysis, the fixed-effects model. In this model, to explore the unobservable omitted variables on the condominium prices, the *within regression* was employed as a methodology.

Table 4.19: the Within Regression Result of the Fixed-Effects Model

Variable	Coefficient	t-statistic	P-value
Household	-0.000855	-0.02	0.988
Age	-16.91029**	-5.24	0.000
Seoul	27.80789**	5.04	0.000
College	3.560468	1.59	0.114
Bus	0.235236**	3.74	0.000
Subway	34.14458	1.24	0.216
Park	2.477327	0.10	0.920
Store	-37.43887	-1.45	0.148
Constant	1132.14**	7.44	0.000

- *N: 300*
- *R-squared*: 0.3977
- *sigma_u*: 370.35962, *sigma_e*: 199.27572, *rho*[24]: 0.77548919
- *F test that all u_i*=0: F(59, 262) = 12.16, Prob>F=0.000
- ** Significant at 5 percent level

[24] "*rho*" is the fraction of variance due to u_i: the portion of u_i to whole error term. And it can be described in the form of a equation as follows: $\rho = \frac{\sigma_u^2}{(\sigma_u^2 + \sigma_e^2)}$

Interestingly, the variable, Bus: the number of bus runs nearby each condominium, is included as a statistically significant one with Age and Seoul, but the influence is not so high, because the coefficient has the value of 0.24. In the mean time, when compared to the result of the pooled OLS regression, the coefficient of Seoul decreases from 85.51 to 27.81, while the constant increases from 1030.63 to 1132.14. This fragmentally implies the fact that the condominium price is influenced by the unobservable omitted variables a little bit. On the other hand, as the rho (ρ) value, by which means the fact that the time-invariant characteristics of the panel entities should be substantially considered as the rho value is close to 1.0, shows 0.78. This is, the error term u_i, time-invariant characteristics of the panel entities, is necessarily taken into account in this model. Following the result of the *F test*, moreover, as the probability of the test is 0.000 so that the hypothesis (H_0: u_i=0 to all i) of the OLS regression is rejected, it reveals the fact that the fixed-effects model is more effective one than the pooled OLS regression.

Meanwhile, the other panel data analysis model in this study, the random-effects model, presented a different result. The result is shown in Table 4.20 as below.

Table 4.20: the GLS Regression Result of the Random-Effects Model

Variable	Coefficient	z-statistic	P-value
Household	0.0239702	0.45	0.655
Age	-16.95221**	-5.49	0.000
Seoul	39.745**	7.22	0.000
College	4.372321**	2.12	0.034
Bus	0.1911835**	3.26	0.001
Subway	35.24949	1.27	0.203
Park	-4.968583	-0.22	0.822
Store	-40.95865	-1.60	0.109
Constant	1087.437**	7.40	0.000

- *N: 300* - *R-squared*: 0.4555
- *sigma_u*: 265.83201, *sigma_e*: 199.27572, *rho*: 0.64022719
- *corr(u_i, X)* = 0 (assumed)[25]
- *theta*[26]= 0.68214156
- ** Significant at 5 percent level

[25] When the estimator of the random-effects model is the consistent estimator, it becomes more effective than the estimator of the fixed-effects model. To be so, the assumption, corr(u_i, X)=0, is required.

[26] If the value of *theta* (θ) is zero, the pooled OLS can be employed, because σ_u^2 is zero (0). Otherwise, if the value of θ is one (1), that is σ_e^2 is zero (0), the within regression is employed. This can be shown as below;

$$\theta = 1 - \sqrt{\frac{\sigma_e^2}{T_i\sigma_u^2+\sigma_e^2}}$$

Unlike the previous case, this time, the variable, College: the admission rate to four-year-course colleges, is included as a statistically significant one with the magnitude, not much high, of 4.37. The variables, Age, Seoul and Bus remain also significant in the random-effects model. The coefficient value of Seoul slightly increases from the previous value of 27.81 to 39.75 while the constant value slightly goes down from 1132.14 to 1087.44. On the other hand, as explained just previously, time-invariant characteristics of the panel entities should be addressed considerably in this model, because the rho (ρ) has the value of 0.64. The value of the *theta* (θ) by which indicates the significance of the error term u_i is 0.68 as shown in the table above. This implies the fact that a model should reflect the between-entity heterogeneity so that the pooled OLS regression cannot be employed as an analysis model.

As the within regression of the fixed-effects model and the GLS regression of the random-effects model are completed, the model appropriateness was tested and thereby the more effective model was determined by running the Hausman test.

Figure 4.3: the Result of the Hausman Test

```
. hausman FE RE

                ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |       FE           RE         Difference          S.E.
-------------+------------------------------------------------------------
   household |   -.0008547     .0239702       -.0248248        .0173859
         age |   -16.91029    -16.95221        .0419261        .9325996
       seoul |    27.80789       39.745       -11.93711        .2918292
     college |    3.560468     4.372321       -.8118533        .8913968
         bus |    .2352356     .1911835        .0440521        .0227498
      subway |    34.14458     35.24949       -1.104905               .
        park |    2.477327    -4.968583         7.44591        10.69044
       store |   -37.43887    -40.95865        3.519787        3.347608
------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(8) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =       11.45
                Prob>chi2 =      0.1775
                (V_b-V_B is not positive definite)
```

The figure above is the result of the Hausman test by the STATA program. As shown in the figure and noted previously, the null hypothesis of the test is: *cov* (X_{it}, u_{it}) = 0. Put another way, as the inference for the error term, u_i, is the primary criterion to determine

the model, if the covariance between X_{it} and u_{it} is zero (0) so that the systemic difference does not exist, the random-effects model becomes more effective one. In this test, the hypothesis is accepted, because the p-value is 0.18. Therefore, in this study, the random-effects model is said to be the more effective one for the panel data.

Lastly, another test, the Breusch-Pagan Lagrangian Multiplier test, to reinforce the model appropriateness of the random-effects model, was conducted. This test is based on the hypothesis of the OLS regression: H_0: var(u_i)=σ_u^2=0", that is, the variance of an error term should not change according to panel entities and over time. Therefore, the p-value, 0.000, in Figure 4.4 below implies the fact that the H_0 is rejected and thereby the random-effects is more effective than the pooled OLS regression, because $u_i \neq 0$ to all panel entities so that the characteristics of the panel entities should be reflected in this analysis model.

Figure 4.4: the Result of the Breusch-Pagan Lagrangian Multiplier Test

```
. xttest0

Breusch and Pagan Lagrangian multiplier test for random effects

        price[complex,t] = Xb + u[complex] + e[complex,t]

        Estimated results:
                         |       Var     sd = sqrt(Var)
                ---------+-----------------------------
                   price |   257574.7       507.5182
                       e |   39710.81       199.2757
                       u |   70666.66        265.832

        Test:   Var(u) = 0
                             chi2(1) =   174.29
                         Prob > chi2 =     0.0000
```

Through the Hausman test and the Breusch-Pagan Lagrangian Multiplier test, this study identified the efficiency of the random-effects model in comparison with other models. From now on, thus, this study deciphers the analysis result on the basis of the GLS regression result of the random-effects model.

4.5.3 Deciphering the analysis result

As the random-effects model was decided for the analysis one, recalling equation 4.12, the analysis fundamentals can be depicted as below.

$$\mathrm{y_{it}} = (\alpha + u_{\mathrm{it}}) + \beta_{\mathrm{i}} X_{\mathrm{it}} + \varepsilon_{\mathrm{it}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4.12)$$

Where y_{it} is the dependent variable of entity i at time t, the hedonic price; β_i is the coefficient for one independent variable X_{it}; and ε_{it} is the within-entity error; $\alpha+u_{it}$ represents a random variable (α: the constant, u_{it}: the between-entity error).

In the mean time, this equation implies two assumptions: The variations across entities are random and uncorrelated with the explanatory variables; and the error term is not correlated with the explanatory variables of which the characteristic is time-invariant. Therefore, the random-effects model regards such unobserved heterogeneity amongst the condominiums (entities) as latent variables so that u_i represents random effects.

Under the fundamentals of the random-effects model, as explained above, this study attempted to decipher the result of the panel data analysis as in the following.

First, considering these two assumptions and the characteristics of real estate at the same time, the random-effects model is indeed deemed to be a more effective one than the fixed-effects model for the following reasons: 1) real estate is regarded as a segmented market. For example, if it is a condominium, each condominium has unique characteristics of its own and its each characteristic is said to rarely interfere each other, because, after each unique characteristic coalesces into a condominium, the characteristics such as its location compose the value of a condominium as a substantial element. Besides, as a condominium is a segmented goods, the variations cannot be identical to each other. That is to say, the variations across condominiums (entities) are random and uncorrelated with each other (variables); 2) given that one purpose of the panel data analysis is to clarify the effect of unobservable omitted variables and a condominium has a lot of discrete characteristics of its own, time-invariant, associating the unobservable omitted factors (the error term) with discrete characteristics of the condominium (explanatory variables) is hardly completed.

Second, the coefficients of the variables turn out to be statistically significant in every analysis, when compared with each other to explore how they changed in the analyses.

Table 4.21: the Comparison of the Coefficients of the Significant Variables

		Constant (Error term)	Seoul	Age	Bus	College
OLS Regression	2005	1,330.44**	78.002**	-18.568**	-	-
	2006	1,215.63**	84.432**	-	-	-
	2007	1,166.78**	92.615**	-	-	-
	2008	1,070.07**	125.033**	-	-	-
	2009	1,075.61**	135.719**	-	-	-
Panel Data Analysis	Pooled OLS	1,030.63**	85.508**	-12.415**	-	-
	Fixed-effects	1,132.14**	27.808**	-16.910**	0.235**	-
	Random-effects	*1,087.44***	*39.745***	*-16.952***	*0.191***	*4.372***

Note: ** Significant at five percent level

As shown in Table 4.21, the coefficient of constant (error term) slightly changes according to analysis models while the coefficient of the variable, Seoul, decreases with substantial magnitude. The variable, Age: the age of each condominium, turns out to be statistically significant in the panel data analysis and its magnitude is not ignorable. In the case of the variable, Bus, it is significant only in the fixed- and random-effects model with small magnitude. Otherwise, the other educational variable, College, has statistically significant magnitude and influences the condominium prices.

With those analysis results, the most decisive decipherment can be drawn out. As the value change of constant (error term) is not much high, it can be said that the effect of unobservable omitted variables which affect the prices of condominiums in Daegu Metropolitan City is also not much high. In other words, the eight explanatory variables in this study are statistically enough to allow us not to consider other additional variables so that selecting the variables and the configuration of variable set in this study are appropriate to analyze the influence of the educational performance on the condominium prices abundantly.

Third, whereas, the coefficient value of the Seoul variable changes; specifically the value in the panel data analyses reduces when compared to that in the OLS regression. This apparently reveals the fact that the influence on the condominium prices, biased to one particular variable, Seoul, has been mitigated through the panel data analysis. This is also

evidenced by the entrance of other variables, Age, Bus and College, which newly turn out statistically significant. Through the new entrance of those variables and the coefficient adjustment of the Seoul variable by panel data analysis, this study could clarify the phenomenon that the OLS regression result is biased to one particular variable and otherwise provide the appropriate variable composition.

Fourth, as a new variable, College, is included as a statistically significant one, this study can confirm the fact that the educational performance in Daegu Metropolitan City indeed influences the housing prices with substantial magnitude. Despite the coefficient value of the Seoul variable largely decreases, as new educational factor is included, the influence of the educational performance seems to assume a considerable role in affecting real estate, with the result of the analysis on the nonlinear effect of the education performance in Subchapter 4.4 by which identifies the education premium on the condominium prices in this city.

Describing the result of the random-effects model in an equation form, the hedonic price can be obtained as below.

$$p(\boldsymbol{z}) = 1{,}087.44 + 39.745\, z_1 + 4.372\, z_2 + 0.191 z_3 - 16.952\, z_4 \quad \text{..... (4.15)}$$

Where $p(z)$ is the hedonic price determined by the panel data analysis, the random-effects model; z_1 represents Seoul; z_2 is College; z_3 and z_4 are Bus and Age respectively.

Following this equation and calculating the hedonic price, when a high school has one more student admitted into the Seoul University and the admission rate to four-year-course college increases by one point percent, the price of an adjacent condominium of which lot size is thirty pyeongs goes up by *KRW four point four million, ceteris paribus*.

Lastly and synthetically, through the panel data analysis, this study obtained a crucial lesson. That is, the most decisive factor determining the condominium price in Daegu Metropolitan City is still the educational performance though its magnitude decreases according to the analysis model. This is evidenced by the facts that: 1) the configuration of

the variables employed in this study is appropriate enough not to consider other variables, because the coefficients of the constant show analogous values regardless of the analysis models; 2) and two variables representing the education factors, the number of student admitted to the Seoul University and the admission rate to four-year-course colleges, are statistically significant simultaneously.

4.6 Research Findings and Analytical Remarks

This study, hitherto, explored the correlation between housing prices and educational performance with two research questions: First, does educational performance influence the prices of condominiums linearly or nonlinearly? Second, does the correlation change in response to time elapse from 2005 to 2009? To clarify two hypotheses, the hedonic pricing model was employed for the analyses and various analysis techniques such as the OLS regression, the dummy-variable regression and the panel data analysis were pursued as the methodology. In doing so, the average price per square meter of condominiums was used for the dependent variable and the number of student admitted into the Seoul University was employed as a major explanatory variable representing the educational performance. This explanatory variable, Seoul, was identified statistically significant, while other seven explanatory variables turn out statistically significant once in a while but, mainly, statistically insignificant.

4.6.1 Research findings

In pursuit of clarifying the correlation between the educational performance and housing prices in Daegu Metropolitan City, *several key research findings* are obtained from the results of the empirical analysis techniques. According to the results, the key findings from this study can be summarized as in the following.

First, in the case of the OLS regression for the year 2009, only the number of student who gained admission to the Seoul University, by which represents the educational fever for admission to top-class universities, is statistically significant to the condominium prices. Not only that, in the respect of its magnitude, when one more student of a high school obtains admission into the Seoul University, the price of the condominium of which the lot size is *thirty pyeongs* goes up by approximately *KRW 13.6 million* in terms of the statistic-economics. Furthermore, this result is also meaningful to identify the fact that overheated educational fever and its bad influence on real estate is not a matter only for the case of Seoul Metropolis so that this matter is necessary to be interpreted on a nationwide scale.

Second, following the result of the five-year time series analysis based on the time period from 2005 to 2009, the influence of educational performance in Daegu Metropolitan City has increased by average 18.5 percent per annum as shown in Figure 4.1. For example, the price of a condominium goes up by approximately *KRW 7.8 million* in the year 2005, while the price of a condominium rises by approximately *KRW 13.6 million* in the year 2009 in terms of the statistic-economics, when a high school send one more student to the Seoul University, respectively.

Third, according to the result of the dummy-variable regression, this study could confirm the existence of the education premium in this city. Put another way, as educational performance influences the condominium prices with different magnitude in accordance with the number of student admitted to the Seoul University, the educational performance and the price of a condominium hold a nonlinear correlation as shown in Figure 4.2. That is, if a student admitted into the Seoul University belongs to the high school which has more than seven successful candidates per annum, the magnitude of the influence, the condominium price, gets almost doubled. This strongly describes the existence of the education premium in Daegu Metropolitan City.

Lastly, through the panel data analysis, this study attempted to identify the effect of unobservable omitted variables and to realistically understand the influence of educational performance on housing prices in this city. Following the analysis result, as the coefficient of the constant shows analogous value regardless of the analysis models, the configuration of the variables employed in this study is appropriate enough not to consider other variables. Besides, the most decisive factor determining the condominium price in Daegu Metropolitan City is still the educational performance despite of the magnitude decrease, because all of the educational factors, the number of student admitted to the Seoul University and the admission rate to four-year-course colleges, show statistically significant value.

In a word, the residential real estate, the condominium prices, in Daegu Metropolitan City is highly or even absolutely influenced by the educational performance, and the education premium has increased during time period from 2005 to 2009.

4.6.2 Analytical remarks

When compared to the domestic literature review targeted on Seoul Metropolis in Subchapter 2.2, the phenomenon incurred by the relation between educational fever and real estate in two cities is likely to be almost identical. Besides, given that the explanatory variable, the number of student admitted to the Seoul University, is the most statistically significant in the analyses targeted on Daegu Metropolitan City, the influence of the educational performance on housing prices in this city is rather greater than that of Seoul Metropolis. This is evidenced by the fact that, generally speaking, when moving to other area because of the education for children, parents do not consider which high schools send more students to plain colleges or universities, but rather consider which high schools send more students to top-class universities. That is also the reason other explanatory variables turn out to be statistically insignificant or significant with less magnitude.

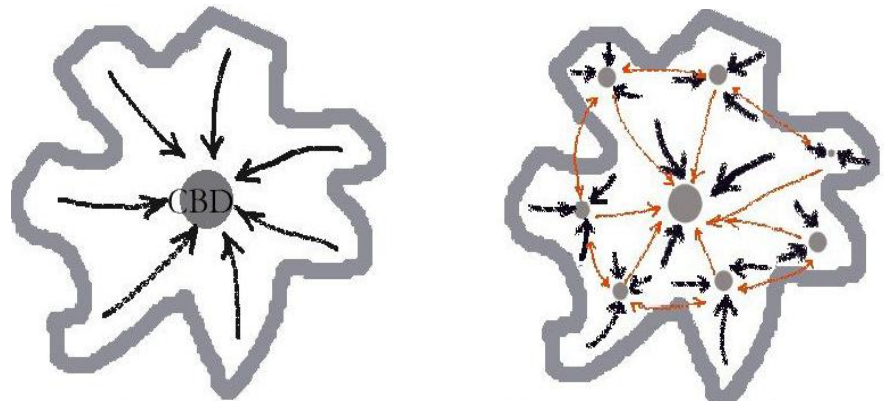
Specifically, the reasons other explanatory variables are clarified to be statistically insignificant or significant with less magnitude are following: 1) in the case of transportation factors, the road conditions in Daegu Metropolitan City is not so bad as that in Seoul Metropolis. This is evidenced by the announcement[27] in 2008 from the Ministry of Land, Transportation and Maritime Affairs saying that the average speed for major routes in Daegu Metropolitan City was 22.7 kilometer per hour, while it recorded 16.7 kilometer per hour in Seoul Metropolis. Moreover, as noted previously, only two subway lines are available in Daegu Metropolitan City, whereas the capital city has nine subway lines. That is to say, the people in Daegu Metropolitan City do not put the first priority on the condition of the public transportation when purchasing their houses; 2) when it comes to factors for living conditions, nowadays, as large numbers of small- and middle-size city parks have been constructed in and outside the condominiums municipally and privately, one variable for living conditions, the number of middle-size city park in the vicinity of the condominiums, is shown as not to be statistically significant. Besides, considering that, when going shopping, people generally use their car to carry their purchases so that they willingly drive the cars, the other variable for living conditions, the number of department and large discount store within ten-minute distance by car from their residence, naturally turns out to be statistically insignificant. In other words, this kind of variables do not affect the home buyers' purchasing decisions in Daegu Metropolitan City; 3) two discrete variables of the condominiums, the number of household in each condominium and the age of each condominium can be elucidated in the respect of *segmented markets* originates from the heterogeneity of real estate differentiated from its location and implicit characteristics. This study, meanwhile, focuses on the whole Daegu Metropolitan City and thereby the correlation of the educational performance and the condominium prices is clarified. Nevertheless, it is deemed that the reason two discrete

[27] Source: http://www.mltm.go.kr/DataCenter/StatisticData/08sta/08/08_22.html

variables of the condominiums are statistically significant with relatively less magnitude is that the analyses based on the whole city do not reflect the characteristic of a segmented market. That is, when the market is analyzed by their internal discrete variables, the geography should focus on much less area than the district unit to reflect the characteristic of a segmented market.

Lastly, explaining synthetically the aspect of the residential real estate in Daegu Metropolitan City based on this study, this city holds the form of *a polycentric city*: "A polycentric city functions very much in the same way as a monocentric city: jobs, wherever they are, attract people from all over the city. The pattern of trips is different, however. In a polycentric city each sub-center generates trips from all over the built-up area of the city," we are advised (Bertaud 2004).

Figure 4.5: Monocentric and Polycentric City Model by Pattern of Daily Trips



(a) The monocentric model

(b) The polycentric model
: The urban village version

Source: http://alain-bertaud.com/images/AB_The_spatial_organization_of_cities_Version_3.pdf

As discussed throughout this study, each district in Daegu Metropolitan City has the function of its own so that this city is said to be a polycentric city. For example, Jung-gu, which the City Hall and the downtown are located in, functions as the main CBD (central business district) of this city, attracting and providing jobs to people with the convergence of the public transportation. Suseong district, meanwhile, attracts people with the noticeable living amenity and the highly priced residence as a prestigious high-school district. For other

districts, the industrial complexes in Buk-gu, Dalseo, Seongseo and Dalseong-gun districts provide jobs to the citizens in this city, generating trips from all over the built-up area of this city. The figure above explains well the notion and the characteristics of the monocentric and the polycentric city models.

Daegu Metropolitan City as a polycentric one can be evidenced by the fact in this study that, despite Jung-gu is the central area of this city, the prices of condominiums are higher in Suseong district followed by Dalseo and Buk-gu districts. In addition, revisiting Table 3.6, the number of household dwelling in condominiums in Dalseo district is almost fourteen times greater than that in Jung-gu district, followed by Suseong and Buk-gu districts sequentially. Such functions of each district in this city, however, as a polycentric city, reflect the improper growth, biased to a particular zone, of the housing market.

Therefore, when a real estate policy for this city is planned, the characteristics of each district as well as other socio-economic factors such as increasing educational fever and not-well-arranged public transportation networks should be seriously considered simultaneously to address real estate policies appropriately.

CHAPTER.5 CONCLUSION

This study, until now, has explored the influence of educational performance on housing prices in Daegu Metropolitan City. Specifically, with the hedonic pricing model, how the prices of condominiums were affected by the educational performance was identified. To dynamically define the influence, a variety of empirical analysis techniques were applied as follows: the multiple regression (OLS), the five-year time series analysis, the dummy-variable regression and the panel data analysis. In doing so, one dependent variable, the average price per square meter of condominiums, and eight explanatory variables were employed. Among those explanatory variables, the educational performance was reflected by two variables, the number of student who obtained admission into the Seoul University and the admission rate to four-year-course colleges.

Following the empirical analysis results, meanwhile, two research hypotheses, the educational factor influences the condominium prices linearly or nonlinearly and the influence changes with a five-year time series analysis from 2005 to 2009, are verified and thereby several key research findings are clarified as in the following.

First, as the variables represent the education factors turn out to be statistically significant, the fact is clarified that the educational performance indeed influences the prices of condominiums in Daegu Metropolitan City. In addition, when analyzed by the OLS regression, its magnitude is KRW 135.719 thousand per square meter. That is, the price of a condominium of which the area is thirty pyeongs (about one hundred square meters) statistic-economically goes up by about *KRW* 13.6 *million*, when a high school has one more student admitted to the Seoul University. The more important point, meanwhile, is that the correlation between overheated educational fever and real estate is not a matter of only Seoul Metropolis so that this phenomenon should be addressed on the nationwide basis.

Second, the influence of such educational performance on housing prices in this city is defined as to be getting serious. Revisiting Table 4.10 and Figure 4.1, the magnitude of the influence has statistically increased by the degree of approximately 18.5 percent per annum from 2005 to 2009 on average, when analyzed by the OLS regression. This growing aspect of the influence implies that the educational fever can intensify the negative impact on Daegu Metropolitan City such as the rise of land value biased toward particular zones.

Third, not only that, this study could confirm the existence of the education premium in this city. That is, the educational performance and the price of a condominium hold nonlinear correlation as shown in Figure 4.2, because the educational performance influences the condominium prices with different magnitude in accordance with the number of student admitted to the Seoul University; if a student admitted into the Seoul University belongs to the high school send more than seven student to the Seoul University per annum, the magnitude of the influence gets almost doubled, when analyzed by the dummy-variable regression.

Lastly, the configuration of the variables employed in this study turns out to be appropriate enough not to consider other variables. This is attributed to the fact that the coefficients of the constants show analogous value regardless of the analysis models. In addition, the most decisive factor determining the condominium price in Daegu is indeed the educational performance, because all of the educational factors, the number of student admitted to the Seoul University and the admission rate to four-year-course colleges, show statistically significant value, when analyzed by the panel data analysis.

5.1 Discussion

Recalling and iterating the purpose of the study, it is to verify the correlation between housing prices and educational performance in Daegu Metropolitan City and to

interpret the relation of education and real estate as a nationwide matter. Such being the case, this study targets on Daegu Metropolitan City, not on Seoul Metropolis where precedent researches were revealed already and thereafter several key research findings by which support the purpose are obtained. On the basis of the key research findings, this study attempts to have several discussions on the *policy implication* to prevent the negative influence of other socio-economic factors on real estate as in the following.

First, the real estate problems such as biased growth of land value etc. do not stand alone without concerning other socio-economic factors. This study provided compelling evidences concerning such real estate problems through the empirical analyses. In order to make the housing market in this country stable and grow on the stability, the overheated educational fever should be taken into consideration while a real estate policy is being made.

Moreover, fundamentally by addressing and improving the education system in this country, such the soaring of real estate value in a particular zone would be prevented. The distribution of high schools with high quality and the best performances to each district can be a good example. In other words, when the high-quality high schools are distributed to each district so that the educational fever for the top-class universities can be controlled, the rise of land value biased to a particular zone would be mitigated or even eliminated. That is, the education premium would be solved by improving the fundamental education system.

Second, when a city is planned or designed, the provision of specialized attraction per district would be another solution. Based on the characteristic of a polycentric city noted in Subchapter 4.6, examples for such specialized attraction per district are following: the opportunities of strong and consistent job offerings based on a specialized industry in the district; differentiated living amenity based on the natural condition in the district; and also differentiated living amenity based on superb neighborhood facilities in the district etc. Put another way, offering differentiated living environment per district is anticipated to disperse

the population and then the phenomenon such as the rise of land value biased toward particular zones can be prevented.

Furthermore, as the result of the panel data analysis in Subchapter 4.5 shows the fact that the effect of unobservable omitted variables on the correlation between the educational performance and the housing prices in Daegu Metropolitan City is not critical; this implies the fact that not too many variables need to be considered when condominiums in this city are empirically analyzed. Therefore, not only by addressing the fundamental education system but also by simultaneously providing specialized attraction with regard to the variables dealt with in this study, such real estate problems can be mitigated. In doing so, making good use of the characteristic, a polycentric city model, of this city is expected to invigorate the solution.

Third, this study daringly insists that redeveloping an area is more effective than building a new town in the respect of real estate planning and administration, when it comes to a city already developed to some extent. That is because building new towns extravagantly can cause the *urban sprawl* so that this can produce unexpected another real estate problems such as unsold condominiums. Despite the redevelopment expenses is much higher than that of building a new town, considering the social costs and additional problems by that, the prudent redeveloping a lag-behind area within a city or a district can generate additional benefits such as urban renewal. And if the redevelopment is associated with such the provision of specialized attraction per district in the second solution, real estate problems are anticipated to be mitigated to a great extent in the long run. That is to say, a systemic long-term redevelopment plan for a city would lead a sounder city environment and a less problematic city development.

Last but not least, the expansion of the public transportation network in a city and its system improvement can be a crucial factor to prevent real estate problems. When a home

buyer makes a purchasing decision, the convenience of transportation network such as transportation cost and commute time also takes part in as a decisive element. Therefore, if the transportation cost and commute time are reduced owing to better transportation conditions, where to reside is not a problem so that the population in a city would be dispersed to whole city area. In addition to that, more convenient public transportation system with reducing the proportion of owner driving would provide a number of secondary merits: clean atmosphere, the reduction of traffic congestion cost and thereby flexible municipal budget planning and management etc. Advanced city planning such as TOD[28] (transit oriented development) can be that kind of solution.

Conclusively, through the policy implications above, real estate problems are expected to be resolved by addressing socio-economic issues simultaneously and then by ultimately decentralizing the population within a city.

5.2 Limitation of the Study

This study clarifies the fact that educational performance also affected housing prices in other region except Seoul Metropolis, but otherwise this analysis highlights the case of only Daegu Metropolitan City so that additional researches focusing on the rest region, in which the price of real estate fluctuates or is gradually growing seemingly because of such educational fever, such as the Pyungchon zone in Anyang City, Donchun-dong in Incheon Metropolitan City, newly rising Haeundae district in Busan Metropolitan City, the Dunsan zone in Daejeon Metropolitan City, Bongsun-dong of a new town in Gwangju Metropolitan City, Nam-gu district in Ulsan Metropolitan City, are highly required as to provide a theoretical background for appropriate nationwide policies on real estate.

[28] TOD is an urban planning for a city providing fabulous access to public transportation in areas residential and commercial real estate are combined. This type of urban planning is for encouraging transit ridership. The Curitiba in the Brazil is a good example.

In addition, to clarify the correlation between educational performance and housing prices, this study employed eight different types of explanatory variables for the empirical analyses to obtain the hedonic price. On the other hand, as it is advised to include as many variables by which influence the price of real estate as possible in the hedonic pricing model, more intensified consideration on selecting those variables is necessary; the average income of the condominium community can be a good example. That is to say, another research employing an apparatus of different variable types will be also meaningful to interpret the phenomenon appropriately.

APPENDICIES

APPENDIX 1. The Number of Student Admitted to the Seoul University during Time Period from 2005 to 2009 of Sixty-one High Schools in Daegu

District	Total	(%)	High school	Num-ber	Yr 2009	Yr 2008	Yr 2007	Yr 2006	Yr 2005	School Total
Buk-gu	119	12	Gangbuk	1-1	-	3	1	2	3	9
			Gu-am	1-2	3	2	-	1	2	8
			Gyeongmyeong girls’	1-3	1	1	1	1	2	6
			Gyeongsang	1-4	4	4	5	4	5	22
			Gyeongsang gils'	1-5	3	3	1	-	3	10
			Haknam	1-6	2	1	2	1	-	6
			Seonggwang	1-7	3	4	3	3	3	16
			Seonghwa gils'	1-8	-	-	-	1	4	5
			Unam	1-9	-	4	1	1	1	7
			Yeongjin	1-10	4	6	2	6	5	23
			Yeongsong gils'	1-11	2	1	-	3	1	7
			Semi Total		22	29	16	23	29	
Dong-gu	25	3	Cheonggu	2-1	2	1	2	-	2	7
			Dongbu girls’	2-2	1	3	-	1	-	5
			Gangdong	2-3	1	1	-	-	-	2
			Jeongdong	2-4	-	-	-	-	2	2
			Yeongsin	2-5	1	-	1	3	4	9
			Semi Total		5	5	3	4	8	
Seo-gu	37	4	Dalseong	3-1	4	1	4	5	3	17
			Daegu Jeil	3-2	1	2	2	-	3	8
			Daegu Seobu	3-3	-	2	2	-	2	6
			Gyeongduk girls’	3-4	-	-	2	1	3	6
			Semi Total		5	5	10	6	11	
Jung-gu	33	3	Geysung	4-1	-	3	5	4	1	13
			Attached to KNU	4-2	2	3	-	5	1	11
			Gyeongbuk Technical	4-3	1	-	-	-	-	1
			Gyeongbuk girls'	4-4	1	-	-	1	1	3
			Sinmyung girls’	4-5	-	1	1	2	1	5
			Semi Total		4	7	6	12	4	
Suseong	**465**	**48**	Daeryun	5-1	11	11	14	18	20	74
			Daegu girl's	5-2	3	4	7	5	9	28
			Daegu Science	5-3	10	10	9	7	7	43
			DaeguHyehwa girls'	5-4	2	1	8	1	7	19
			DaeguNamsan	5-5	1	3	7	1	8	20
			Dongmun	5-6	3	2	1	-	-	6
			Deokwon	5-7	10	5	6	15	11	47
			Gyeongbuk	5-8	1	5	9	12	9	36
			Gyeongsin	5-9	10	13	20	19	8	70
			Jeongwha girl's	5-10	3	6	5	6	4	24
			Neungin	5-11	5	8	15	8	9	45
			Oseong	5-12	3	7	11	7	9	37
			Siji	5-13	2	2	2	4	6	16
			Semi Total		64	77	114	103	107	

District	Total	(%)	High school	Num-ber	Yr 2009	Yr 2008	Yr 2007	Yr 2006	Yr 2005	School Total
Dalseo	197	20	Daegu F/L	6-1	6	5	10	9	7	37
			Daegeon	6-2	3	8	9	3	1	24
			Dowon	6-3	1	2	3	2	-	8
			Daegu Sangwon	6-4	1	4	1	-	-	6
			Daegok	6-5	2	2	-	3	-	7
			Gyeongwha girls'	6-6	1	2	3	1	1	8
			Gyeongwon	6-7	1	5	3	3	1	13
			Hyosung girl's	6-8	4	3	2	3	3	15
			Sangin	6-9	-	1	2	-	5	8
			Songhyeon girls'	6-10	-	1	1	2	2	6
			Seongsan	6-11	2	4	1	1	-	8
			Seongseo	6-12	3	3	3	5	2	16
			Waryong	6-13	1	-	2	1	4	8
			Wonhwa girls'	6-14	2	1	3	2	1	9
			Yeongnam	6-15	3	2	6	3	10	24
			Semi Total		30	43	49	38	37	
Nam-gu	83	9	Daegu	7-1	2	1	4	2	6	15
			Gyeongbuk Arts	7-2	2	-	1	1	-	4
			Gyeongil girls'	7-3	4	3	5	12	9	33
			Hyeopseong	7-4	2	7	4	5	5	23
			Simin	7-5	1	3	-	3	1	8
			Semi Total		11	14	14	23	21	
Dalseong-gun	7	1	Daewon	8-1	-	1	1	-	-	2
			Hwawon	8-2	-	2	-	-	1	3
			Hyeonpung	8-3	-	-	1	1	-	2
			Semi Total		-	3	2	1	1	
Total	**966**	100			**141**	**183**	**214**	**210**	**218**	

APPENDIX 2. Admission Rate to Four-year-course Colleges of Sixty-one High Schools in Daegu[29]

District	Average (%)	High school	School Number	Admission Rate (%)
Buk-gu	55.8	Gangbuk	1-1	56.8
		Gu-am	1-2	58.6
		Gyeongmyeong girls’	1-3	57.7
		Gyeongsang	1-4	52.1
		Gyeongsang gils'	1-5	54.3
		Haknam	1-6	47.4
		Seonggwang	1-7	68.2
		Seonghwa gils'	1-8	64.1
		Unam	1-9	57.4
		Yeongjin	1-10	50.6
		Yeongsong gils'	1-11	46.6
Dong-gu	58.8	Cheonggu	2-1	58.7
		Dongbu	2-2	62.2
		Gangdong	2-3	52.6
		Jeongdong	2-4	65.2
		Yeongsin	2-5	55.2
Seo-gu	50.6	Dalseong	3-1	56.0
		Daegu Jeil	3-2	49.0
		Daegu Seobu	3-3	48.1
		Gyeongduk girls’	3-4	49.2
Jung-gu	46.1	Geysung	4-1	53.2
		Attached to KNU	4-2	56.6
		Gyeongbuk Technical	4-3	0.0
		Gyeongbuk girls'	4-4	56.4
		Sinmyung	4-5	64.4
Suseong	64.7	Daeryun	5-1	67.5
		Daegu girl's	5-2	61.0
		Daegu Science	5-3	90.9
		DaeguHyehwa girls'	5-4	61.0
		DaeguNamsan	5-5	66.5
		Dongmun	5-6	67.7
		Deokwon	5-7	65.0
		Gyeongbuk	5-8	53.6
		Gyeongsin	5-9	59.8
		Jeongwha girl's	5-10	65.9
		Neungin	5-11	61.4
		Oseong	5-12	58.7
		Siji	5-13	62.0

[29] Source: the School Information Service (http://www.schoolinfo.go.kr/index.jsp)

District	Average (%)	High school	School Number	Admission Rate (%)
Dalseo	59.7	Daegu F/L	6-1	79.1
		Daegeon	6-2	63.3
		Dowon	6-3	54.1
		DaeguSangwon	6-4	57.4
		Daegok	6-5	62.0
		Gyeongwha girls'	6-6	56.5
		Gyeongwon	6-7	70.9
		Hyosung girl's	6-8	62.5
		Sangin	6-9	55.2
		Songhyeon girls'	6-10	58.8
		Seongsan	6-11	55.7
		Seongseo	6-12	47.3
		Waryong	6-13	47.8
		Wonhwa girls'	6-14	56.2
		Yeongnam	6-15	69.0
Nam-gu	65.2	Daegu	7-1	58.6
		Gyeongbuk Arts	7-2	72.8
		Gyeongil girls'	7-3	57.7
		Hyeopseong	7-4	82.1
		Simin	7-5	54.8
Dalseong-gun	60.9	Daewon	8-1	55.8
		Hwawon	8-2	51.4
		Hyeonpung	8-3	75.4
Average	57.7			

APPENDIX 3. Sixty Condominium Apartment Complexes nearby High Schools[30]

District	Condominium Number	Title of Condominium
Buk-gu (11)	1-1	Jungang Hansin Apt.
	1-2	Chilgok Mirae Town
	1-3	Saedongne Geumsung Apt
	1-4	Seongwha Apt.
	1-5	Namyeong Town
	1-6	Chilkok Jugong Greenville Complex 2
	1-7	Yuseong Cheonggu Apt.
	1-8	Bokhyeon Seohan Town Il-cha
	1-9	Daegu Chilgok Buyeong Apt. Complex 2
	1-10	Bokhyeon Kunyeong Apt.
	1-11	Taejeon Daebaek Mansion I-cha
Dong-gu (5)	2-1	Woobang Pureun Town
	2-2	Seongji Apt.
	2-3	Yeongjo Areumdaun Nanal Complex 3
	2-4	Yonggye Town
	2-5	Sincheon Garam Town
Seo-gu (4)	3-1	Samik Mansion
	3-2	Bisan Woobang Mansion
	3-3	Siyeong Seosin Apt.
	3-4	Kkotdongne Apt
Jung-gu (5)	4-1	Namsan Green Town
	4-2	Woobang Cheongun Mansion.
	4-3	Boseong Hwangsil Town
	4-4	Boseong Songnim Apt.
	4-5	Dongseo Town
Suseong (13)	5-1	Taewang Anus Apt
	5-2	Woobang Manchon I-cha Apt.
	5-3	Gungjeon Mansion
	5-4	Suseong I-cha Woobang Town
	5-5	Shinsegye Town
	5-6	Metro Palace Complex 3
	5-7	Siji oh-cha Taewang Heights
	5-8	Woobang Manchon Il-cha Apt.
	5-9	Taewang Yuseong Highville
	5-10	Woobang Cheongsol Mansion
	5-11	Beomeo Cheonggu Heights.
	5-12	Taewang Riverview
	5-13	Siji Boseong Town

[30] Source: the Daegu Life Geographic Service (http://gis.go.kr/multi/main/main.jsp?user_menu_id=1&user_lan_id=1&user_lan_suffix=en)

District	Condominium Number	Title of Condominium
Dalseo (15)	6-1	Yongsan Seohan Hwaseong Town Complex 1
	6-2	Hansaem Town
	6-3	Mirisaem Jugong Complex 2
	6-4	Songhyeon Jugong Apt. Complex 3
	6-5	Sansae Jugong Complex 7
	6-6	Woobang Lilac Mansion
	6-7	Pureunmaul Apt.
	6-8	Boseong Eunha Town
	6-9	Sangin Jerim Town
	6-10	Green Mansion I-cha Apt.
	6-11	Yongsan Park Town
	6-12	Sindang Hanhwa Ggumegreen Apt.
	6-13	Seongseo Dongseo Seohan Town
	6-14	Seongdang Boseong Mansion
	6-15	Daegok Gangsan Town
Nam-gu (5)	7-1	Hyoseong Town
	7-2	Boseong Sanga Mansion
	7-3	Icheon Jugong Complex 2
	7-4	Taesung Mansion
	7-5	Boseong Cheongnok Town
Dalseong-gun (2)	8-1	Geumgang Mansion Complex 2
	8-2	Myeonggok Mireaville Apt. Complex 1

APPENDIX 4. Discrete Variables of Sixty Condominium Apartment Complexes

Condominium	The Number of Household	Age[31]				
		Yr 2009	Yr 2008	Yr 2007	Yr 2006	Yr 2005
1-1	892	16.0	15.0	14.0	13.0	12.0
1-2	720	14.1	13.1	12.1	11.1	10.1
1-3	110	27.9	26.9	25.9	24.9	23.9
1-4	305	20.4	19.4	18.4	17.4	16.4
1-5	102	12.8	11.8	10.8	9.8	8.8
1-6	656	8.6	7.6	6.6	5.6	4.6
1-7	1,493	17.3	16.3	15.3	14.3	13.3
1-8	454	13.3	12.3	11.3	10.3	9.3
1-9	1,194	6.4	5.4	4.4	3.4	2.4
1-10	386	11.2	10.2	9.2	8.2	7.2
1-11	270	14.5	13.5	12.5	11.5	10.5
2-1	611	13.5	12.5	11.5	10.5	9.5
2-2	299	19.2	18.2	17.2	16.2	15.2
2-3	1,140	6.25	5.25	4.25	3.25	2.25
2-4	138	11	10	9	8	7
2-5	1,376	11.8	10.8	9.8	8.8	7.8
3-1	503	30.1	29.1	28.1	27.1	26.1
3-2	183	14.7	13.7	12.7	11.7	10.7
3-3	180	31.3	30.3	29.3	28.3	27.3
3-4	525	28	27	26	25	24
4-1	804	4.7	3.7	2.7	1.7	0.7
4-2	669	23	22	21	20	19
4-3	1,058	16.8	15.8	14.8	13.8	12.8
4-4	317	17	16	15	14	13
4-5	145	24.5	23.5	22.5	21.5	20.5
5-1	480	5.6	4.6	3.6	2.6	1.6
5-2	1,244	12.6	11.6	10.6	9.6	8.6
5-3	538	21.5	20.5	19.5	18.5	17.5
5-4	535	23.3	22.3	21.3	20.3	19.3
5-5	930	20	19	18	17	16
5-6	878	6.9	5.9	4.9	3.9	2.9
5-7	416	5.3	4.3	3.3	2.3	1.3
5-8	1,224	12.6	11.6	10.6	9.6	8.6
5-9	277	6.7	5.7	4.7	3.7	2.7
5-10	194	15.4	14.4	13.4	12.4	11.4
5-11	240	9.3	8.3	7.3	6.3	5.3
5-12	288	6	5	4	3	2
5-13	332	14.8	13.8	12.8	11.8	10.8
6-1	492	10.8	9.8	8.8	7.8	6.8
6-2	1,026	12	11	10	9	8
6-3	1,120	11.6	10.6	9.6	8.6	7.6
6-4	1,080	22.1	21.1	20.1	19.1	18.1
6-5	1,302	13.2	12.2	11.2	10.2	9.2

[31] Age was calculated by subtracting “the year building completed” from “every December from 2005 to 2009.”

Condominium	The Number of Household	Age				
		Yr 2009	Yr 2008	Yr 2007	Yr 2006	Yr 2005
6-6	175	22.3	21.3	20.3	19.3	18.3
6-7	672	12.1	11.1	10.1	9.1	8.1
6-8	1,521	15.6	14.6	13.6	12.6	11.6
6-9	435	16.3	15.3	14.3	13.3	12.3
6-10	672	23.3	22.3	21.3	20.3	19.3
6-11	802	9.3	8.3	7.3	6.3	5.3
6-12	833	4.25	3.25	2.25	1.25	0.25
6-13	974	15.1	14.1	13.1	12.1	11.1
6-14	425	24.7	23.7	22.7	21.7	20.7
6-15	1,480	12	11	10	9	8
7-1	1,162	21.5	20.5	19.5	18.5	17.5
7-2	485	21.1	20.1	19.1	18.1	17.1
7-3	320	6.8	5.8	4.8	3.8	2.8
7-4	198	14.9	13.9	12.9	11.9	10.9
7-5	347	11	10	9	8	7
8-1	284	18.5	17.5	16.5	15.5	14.5
8-2	976	9.7	8.7	7.7	6.7	5.7

APPENDIX 5. Average Price per Square Meter of Each Condominium Apartment Complex

(in KRW thousand)

Number of Condominium	Lot Size (m2)	Average Price per Square Meter				
		Yr 2009	Yr 2008	Yr 2007	Yr 2006	Yr 2005
1-1	49	986	959	959	959	878
	66	914	902	902	886	828
	82	884	886	939	939	864
	105	884	886	939	939	864
	Avg.	917	908	935	931	859
1-2	109	1,105	1,131	1,156	1,154	1,038
	161	1,128	1,372	1,403	1,379	1,137
	Avg.	1,117	1,252	1,280	1,267	1,088
1-3	72	833	833	833	833	833
	89	876	876	876	876	876
	Avg.	855	855	855	855	855
1-4	62	989	887	887	876	843
	76	998	987	987	979	954
	99	1,162	1,045	1,045	1,041	1,013
	Avg.	1,050	973	973	965	937
1-5	79	981	942	867	867	867
	92	967	967	967	967	967
	105	881	869	833	833	833
	Avg.	943	926	889	889	889
1-6	76	1,386	1,453	1,513	1,475	1,291
	109	1,399	1,399	1,459	1,420	1,284
	Avg.	1,393	1,426	1,486	1,448	1,288
1-7	46	848	848	848	848	843
	62	879	879	872	839	835
	Avg.	864	864	860	844	839
1-8	76	1,217	1,179	1,124	1,105	1,105
	85	1,176	1,108	1,018	988	988
	92	1,277	1,157	1,049	1,022	1,022
	102	1,373	1,315	1,226	1,191	1,191
	142	1,268	1,155	1,081	1,074	1,074
	158	1,297	1,200	1,112	1,092	1,092
	Avg.	1,268	1,186	1,102	1,079	1,079
1-9	78	1,442	1,450	1,603	1,571	1,378
	100	1,556	1,570	1,644	1,665	1,472
	Avg.	1,499	1,510	1,624	1,618	1,425
1-10	79	1,406	1,416	1,392	1,345	1,241
	105	1,510	1,518	1,480	1,462	1,383
	122	1,585	1,640	1,680	1,631	1,441
	158	1,487	1,564	1,564	1,522	1,419
	Avg.	1,497	1,535	1,529	1,490	1,371

(in KRW thousand)

Number of Condominium	Lot Size (m2)	Average Price per Square Meter				
		Yr 2009	Yr 2008	Yr 2007	Yr 2006	Yr 2005
1-11	89	818	829	871	821	714
	109	856	967	1,009	998	860
	148	1,149	1,160	1,182	1,109	953
	Avg.	941	985	1,021	976	842
2-1	82	1,159	1,159	1,159	1,159	1,091
	85	1,118	1,118	1,118	1,118	1,050
	109	1,284	1,284	1,284	1,284	1,234
	142	1,338	1,338	1,338	1,338	1,268
	Avg.	1,225	1,225	1,225	1,225	1,161
2-2	59	925	1,032	1,061	982	727
	69	902	1,036	993	978	690
	72	862	1,009	984	940	671
	Avg.	896	1,026	1,013	967	696
2-3	103	1,407	1,479	1,483	1,622	1,517
	Avg.	1,407	1,479	1,483	1,622	1,517
2-4	39	848	859	866	866	833
	79	881	890	889	850	791
	105	923	942	906	867	800
	Avg.	884	897	887	861	808
2-5	56	1,161	1,161	1,161	1,149	1,138
	72	1,164	1,188	1,177	1,167	1,149
	85	1,119	1,124	1,118	1,114	1,093
	109	1,376	1,373	1,372	1,351	1,332
	Avg.	1,205	1,212	1,207	1,195	1,178
3-1	62	1,263	1,331	1,331	1,317	1,134
	89	1,189	1,337	1,395	1,348	1,228
	115	1,304	1,377	1,460	1,420	1,207
	Avg.	1,252	1,348	1,395	1,362	1,190
3-2	85	1,127	1,088	1,088	1,088	1,088
	112	1,272	1,272	1,272	1,213	1,183
	Avg.	1,200	1,180	1,180	1,151	1,136
3-3	59	890	890	906	890	890
	Avg.	890	890	906	890	890
3-4	62	1,331	1,344	1,411	1,435	1,306
	79	1,266	1,279	1,361	1,378	1,266
	Avg.	1,299	1,312	1,386	1,407	1,286

(in KRW thousand)

Number of Condominium	Lot Size (m2)	Average Price per Square Meter				
		Yr 2009	Yr 2008	Yr 2007	Yr 2006	Yr 2005
4-1	108	1,713	1,794	1,871	1,879	1,700
	109	1,697	1,778	1,854	1,862	1,721
	120	1,542	1,615	1,646	1,656	1,427
	122	1,516	1,588	1,563	1,573	1,322
	131	1,800	1,915	2,004	1,987	1,769
	Avg.	1,654	1,738	1,788	1,791	1,588
4-2	109	1,506	1,558	1,619	1,594	1,512
	128	1,370	1,522	1,678	1,715	1,554
	148	1,295	1,437	1,508	1,516	1,361
	155	1,360	1,496	1,575	1,613	1,546
	198	1,540	1,692	1,692	1,692	1,604
	228	1,405	1,555	1,557	1,557	1,499
	Avg.	1,413	1,543	1,605	1,615	1,513
4-3	89	1,162	1,172	1,176	1,190	1,122
	109	1,269	1,372	1,420	1,492	1,372
	148	1,413	1,516	1,544	1,565	1,524
	165	1,268	1,385	1,414	1,452	1,422
	198	1,132	1,221	1,247	1,285	1,259
	257	1,067	1,133	1,163	1,218	1,188
	Avg.	1,219	1,300	1,327	1,367	1,315
4-4	92	984	1,005	983	974	921
	109	1,223	1,248	1,221	1,252	1,146
	165	1,035	1,076	1,077	1,140	1,025
	Avg.	1,081	1,110	1,094	1,122	1,031
4-5	79	1,374	1,456	1,456	1,362	919
	102	1,275	1,311	1,332	1,405	893
	105	1,284	1,286	1,294	1,365	898
	Avg.	1,311	1,351	1,361	1,377	903
5-1	121	3,065	3,178	3,182	3,141	2,953
	136	2,745	2,828	2,831	2,790	2,627
	154	3,666	3,734	3,734	3,681	3,482
	181	3,950	3,950	3,950	3,856	3,616
	201	3,534	3,483	3,483	3,445	3,257
	222	4,392	4,392	4,392	4,255	3,624
	247	4,656	4,656	4,443	4,163	3,765
	290	4,310	4,310	4,121	3,843	3,621
	Avg.	3,790	3,816	3,767	3,647	3,368

(in KRW thousand)

Number of Condominium	Lot Size (m2)	Average Price per Square Meter				
		Yr 2009	Yr 2008	Yr 2007	Yr 2006	Yr 2005
5-2	76	1,459	1,389	1,351	1,349	1,374
	105	1,881	1,881	1,881	1,905	1,871
	142	1,971	1,971	1,971	1,925	1,793
	161	2,204	2,205	2,205	2,174	1,990
	Avg.	1,879	1,862	1,852	1,838	1,757
5-3	109	2,439	2,567	2,691	2,645	2,315
	132	2,431	2,721	2,696	2,680	2,265
	158	2,463	2,598	2,621	2,563	2,264
	198	2,353	2,572	2,576	2,576	2,195
	231	2,408	2,554	2,554	2,554	2,016
	Avg.	2,419	2,602	2,628	2,604	2,211
5-4	79	2,118	2,078	1,973	1,962	1,878
	92	2,149	2,246	2,188	2,199	2,045
	109	2,148	2,194	2,225	2,317	2,167
	Avg.	2,138	2,173	2,129	2,159	2,030
5-5	109	1,716	1,896	2,003	2,017	1,885
	142	1,670	1,831	2,025	2,051	1,909
	161	1,659	1,894	2,101	2,135	1,969
	228	1,694	1,859	2,029	1,988	1,882
	290	1,651	1,822	1,862	1,833	1,734
	Avg.	1,678	1,860	2,004	2,005	1,876
5-6	102	1,828	1,940	1,944	1,221	2,128
	119	1,870	1,996	1,971	2,181	2,166
	148	1,926	2,027	2,114	2,317	2,294
	178	1,842	1,884	1,964	2,317	2,280
	Avg.	1,867	1,962	1,998	2,009	2,217
5-7	103	1,802	1,917	1,917	1,917	1,818
	112	1,962	2,121	2,121	2,121	2,046
	147	2,044	2,234	2,245	2,245	2,124
	Avg.	1,936	2,091	2,094	2,094	1,996
5-8	82	1,462	1,427	1,415	1,415	1,399
	112	1,856	1,853	1,853	1,861	1,860
	165	2,045	2,260	2,273	2,263	2,191
	221	1,833	2,021	2,059	2,051	1,931
	251	1,650	2,075	2,092	2,065	1,911
	Avg.	1,769	1,927	1,938	1,931	1,858

(in KRW thousand)

Number of Condominium	Lot Size (m2)	Average Price per Square Meter				
		Yr 2009	Yr 2008	Yr 2007	Yr 2006	Yr 2005
5-9	105	2,548	2,802	2,825	2,833	2,659
	109	2,500	2,745	2,748	2,752	2,592
	165	2,379	2,702	2,863	2,980	2,718
	198	2,361	2,782	2,803	2,803	2,584
	Avg.	2,447	2,758	2,810	2,842	2,638
5-10	89	1,180	1,180	1,199	1,283	1,292
	109	1,606	1,581	1,642	1,720	1,720
	Avg.	1,393	1,381	1,421	1,502	1,506
5-11	76	1,763	1,763	1,763	1,775	1,694
	89	1,517	1,517	1,517	1,525	1,445
	105	2,000	2,000	2,151	2,242	1,990
	165	2,303	2,303	2,399	2,485	2,114
	221	2,172	2,172	2,255	2,262	1,973
	Avg.	1,951	1,951	2,017	2,058	1,843
5-12	107	2,313	2,370	2,461	2,555	2,366
	108	2,292	2,348	2,438	2,531	2,365
	147	2,221	2,344	2,440	2,850	2,368
	185	2,270	2,315	2,395	2,673	2,291
	Avg.	2,274	2,344	2,434	2,652	2,348
5-13	109	1,477	1,557	1,665	1,665	1,656
	142	1,452	1,692	1,866	1,866	1,834
	161	1,641	1,832	1,985	1,988	1,923
	Avg.	1,523	1,694	1,839	1,840	1,804
6-1	79	1,440	1,545	1,640	1,693	1,645
	109	1,468	1,544	1,713	1,761	1,696
	138	1,726	1,905	2,012	2,040	1,854
	161	1,533	1,825	1,941	1,902	1,818
	Avg.	1,542	1,705	1,827	1,849	1,753
6-2	79	1,281	1,366	1,466	1,533	1,459
	105	1,464	1,450	1,518	1,641	1,564
	Avg.	1,373	1,408	1,492	1,587	1,512
6-3	95	1,287	1,333	1,445	1,531	1,422
	105	1,230	1,248	1,361	1,508	1,404
	Avg.	1,259	1,291	1,403	1,520	1,413

(in KRW thousand)

Number of Condominium	Lot Size (m2)	Average Price per Square Meter				
		Yr 2009	Yr 2008	Yr 2007	Yr 2006	Yr 2005
6-4	82	1,246	1,304	1,311	1,349	1,225
	89	1,281	1,310	1,331	1,378	1,288
	95	1,380	1,432	1,452	1,506	1,373
	102	1,431	1,485	1,514	1,544	1,407
	109	1,365	1,425	1,472	1,464	1,347
	Avg.	1,341	1,391	1,416	1,448	1,328
6-5	52	1,061	1,104	1,118	1,167	1,125
	79	926	954	989	1,059	1,001
	85	882	898	940	1,010	940
	Avg.	956	985	1,016	1,079	1,022
6-6	79	1,266	1,266	1,377	1,474	1,453
	112	1,168	1,250	1,304	1,352	1,362
	Avg.	1,217	1,258	1,341	1,413	1,408
6-7	105	1,374	1,404	1,477	1,569	1,511
	138	1,360	1,446	1,520	1,591	1,481
	161	1,366	1,453	1,489	1,566	1,461
	Avg.	1,367	1,434	1,495	1,575	1,484
6-8	85	1,127	1,157	1,206	1,226	1,116
	109	1,340	1,443	1,458	1,515	1,469
	145	1,448	1,500	1,546	1,621	1,418
	165	1,404	1,439	1,477	1,556	1,501
	244	1,332	1,416	1,467	1,465	1,424
	Avg.	1,330	1,391	1,431	1,477	1,386
6-9	85	912	966	971	971	962
	105	1,071	1,155	1,214	1,231	1,138
	Avg.	992	1,061	1,093	1,101	1,050
6-10	72	1,196	1,148	1,146	1,181	1,164
	79	1,155	1,296	1,329	1,316	1,202
	92	1,073	1,223	1,286	1,359	1,270
	109	1,151	1,259	1,355	1,447	1,282
	125	1,183	1,307	1,363	1,438	1,278
	148	1,227	1,274	1,308	1,334	1,216
	191	1,114	1,074	1,086	1,119	1,097
	Avg.	1,157	1,226	1,268	1,313	1,216
6-11	52	1,397	1,393	1,442	1,370	1,277
	79	1,237	1,293	1,489	1,440	1,345
	102	1,244	1,342	1,471	1,434	1,346
	105	1,351	1,428	1,611	1,579	1,522
	Avg.	1,307	1,364	1,503	1,456	1,373

(in KRW thousand)

Number of Condominium	Lot Size (m2)	Average Price per Square Meter				
		Yr 2009	Yr 2008	Yr 2007	Yr 2006	Yr 2005
6-12	106	1,429	1,515	1,659	1,710	1,646
	144	1,551	1,751	1,846	1,862	1,858
	Avg.	1,490	1,633	1,753	1,786	1,752
6-13	69	1,043	1,083	1,130	1,100	1,042
	79	981	1,060	1,127	1,091	1,033
	105	1,177	1,258	1,286	1,325	1,228
	Avg.	1,067	1,134	1,181	1,172	1,101
6-14	82	1,232	1,212	1,294	1,471	1,496
	92	1,164	1,168	1,325	1,506	1,513
	105	1,179	1,190	1,347	1,464	1,489
	Avg.	1,192	1,190	1,322	1,480	1,499
6-15	105	1,495	1,573	1,603	1,687	1,606
	142	1,407	1,513	1,557	1,661	1,633
	161	1,367	1,545	1,610	1,699	1,669
	Avg.	1,423	1,544	1,590	1,682	1,636
7-1	132	1,282	1,340	1,394	1,439	1,353
	155	1,199	1,316	1,411	1,419	1,383
	198	1,364	1,460	1,465	1,465	1,429
	257	1,226	1,469	1,528	1,498	1,373
	Avg.	1,268	1,396	1,450	1,455	1,385
7-2	112	1,183	1,183	1,183	1,164	967
	135	1,241	1,241	1,241	1,245	1,148
	161	1,289	1,289	1,289	1,304	1,238
	241	1,089	1,089	1,089	1,097	1,103
	Avg.	1,201	1,201	1,201	1,203	1,114
7-3	66	1,326	1,326	1,326	1,345	1,258
	79	1,456	1,456	1,464	1,474	1,357
	115	1,471	1,500	1,500	1,493	1,362
	Avg.	1,418	1,427	1,430	1,437	1,326
7-4	85	1,029	1,029	1,029	1,029	988
	105	1,048	1,083	1,109	1,119	1,095
	148	963	1,001	1,014	1,014	1,014
	161	1,025	1,091	1,118	1,118	1,118
	Avg.	1,016	1,051	1,068	1,070	1,054
7-5	85	1,124	1,153	1,153	1,133	1,105
	105	1,288	1,347	1,357	1,347	1,279
	142	1,244	1,362	1,408	1,360	1,289
	Avg.	1,219	1,287	1,306	1,280	1,224

(in KRW thousand)

Number of Condominium	Lot Size (m2)	Average Price per Square Meter[32]				
		Yr 2009	Yr 2008	Yr 2007	Yr 2006	Yr 2005
8-1	82	1,006	1,006	1,018	1,104	971
	109	872	891	946	1,122	952
	Avg.	939	949	982	1,113	962
8-2	102	1,255	1,307	1,399	1,593	1,321
	Avg.	1,255	1,307	1,399	1,593	1,321

Source: the Budongsan114 (http://www.r114.co.kr/z/apt/asyse/show_pass_open_guide.asp?only=0&m_=37&g_=&solkind=1&pgtype=)

[32] A bundle of average price per square meter was obtained by calculating as follows: first, averaging maximum price and minimum price of a condominium apartment complex (the prices were from the *Budongsan114* on a monthly basis) and thereby prices of each month were gained; second, averaging the prices of each month so that prices of each year calculated; lastly, dividing the prices of each year by lot sizes and then eventually average price per square meter were obtained in KRW thousand.

APPENDIX 6. The Bus Information[33] nearby Condominium Apartment Complexes

Condo-minium	Bus Number	Interval[34] (in minutes)	Bus Runs[35]
1-1	719, 937, chilgok1, chilgok1-1, chilgok2	11.5, 11.5, 16.5, 16.5, 25.5	301
1-2	427, 704, 708, 719, 726, 937, buk-gu1, chilgok3	10.5, 11.5, 10.5, 11.5, 10.5, 11.5, 12.5, 25.5	599
1-3	303, 303-1, 323, 623, 410-1, 503, 653, 706, buk-gu2, dong-gu1-1, dong-gu2, rapid 2	13, 13, 12.5, 10.5, 13.5, 11.5, 12.5, 10.5, 17.5, 16, 13.5, 9.5	868
1-4	101, 101-1, 300, 303, 303-1, 305, 323, 323-1, 503, 623, 937, buk-gu1	13.5, 13.5, 11.5, 13, 13, 10.5, 12.5, 12.5, 11.5, 10.5, 11.5, 12.5	894
1-5	202, 356, 349, 403, 939, belt3-1, buk-gu1, buk-gu3, chilgok2	11.5, 10.5, 12.5, 12.5, 12.5, 11.5, 12.5, 12.5, 15.5	660
1-6	704, 706, 726, 937, 939, buk-gu1, chilgok1, chilgok1-1, chilgok2, rapid2	11.5, 10.5, 10.5, 11.5, 12.5, 12.5, 16.5, 16.5, 15.5, 9.5	734
1-7	101, 101-1, 300, 303, 303-1, 305, 323, 323-1, 623, 653, 937, buk-gu1, rapid2	13.5, 13.5, 11.5, 13, 13, 10.5, 12.5, 12.5, 10.5, 12.5, 11.5, 12.5, 9.5	982
1-8	101, 101-1, 300, 303, 303-1, 305, 323, 323-1, 503, 623, 706, 836, 937, belt3-1, buk-gu1, buk-gu2, dong-gu1-1	13.5, 13.5, 11.5, 13, 13, 10.5, 12.5, 12.5, 11.5, 10.5, 10.5, 10.5, 11.5, 11.5, 12.5, 17.5, 16	1,251
1-9	706, 726, 937, 939, buk-gu1, chilgok1-1, chilgok2, rapid2	10.5, 10.5, 11.5, 12.5, 16.5, 15.5, 9.5	529
1-10	101-1, 300, 303, 303-1, 323, 323-1, 410, 410-1, 503, 623, 706, 719, 836, 937, buk-gu1, buk-gu2, dong-gu1, dong-gu1-1, rapid3	13.5, 11.5, 13, 12.5, 12.5, 13.5, 13.5, 11.5, 10.5, 10.5, 11.5, 10.5, 11.5, 12.5, 17.5, 16, 16, 10.5	1,305
1-11	719, 724, 750, 937, chilgok1, chilgok1-1, chilgok2	11.5, 8.5, 12.5, 11.5, 16.5, 16.5, 15.5	502
2-1	101-1, 106, 400-1, 410, 420, 508, 518, 651, 724, 805, 909, buk-gu3, dong-gu1, dong-gu1-1, dong-gu2, rapid3	13.5, 13.5, 15.5, 13.5, 11.5, 9.5, 11.5, 11.5, 8.5, 11.5, 12.5, 12.5, 16, 16, 13.5, 10.5	1,181
2-2	508, 708, 805, 808, 814, 836, 849-1, 980, dong-gu2	9.5, 10.5, 11.5, 9.5, 8.5, 10.5, 23, 10.5, 13.5	737
2-3	508, 518, 618, 708, 808, 814, 818, 849, 849-1, dong-gu2	9.5, 11.5, 10.5, 10.5, 9.5, 8.5, 23, 23, 13.5	690
2-4	508, 518, 618, 708, 719, 805, 808, 814, 836, 849, 980, dong-gu2, buk-gu3	9.5, 11.5, 10.5, 10.5, 11.5, 11.5, 9.5, 8.5, 10.5, 23, 10.5, 13.5, 12.5	1,051
2-5	101, 156, 305, 401, 403, 410, 414, 420-1, 521, 618, 650, 651, 708, 808, 980, buk-gu2, buk-gu3,dong-gu2, dong-gu3, rapid1	13.5, 11.5, 10.5, 9.5, 12.5, 13.5, 10.5, 11.5, 12.5, 10.5, 11.5, 11.5, 10.5, 9.5, 10.5, 17.5, 12.5, 13.5, 25, 11.5	1,513
3-1	156, 305, 356, 400, 402, 405, 425, 508, 509, 521, 527, 600, 623, 726, 750, dalseo2, dalseo4-1, rapid3, seongseo2	11.5, 10.5, 10.5, 15.5, 10.5, 11.5, 11.5, 9.5, 10.5, 12.5, 11.5, 11.5, 10.5, 10.5, 12.5, 13.5, 15.5, 10.5, 23	1,452
3-2	156, 309, 323, 400, 400-1, 402, 405, 420, 420-1, 425, 452, 508, 521, 527, 618, 623, 653, 724, belt2, belt2-1, rapid1	11.5, 9.5, 12.5, 15.5, 15.5, 10.5, 11.5, 11.5, 11.5, 11.5, 13.5, 9.5, 12.5, 11.5, 10.5, 10.5, 12.5, 8.5, 11.5, 11.5, 11.5	1,656

[33] Source: the Daegu Metropolitan City Bus Information (http://businfo.daegu.go.kr)

[34] Source: the *Daegu Metropolitan City Bus Route Guide*

[35] Assuming that buses run for fifteen hours (from seven a.m. to ten p.m.), total bus runs for each apartment complex were calculated as follows: $\Sigma \frac{\text{Fifteen Hours} \times 60}{\text{Interval of Bus } N}$

Condominium	Bus Number[36]	Interval (in minutes)	Bus Runs
3-3	323, 356, 400-1, 420, 420-1, 452, 521, 724, 726, 750, belt3, belt3-1, rapid1	12.5, 10.5, 15.5, 11.5, 11.5, 13.5, 12.5, 8.5, 10.5, 12.5, 8.5, 11.5, 11.5	1,037
3-4	202, 202-1, 356, 400, 402, 405, 420-1, 425, 508, 521, 623, 726, 750, belt3-1, rapid1	11.5, 11.5, 10.5, 15.5, 10.5, 11.5, 11.5, 11.5, 9.5, 12.5, 10.5, 10.5, 12.5, 11.5, 11.5	1,187
4-1	156, 202, 300, 305, 323, 323-1, 400, 400-1, 402, 509, 527, 600, 609, 618, 650, 651, 706, 808, 836, 909, belt2, belt2-1, dalseo2, seongseo2,	11.5, 11.5, 11.5, 10.5, 12.5, 12.5, 15.5, 15.5, 10.5, 10.5, 11.5, 11.5, 9.5, 10.5, 11.5, 11.5, 10.5, 9.5, 10.5, 12.5, 11.5, 11.5, 13.5, 23	1,846
4-2	303, 303-1, 305, 309, 323, 401, 403, 420, 420-1, 425, 427, 609, 649, 730, 805, 840, 939, dong-gu1-1, rapid2,	13, 13, 10.5, 9.5, 12.5, 9.5, 12.5, 11.5, 11.5, 11.5, 10.5, 9.5, 10.5, 11.5, 11.5, 8.5, 12.5, 16, 9.5	1,544
4-3	106, 202, 202-1, 300, 305, 323, 400, 402, 509, 518, 600, 609, 618, 650, 651, 706, 808, 836, 909, belt2, dalseo2, seongseo2	13.5, 11.5, 11.5, 11.5, 10.5, 12.5, 15.5, 10.5, 10.5, 11.5, 11.5, 9.5, 10.5, 11.5, 11.5, 10.5, 9.5, 10.5, 12.5, 11.5, 13.5, 23	1,704
4-4	106, 202, 300, 305, 349, 400, 402, 405, 410-1, 414, 414-1, 420, 420-1, 503, 509, 518, 609, 649, 650, 651, 704, 706, 805, 836, 840, 909, belt2, buk-gu2, dalseo2	13.5, 11.5, 11.5, 10.5, 12.5, 15.5, 10.5, 11.5, 13.5, 10.5, 10.5, 11.5, 11.5, 11.5, 10.5, 11.5, 9.5, 10.5, 11.5, 11.5, 11.5, 10.5, 11.5, 10.5, 8.5, 12.5, 11.5, 17.5, 13.5	**2,279**
4-5	156, 300, 305, 400, 400-1, 405, 323, 323-1, 509, 527, 600, 609, 618, 651, 808, 836, 909, belt2, belt2-1, dalseo2, seongseo2	11.5, 11.5, 10.5, 15.5, 15.5, 11.5, 12.5, 12.5, 10.5, 11.5, 11.5, 9.5, 10.5, 11.5, 9.5, 10.5, 12.5, 11.5, 11.5, 13.5, 23	1,596
5-1	349, 414, 425, 427, 449, belt3, suseong1	12.5, 11, 11.5, 10.5, 10.5, 8.5, 16	566
5-2	309, 349, 425, 427, 449, 509, 609, 649, 724, 840, 849, 849-1, 909, 937, 939	9.5, 12.5, 11.5, 10.5, 10.5, 10.5, 9.5, 10.5, 8.5, 8.5, 23, 23, 12.5, 11.5, 12.5	1,195
5-3	309, 323, 323-1, 402, 420-1, 425, 427, 509, 609, 649, 724, 814, 840, 939, belt2, belt2-1, gachang1, suseong1, suseong1-1	9.5, 12.5, 12.5, 10.5, 11.5, 11.5, 10.5, 10.5, 9.5, 10.5, 8.5, 8.5, 8.5, 12.5, 11.5, 11.5, 15.5, 16, 16	1,550
5-4	349, 414, 425, 427, 449, belt3, suseong1	12.5, 11, 11.5, 10.5, 10.5, 8.5, 16	566
5-5	323-1, 400, 400-1, 402, 414, 414-1, 427, 509, 704, belt2-1, gachang1, gachang2, rapid2	12.5, 15.5, 15.5, 10.5, 11, 11, 10.5, 10.5, 11.5, 11.5, 15.5, 15.5, 9.5	976
5-6	323, 323-1, 414, 414-1, 420, 420-1, 508, 518, 521, 651, 708, 937, belt2-1, gachang1	12.5, 12.5, 11, 11, 11.5, 11.5, 9.5, 11.5, 12.5, 11.5, 10.5, 11.5, 11.5, 15.5	1,088
5-7	309, 349, 403, 449, 509, 604, 609, 649, 724, 840, 849, 849-1, 909, 937, 939	9.5, 12.5, 12.5, 10.5, 10.5, 14.5, 9.5, 10.5, 8.5, 8.5, 23, 23, 12.5, 11.5, 12.5	1,165
5-8	309, 349, 425, 427, 449, 509, 609, 649, 724, 840, 849, 849-1, 909, 937, 939	9.5, 12.5, 11.5, 10.5, 10.5, 10.5, 9.5, 10.5, 8.5, 8.5, 23, 23, 12.5, 11.5, 12.5	1,195
5-9	309, 323, 323-1, 402, 420-1, 425, 427, 509, 609, 649, 724, 814, 840, 939, belt2, belt2-1, gachang1, suseong1, suseong1-1	9.5, 12.5, 12.5, 10.5, 11.5, 11.5, 10.5, 10.5, 9.5, 10.5, 8.5, 8.5, 8.5, 12.5, 11.5, 11.5, 15.5, 16, 16	1,550
5-10	309, 349, 414, 414-1, 420, 420-1, 427, 449, 509, 609, 649, 724, 840, 849, 849-1, 909, 937, 939, belt3, belt3-1, suseong1, suseong1-1	9.5, 12.5, 11, 11, 11.5, 11.5, 10.5, 10.5, 10.5, 9.5, 10.5, 8.5, 8.5, 23, 23, 12.5, 11.5, 12.5, 8.5, 11.5, 16, 16	1,733

[36] The bus numbers were obtained by surveying all bus stops within a radius of approximately six-hundred meters of each condominium, based on the Daegu Life Geographic Service.

Condo-minium	Bus Number	Interval (in minutes)	Bus Runs
5-11	309, 349, 414, 414-1, 420, 420-1, 427, 449, 509, 609, 649, 724, 840, 849, 849-1, 909, 937, 939, belt3, belt3-1, suseong1, suseong1-1	9.5, 12.5, 11, 11, 11.5, 11.5, 10.5, 10.5, 10.5, 9.5, 10.5, 8.5, 8.5, 23, 23, 12.5, 11.5, 12.5, 8.5, 11.5, 16, 16	1,733
5-12	303-1, 309, 323, 400, 400-1, 402, 403, 420-1, 425, 427, 509, 609, 649, 704, 840, 939, belt2, gachang2	13, 9.5, 12.5, 15.5, 15.5, 10.5, 12.5, 11.5, 11.5, 10.5, 10.5, 9.5, 10.5, 11.5, 8.5, 12.5, 11.5, 15.5	1,411
5-13	309, 349, 403, 449, 509, 604, 609, 649, 724, 840, 849, 849-1, 909, 937, 939	9.5, 12.5, 12.5, 10.5, 10.5, 14.5, 9.5, 10.5, 8.5, 8.5, 23, 23, 12.5, 11.5, 12.5	1,195
6-1	202, 202-1, 402, 503, 527, dalseo2, dalseo3, rapid1, seongseo3	11.5, 11.5, 10.5, 11.5, 11.5, 13.5, 15.5, 11.5, 30	632
6-2	305, 402, 405, 503, 509, 521, 527, 564, 655, dalseo2, dalseo3, rapid1, seongseo1, seongseo1-1, seongseo3	10.5, 10.5, 11.5, 11.5, 10.5, 12.5, 11.5, 11.5, 13.5, 13.5, 15.5, 11.5, 23.5, 23.5, 30	1,018
6-3	106, 604, 618, 649, 653, 706, 726, dalseo1, dalseo2, dalseo3	13.5, 14.5, 10.5, 10.5, 12.5, 10.5, 10.5, 13.5, 13.5, 15.5	735
6-4	600, 618, 649, 650, 653, 726, 836, dalseo2, dalseo4, dalseo4-1, dalseong1	11.5, 10.5, 10.5, 11.5, 12.5, 10.5, 13.5, 15.5, 15.5, 31.5	697
6-5	106, 604, 618, 649, 653, 706, 726, dalseo1, dalseo2, dalseo3	13.5, 14.5, 10.5, 10.5, 12.5, 10.5, 10.5, 13.5, 13.5, 15.5	735
6-6	106, 156, 202, 202-1, 356, 518, 653, 655, 726, 750, 805, dalseo4	13.5, 11.5, 11.5, 11.5, 10.5, 11.5, 12.5, 13.5, 10.5, 12.5, 11.5, 15.5	898
6-7	305, 402, 405, 503, 509, 521, 527, 564, 655, dalseo2, dalseo3, rapid1, seongseo1, seongseo1-1, seongseo3	10.5, 10.5, 11.5, 11.5, 10.5, 12.5, 11.5, 11.5, 13.5, 13.5, 15.5, 11.5, 23.5, 23.5, 30	1,018
6-8	106, 356, 600, 604, 618, 623, 650, 651, 653, 655, 706, 836, dalseo1, dalseo3, dalseo4-1, dalseong2	13.5, 10.5, 11.5, 14.5, 10.5, 10.5, 11.5, 11.5, 12.5, 13.5, 10.5, 10.5, 13.5, 15.5, 15.5, 23.5	1,152
6-9	356, 604, 649, 653, 706, 726, dalseo1, dalseo2, dalseo3, dalseo4, dalseo4-1, dalseong1	10.5, 14.5, 10.5, 10.5, 10.5, 13.5, 13.5, 15.5, 15.5, 15.5, 31.5	741
6-10	106, 156, 202, 202-1, 356, 518, 564, 604, 609, 623, 651, 653, 655, 706, 726, 750, 805, dalseong2	13.5, 11.5, 11.5, 11.5, 10.5, 11.5, 11.5, 14.5, 9.5, 10.5, 11.5, 12.5, 13.5, 10.5, 10.5, 12.5, 11.5, 23.5	1,152
6-11	202, 202-1, 402, 503, 527, dalseo2, dalseo3, rapid1, seongseo3	11.5, 11.5, 10.5, 11.5, 11.5, 13.5, 15.5, 11.5, 30	632
6-12	305, 402, 405, 508, 509, dalseo1, rapid1, seongseo3	10.5, 10.5, 11.5, 9.5, 10.5, 13.5, 11.5, 30	605
6-13	305, 402, 405, 503, 509, 521, 527, 564, 655, dalseo2, dalseo3, rapid1, seongseo1, seongseo1-1, seongseo3	10.5, 10.5, 11.5, 11.5, 10.5, 12.5, 11.5, 11.5, 13.5, 13.5, 15.5, 11.5, 23.5, 23.5, 30	1,018
6-14	106, 156, 202, 202-1, 356, 518, 564, 604, 609, 623, 651, 653, 655, 706, 726, 750, 805, dalseong2	13.5, 11.5, 11.5, 11.5, 10.5, 11.5, 11.5, 14.5, 9.5, 10.5, 11.5, 12.5, 13.5, 10.5, 10.5, 12.5, 11.5, 23.	1,152
6-15	106, 604, 618, 649, 653, 706, 726, dalseo1, dalseo2, dalseo3	13.5, 14.5, 10.5, 10.5, 12.5, 10.5, 10.5, 13.5, 13.5, 15.5	735
7-1	349, 400, 400-1, 401, 405, 410, 410-1, 452, 564, 604, 730, belt3, belt3-1, gachang2	12.5, 15.5, 15.5, 9.5, 11.5, 13.5, 13.5, 13.5, 11.5, 14.5, 11.5, 8.5, 11.5, 15.5	1,022
7-2	106, 202, 202-1, 349, 400, 400-1, 402, 405, 410, 410-1, 414, 414-1, 503, 509, 518, 649, 650, 704, 706, 730, 805, belt2, belt2-1	13.5, 11.5, 11.5, 12.5, 15.5, 15.5, 10.5, 11.5, 13.5, 13.5, 11, 11, 11.5, 10.5, 11.5, 10.5, 11.5, 11.5, 10.5, 11.5, 11.5, 11.5, 11.5	1,755

Condo-minium	Bus Number	Interval (in minutes)	Bus Runs
7-3	323, 323-1, 400, 400-1, 401, 402, 414, 414-1, 427, 509, 704, 730, belt2, belt2-1, gachang2	12.5, 12.5, 15.5, 15.5, 9.5, 10.5, 11, 11, 10.5, 10.5, 11.5, 11.5, 11.5, 11.5, 15.5	1,147
7-4	349, 400, 400-1, 401, 405, 410, 410-1, 452, 564, 604, 730, belt3, belt3-1, gachang2	12.5, 15.5, 15.5, 9.5, 11.5, 13.5, 13.5, 13.5, 11.5, 14.5, 11.5, 8.5, 11.5, 15.5	1,022
7-5	300, 410, 410-1, 452, 750, dalseo2, dalseo4, dalseo4-1	11.5, 13.5, 13.5, 13.5, 12.5, 13.5, 15.5, 15.5	533
8-1	600, 604, 609, 623, 650, 651, 655, 836, dalseo1, dalseo3, dalseong1, dalseong2, dalseong5	11.5, 14.5, 19.5, 10.5, 11.5, 11.5, 13.5, 10.5, 13.5, 15.5, 31.5, 23.5, 55	789
8-2	600, 604, 623, 651, 655, 836, dalseong2, dalseong5	11.5, 14.5, 10.5, 11.5, 13.5, 10.5, 23.5, 55	511

APPENDIX 7. The Number of Subway Station nearby Condominiums

Condo-minium	Station[37] (Line number)	The Number of Station[38]				
		Yr 2009	Yr 2008	Yr 2007	Yr 2006	Yr 2005
1-1	-	0	0	0	0	0
1-2	-	0	0	0	0	0
1-3	Daegu (1)	1	1	1	1	1
1-4	-	0	0	0	0	0
1-5	-	0	0	0	0	0
1-6	-	0	0	0	0	0
1-7	-	0	0	0	0	0
1-8	-	0	0	0	0	0
1-9	-	0	0	0	0	0
1-10	-	0	0	0	0	0
1-11	-	0	0	0	0	0
2-1	Sincheon (1)	1	1	1	1	1
2-2	-	0	0	0	0	0
2-3	Gaksan (1), Ansim (1)	2	2	2	2	2
2-4	Yulha (1)	1	1	1	1	1
2-5	Chilsungsijang (1), Sincheon (1)	2	2	2	2	2
3-1	Duryu (2)	1	1	1	1	0
3-2	-	0	0	0	0	0
3-3	-	0	0	0	0	0
3-4	-	0	0	0	0	0
4-1	Bangogae (2) Seomunsijang (2)	2	2	2	2	0
4-2	Gyungdaebyungwon (1)	1	1	1	1	1
4-3	Seomunsijang (2)	1	1	1	1	0
4-4	Seomunsijang (2)	1	1	1	1	0
4-5	Bangogae (2)	1	1	1	1	0
5-1	-	0	0	0	0	0
5-2	Damti (2)	1	1	1	1	0
5-3	Beomeo (2)	1	1	1	1	0
5-4	-	0	0	0	0	0
5-5	Daegu-eunhaeng (2)	1	1	1	1	0
5-6	-	0	0	0	0	0
5-7	-	0	0	0	0	0
5-8	Damti (2)	1	1	1	1	0
5-9	Beomeo (2)	1	1	1	1	0
5-10	Suseong-gucheong (2) Manchon (2)	2	2	2	2	0
5-11	Suseong-gucheong (2) Manchon (2)	2	2	2	2	0
5-12	Daegu-eunhaeng (2)	1	1	1	1	0
5-13	-	0	0	0	0	0

[37] The subway line number 1 opened in 1998 and line number 2 opened in late 2005.

[38] The subway stations within a radius of approximately six-hundred meters of each condominium were all counted based on the Daegu Life Geographic Service.

Condo-minium	Station (Year started)	The Number of Station				
		Yr 2009	Yr 2008	Yr 2007	Yr 2006	Yr 2005
6-1	Yongsan (2)	1	1	1	1	0
6-2	Seongseo-gongdan (2)	1	1	1	1	0
6-3	-	0	0	0	0	0
6-4	Sangin (1), Wolcheon (1)	2	2	2	2	2
6-5	-	0	0	0	0	0
6-6	-	0	0	0	0	0
6-7	Seongseo-gongdan (2)	1	1	1	1	0
6-8	Sangin (1)	1	1	1	1	1
6-9	-	0	0	0	0	0
6-10	Songhyeon (1)	1	1	1	1	1
6-11	-	0	0	0	0	0
6-12	-	0	0	0	0	0
6-13	Seongseo-gongdan (2)	1	1	1	1	0
6-14	Songhyeon (1)	1	1	1	1	1
6-15	-	0	0	0	0	0
7-1	-	0	0	0	0	0
7-2	Gyodae (1) Myeongdeok (1)	2	2	2	2	2
7-3	-	0	0	0	0	0
7-4	-	0	0	0	0	0
7-5	Hyeonchungro (1)	1	1	1	1	1
8-1	Daegok (1)	1	1	1	1	1
8-2	-	0	0	0	0	0

APPENDIX 8. The Number of City Park nearby Condominium Apartment Complexes

Condo-minium	City Park (Year built/Area(in 1,000 m^2))	The Number of City Park[39]				
		Yr 2009	Yr 2008	Yr 2007	Yr 2006	Yr 2005
1-1	Gwaneum (1999/69) Taejeon (1999/54)	2	2	2	2	2
1-2	Guam (1999/25)	1	1	1	1	1
1-3	-	0	0	0	0	0
1-4	-	0	0	0	0	0
1-5	Chimsan (1993/291)	1	1	1	1	1
1-6	Hamji (2001/47)	1	1	1	1	1
1-7	Daebul (2000/117)	1	1	1	1	1
1-8	Daebul (2000/117)	1	1	1	1	1
1-9	Hamji (2001/47)	1	1	1	1	1
1-10	Daebul (2000/117)	1	1	1	1	1
1-11	Gwaneum (1999/69) Taejeon (1999/54)	2	2	2	2	2
2-1	-	0	0	0	0	0
2-2	-	0	0	0	0	0
2-3	Sinseo (2001/1)	1	1	1	1	1
2-4	Daeguseon (2010/33)	0	0	0	0	0
2-5	Sincheon River[40]	1	1	1	1	1
3-1	Gamsam (2003/16)	1	1	1	1	1
3-2	-	0	0	0	0	0
3-3	Pyeongni (1979/19)	1	1	1	1	1
3-4	-	0	0	0	0	0
4-1	-	0	0	0	0	0
4-2	Daebong (1958/61) Sincheon River	2	2	2	2	2
4-3	-	0	0	0	0	0
4-4	-	0	0	0	0	0
4-5	-	0	0	0	0	0
5-1	Beomeo (1965/1,132)	1	1	1	1	1
5-2	-	0	0	0	0	0
5-3	Beomeo (1965/1,132) Simin (1965/198)	2	2	2	2	2
5-4	Beomeo (1965/1,132)	1	1	1	1	1
5-5	Sincheon River	1	1	1	1	1
5-6	**Hwarang (2009/45)**	**1**	**0**	**0**	**0**	**0**
5-7	Sinmae (2010/1)	0	0	0	0	0
5-8	-	0	0	0	0	0
5-9	Beomeo (1965/1,132)	1	1	1	1	1
5-10	Beomeo (1965/1,132)	1	1	1	1	1

[39] The city parks of which the area is greater than 10,000 m^2 within a radius of approximately six-hundred meters of each condominium were all counted based on the Daegu Life Geographic Service. Parks located in condominium premises and two urban natural parks (the Apsan and the Waryongsan) were excluded.

[40] The Sincheon River Park was completed in 1998 alongside the Sincheon River of which its length is about 12.5 kilometers and this river park provides natural view, and sports facilities etc. to neighboring citizens.

Condo-minium	Park (Year built/Area(in 1,000 m^2))	The Number of Park				
		Yr 2009	Yr 2008	Yr 2007	Yr 2006	Yr 2005
5-11	Beomeo (1965/1,132)	1	1	1	1	1
5-12	Sincheon River	1	1	1	1	1
5-13	Sinmae (2010/1)	0	0	0	0	0
6-1	Sangni (1995/243) Yongsan (1998/17)	2	2	2	2	2
6-2	Igok Bunsu (1997/15) Igok Jeongja (1990/14) Bulmigol (1997/72) Seonwon (1977/114)	4	4	4	4	4
6-3	Dowon (2003/16)	1	1	1	1	1
6-4	Haksan(1990/660)	1	1	1	1	1
6-5	Daegok (2000/10)	1	1	1	1	1
6-6	Duryu (1977/1,654) Bolli (1996/22)	2	2	2	2	2
6-7	Bulmigol (1997/72) Seonwon (1977/114) Baesil (1995/30) Waryong (1995/19) Igok Bunsu (1997/15) Igok Jeongja (1990/14)	6	6	6	6	6
6-8	Haksan(1990/660) Wolmyeong (1992/10)	2	2	2	2	2
6-9	Wolgok (2002/35)	1	1	1	1	1
6-10	Haksan(1990/660) Bolli (1996/22)	2	2	2	2	2
6-11	Sangni (1995/243) Yongsan (1998/17)	2	2	2	2	2
6-12	-	0	0	0	0	0
6-13	Bulmigol (1997/72) Baesil (1995/30) Waryong (1995/19)	3	3	3	3	3
6-14	Haksan(1990/660) Bolli (1996/22)	2	2	2	2	2
6-15	Daegok (2000/10) Dowon (2003/16)	2	2	2	2	2
7-1	Sincheon River	1	1	1	1	1
7-2	Daebong (1958/61)	1	1	1	1	1
7-3	Sincheon River Daebong (1958/61)	2	2	2	2	2
7-4	Sincheon River	1	1	1	1	1
7-5	-	0	0	0	0	0
8-1	Cheonnae (1985/153)	1	1	1	1	1
8-2	Myeonggok Sports (2015/492)	0	0	0	0	0

APPENDIX 9. The Number of Department Store and Discount Store nearby Condominiums

Condo-minium	Store[41](Year built)	The Number of Store[42]				
		Yr 2009	Yr 2008	Yr 2007	Yr 2006	Yr 2005
1-1	Donga Dpt. Store (1997)	1	1	1	1	1
1-2	Donga Dpt. Store (1997)	1	1	1	1	1
1-3	Homeplus (1997) E-mart (2002)	2	2	2	2	2
1-4	Costco (1997)	1	1	1	1	1
1-5	-	0	0	0	0	0
1-6	Homeplus (2001)	1	1	1	1	1
1-7	Costco (1997)	1	1	1	1	1
1-8	Costco (1997)	1	1	1	1	1
1-9	Homeplus (2001) Donga Dpt. Store (1997)	2	2	2	2	2
1-10	Costco (1997)	1	1	1	1	1
1-11	Donga Dpt. Store (1997)	1	1	1	1	1
2-1	-	0	0	0	0	0
2-2	E-mart (2004)	1	1	1	1	1
2-3	E-mart (2004)	1	1	1	1	1
2-4	Lotte mart (2010)	0	0	0	0	0
2-5	-	0	0	0	0	0
3-1	Homeplus (2003)	1	1	1	1	1
3-2	-	0	0	0	0	0
3-3	-	0	0	0	0	0
3-4	-	0	0	0	0	0
4-1	Homeplus (2003) Donga Shopping (1984)	2	2	2	2	2
4-2	Donga Shopping (1984) Daebaek Plaza (1993)	2	2	2	2	2
4-3	Donga Shopping (1984)	1	1	1	1	1
4-4	Donga Shopping (1984)	1	1	1	1	1
4-5	Homeplus (2003)	1	1	1	1	1
5-1	Homeplus (2010)	0	0	0	0	0
5-2	-	0	0	0	0	0
5-3	-	0	0	0	0	0
5-4	Homeplus (2010)	0	0	0	0	0
5-5	Daebaek Plaza (1993)	1	1	1	1	1
5-6	E-mart (2001)	1	1	1	1	1
5-7	E-mart (2000) E-mart (2006)	2	2	2	2	1
5-8	-	0	0	0	0	0
5-9	-	0	0	0	0	0
5-10	-	0	0	0	0	0
5-11	-	0	0	0	0	0
5-12	Daebaek Plaza (1993)	1	1	1	1	1
5-13	E-mart (2000) E-mart (2006)	2	2	2	2	1

[41] In the case of discount stores, the four brands well-known for large discount stores in operation were sought and employed: Costco, E-mart, Homeplus and Lotte mart.

[42] Department stores and discount stores within a radius of approximately one kilometers of each condominium were all counted based on the Daegu Life Geographic Service.

Condo-minium	Store (Year built)	The Number of Store				
		Yr 2009	Yr 2008	Yr 2007	Yr 2006	Yr 2005
6-1	E-mart (2002)	1	1	1	1	1
6-2	E-mart (1999)	1	1	1	1	1
6-3	-	0	0	0	0	0
6-4	Homeplus (2007) Lotte Dpt. Store (2004)	2	2	2	1	1
6-5	-	0	0	0	0	0
6-6	E-mart (2002)	1	1	1	1	1
6-7	E-mart (1999)	1	1	1	1	1
6-8	E-mart (2001) Homeplus (2007) Lotte Dpt. Store (2004)	3	3	3	2	2
6-9	Homeplus (2007)	1	1	1	0	0
6-10	-	0	0	0	0	0
6-11	E-mart (2002)	1	1	1	1	1
6-12	-	0	0	0	0	0
6-13	E-mart (1999)	1	1	1	1	1
6-14	-	0	0	0	0	0
6-15	Homeplus (2007)	1	1	1	0	0
7-1	-	0	0	0	0	0
7-2	Daebaek Plaza (1993) Donga Shopping (1984)	2	2	2	2	2
7-3	Daebaek Plaza (1993)	1	1	1	1	1
7-4	Daebaek Plaza (1993)	1	1	1	1	1
7-5	Homeplus (2005)	1	1	1	1	1
8-1	-	0	0	0	0	0
8-2	-	0	0	0	0	0

REFERENCES

Baltagi, Badi H. 2008. *Econometric Analysis of Panel Data*. 4th ed. Chichester, UK : John Wiley & Sons, Ltd

Bertaud, Alain. 2004. The spatial organization of cities: Deliberate outcome or unforeseen consequence? http://alain-bertaud.com/images/AB_The_spatial_organization_of_cities_Version_3.pdf, A web page dedicated to the study of urban spatial structures

Bogart, William T. and Brian A. Cromwell. 2000. How much is a neighborhood school worth? *Journal of Urban Economics* 47: 479-505.

Brasington, David M. 1999. Which measures of school quality does the housing market value? *Journal of Real Estate Research* Vol. 18, No. 3: 395-413.

Brasington, David M. and Donald R. Haurin. 2004. Educational outcomes and house values: A test of the value-added approach. Working Paper 2005-03, Department of Economics, Louisiana State University

Chiodo, Abbigail J., Rubén Hernández-Murillo, and Michael T. Owyang. 2010. Nonlinear effects of school quality on house prices. *Federal Reserve Bank of St. Louis Review*, May/June 2010, 92(3): 185-204.

Choi, Hee-sook. 2008. A study on the effect of parents and relatives' social capital on the students' academic achievements. PhD diss., Yonsei Univ.

Choi, Hyung-jae. 2007. The effect of private tutoring on college entrance. *Journal of Korea International Economic Association* Vol. 14, No. 1: 73-110.

Choi, Chung-ik. 2008. Panel Data model: time-series analysis and cross-section analysis, simultaneously. *Journal of the Korea Research Institute for Human Settlements* Vol. 320: 120-127.

Chung, Hyun. 2000. A study on the analysis of changing patterns and the determinants of residential location in Taegu. *Journal of the Real Estate Analysts Association* Vol. 6, No. 1: 63-82.

Downes, Thomas A. and Jeffry E. Zabel. 1997. The impact of school characteristics on house price: Chicago 1987-1991. Department of Economics, Tufts University

Eom, Keun-Yong, Choong-Han Yoon and Duk-Ho Lim. 2006. The effects of educational environments on housing price. *Journal of Economic Studies* Vol. 24, No. 4: 99-115.

Fallis, George B. 1985. *Housing economics*. Toronto: Butterworth-Heinemann Press.

Jang, Sung-su and Suk-min Hong. 2007. A study on the regional differentiation of housing market regulations. Working Paper 2007-3, the Korea Housing Institute

Jung, Su-Yeon. 2006. Impact of educational variable on apartment price in Seoul. *Journal of the Real Estate Analysts Association* Vol. 11, No. 2: 69-86.

Kang, Tea-Hwan and Deok-Keun Choi. 2002. A study on the price and supply characteristics of condominium apartments in Daegu. *Journal of the Real Estate Analysts Association* Vol. 8, No. 1: 69-77.

Kim, Hoon. 2005. An exploratory study on the lifestyle trait of house consumers. *Journal of Korea Planners Association* Vol. 41, No. 2: 153-166.

Kim, Hyun-a and Seung-woo Lee. 2005. A Study on the Influence of Real Estate Policies on the Construction Industry. Working Paper 2005-01, Construction and Economy Research Institute of Korea

Kim, Jong Soon. 2008. A study into low academic levels in rural area elementary schools. Master's thesis, Kangwon National Univ.

Kim, Kyung-Min and Yang-Won Lee. 2007. Impacts of education factors on apartment prices. *The Korea Spatial Planning Review* Vol. 55: 239-252.

Kim, Sung Woo and Kyoun Sup Chung. 2010. Comparative study of the fitness between traditional OLS models and spatial econometrics models using the real transaction price in Busan. *Journal of the Real Estate Analysts Association* Vol. 16, No. 3: 41-55.

Kim, Youkyung and Sunku Hahn. 2007. Measuring the effect of high school qualities on the apartment prices in Korea. *Journal of Institute of East&West Studies* Vol. 19, No. 2: 69-87.

Koomin Bank. KB Research Institute. *Survey on Actual Condition of Housing Finance*. 2009. http://land.kbstar.com/quics?page=B002213#

Lee, Byeong-gi. 2007. The housing and real estate policy. Issue paper 07-08, Korea Economic Research Institute

Lee, Young-beom and Chong-goo Park. 2010. An analysis of the stance of real estate policy during participatory government and Lee MyungBak government. *Journal of Residential Environment Institution of Korea* Vol. 8, No. 1: 85-99.

Min, In-sik and Pil-seon Choi. 2009. *STATA Panel Data Analysis*. Seoul, Korea: The Korean Association of STATA Press

Park, Won Gap and Gab Youl Kim. 2006. The effect of educational policy on the housing Market. *Journal of Korea Real Estate Research Institute* Vol. 16, No. 1: 147-163.

Rho, Taeug and Changdeok Kang. 2009. The impact of urban environment in the price of residential land. *Journal of the Real Estate Analysts Association* Vol. 15, No. 1: 81-101.

Shin, Ki-Hyun. 2009. A critical review on the concept of education fever: Focus on metaphor and education. *The Korean Society for the Study of Educational Principles* 14(1): 57-82.

Sim, Gyu-seop, Seung-ji Bak, Jin-woo Lee, Jong-ho Kim and Sung-woo Kim. 2009. *Real estate invest map for the education-specialized zones*. Seoul: Kim&Jung Press. Note: the last name first only for the first author.

Torres-Reyna, Oscar. 2011. Panel Data Analysis, Fixed & Random Effects (using Stata 10.x). Data & Statistical Services, Princeton University
http://dss.princeton.edu/training/panel101.pdf

Wong, S.K., K.C. Wong, K.W. Chau, C.Y. Yiu, and D.C.W. Ho. 2008. Does student quality fluctuate with real estate prices? *Journal of Real Estate Practice and Education* 11, 2: 145-158.

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