

An Empirical Analysis of Seoul' s Office Market

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Jae-Young Son

Department of Real Estate Science

Konkuk University

Seoul, Korea

Jyson@kkucc.konkuk.ac.kr

Kyung-Hwan Kim

Department of Economics

Sogang University

CPO Box 1142, Seoul, Korea

kyungkim@ccs.sogang.ac.kr

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I. Introduction

Real estate sector accounts for a large share of total output of the Korean economy, although the contribution of the sector dropped significantly in the aftermath of the economic crisis which started in late 1997. During the 1990-97 period, residential construction accounted for 34~37 % of total capital formation and 6.3~8.9 % of GDP in Korea., and the figures for the non-residential construction were about 80 % of those of residential construction. Whereas substantial research has been carried out in Korea on urban housing markets, there has been very little research on the office market. A major reason has been the lack of reliable time series data on market rents, vacancy rates, and construction costs of office space. Several real estate consulting firms started gathering such data recently. But the time series data are very short, and cross-section data are not available in a format that is appropriate for various analyses.

The need for systematic collection and careful analysis of cross-section data on Korean office markets is strong for a few important reasons. First, the knowledge obtained from cross-section analyses can be helpful in establishing a cost-effective information system on the office markets. Secondly, cross-section analyses can provide information on costs of and returns on office buildings, and thereby assist in decision-making for developers and investors. Thirdly, careful analysis of office markets can provide basic data required for the successful market making for REIT (Real Estate Investment Trust) which is being introduced in Korea.

This paper provides an empirical analysis of the Seoul's office market using available time series data and cross-sectional data collected by the authors in collaboration with Bu-Dong-San Bank Co., a leading company in the real estate information business. In section II, we review the previous studies on the Korean office markets. Section III provides an analysis of time series data on the office stock and new office supply in Seoul. In Section IV, we estimate a set of hedonic equations for office rents. Section V summarizes major findings of the paper.

II. A Review of Previous Studies on Seoul's Office Market

In this section, we review the literature on empirical studies on Seoul's office market, both time series analyses and cross-sectional analyses. First of all, there are a few empirical studies on the supply of new office space using time series data on completions of office buildings in Seoul. Choi (1995) analyzed data on 3,699 office buildings with six stories or more completed between 1960 and 1994 compiled by the Association of Fire Insurance Companies. He estimated total

office space stock as a function of time trend variables.

$$Q_t = -35.0 + 29.92 t - 0.405 t^2 + 0.105 t^3 + 0.061 \text{ DUM},$$

where $t=1$ for 1960, $t=2$ for 1961 etc, and DUM is a dummy variable which equals 1 for 1991 and 1992 and 0 for all other years. The dummy variable was included to control for an abrupt surge of construction activity as owners of undeveloped land were forced to develop their property in order to escape from a tax on unrealized capital gains from undeveloped land introduced in 1990.

Choi found that the coefficients of all time trend variables and the dummy variable were statistically significant. The adjusted R^2 value was 0.9959. However, the same model did not perform equally well when it was applied to a subset of office buildings which have at least 10 stories or 10,000 square meters of floor space. He also estimated a simple double-log relationship between total office space available in a given year and real GNP of the previous year. The result was

$$\ln Q_t = -1.543 + 1.772 \ln \text{GNP}_{t-1} \text{ for the entire sample and}$$

$\ln Q_t = -2.301 + 1.865 \ln \text{GNP}_{t-1}$ for the sub-sample of larger buildings. The adjusted R^2 values were 0.9713 and 0.9670, respectively, and the coefficient of $\ln \text{GNP}_{t-1}$ was statistically significant in both equations. The estimation results suggest that larger office buildings are somewhat more elastic with respect to the growth of the national economy.

Park (1999) did an empirical analysis of the Seoul's office market using the theoretical framework of Wheaton (1996). He constructed an index for office rent for the 1974-98 period. He then estimated real rent (R_t), the rent index divided by the Consumer Price Index, as a function of the number of office workers (E_t), the total office space stock, and the previous year's rent. He found that the real rent increases with the number of office workers and the previous year's rent, and falls with the total stock of office space. The coefficients of all three variables were statistically significant and adjusted R^2 was 0.9091.

Park also estimated an equation for new supply of office space defined as the increase in the total office space during a year (C_t). The preferred equation was

$$C_t = -1316357 + 16836.1 R_{t-6} + 10.2424 (E_{t-6} - E_{t-7}) + 1798410.7 \text{ DUM}$$

where DUM takes a value of 1 for 1991 and 1992 and 0 otherwise for the same reason as that in Choi (1995). The estimation result suggests that the volume of new construction increases with real rent and the growth of the number of office workers with a six-year lag . The adjusted R^2 was 0.6202.

On the cross-section side, Kim (1995) estimated hedonic rent functions using data on 200 office buildings and reported that office rents rise with total floor area of the building and fall with distance from the nearest subway station. Huh (1998) estimated separate hedonic regressions for three sub-markets using data on 400 office buildings, and found that different factors affect rents in different sub-markets. For example, land price, total floor area, and shape of the site were found to be the major determinants of rents in the Central Business District, while proximity to subway stations and total floor area had a significant impact on office rents in Yoido. In the case of the Kangnam sub-market, floor space of the third floor of the building and the age of the building, and distance to the nearest subway stations were identified as key factors in determining office rents. The paper by Kim, Lee and Lee (1999) is the most recent cross-section study using data on 450 office buildings. They reported that the type of lease, the sub-market the building is located in, the number of elevators, total floor area, and the proximity to the nearest subway stations were major determinants of office rents.

A common problem arises in cross-section studies including those mentioned above concerning the treatment of the different types of lease contracts being practiced in Korea. Some office space is rented on a monthly rent base with a security deposit, while other landlords ask for a lump sum deposit known as Chonsei up front in lieu of monthly rents. Huh (1997) analyzed data on only those buildings for which both chonsei deposit and monthly rents were known. In other cases, the tenants are given the choice between monthly rents and the chonsei deposit which are linked to each other through an implicit interest rate. Kim et al (1999) applied the corporate bond yield to the amount of deposit to compute the implicit monthly rent. In practice, however, the implicit interest rate varies across sub-markets as well as across buildings within each sub-market, and therefore, applying a single interest rate is not appropriate. We will address this issue in the analysis reported in section IV below.

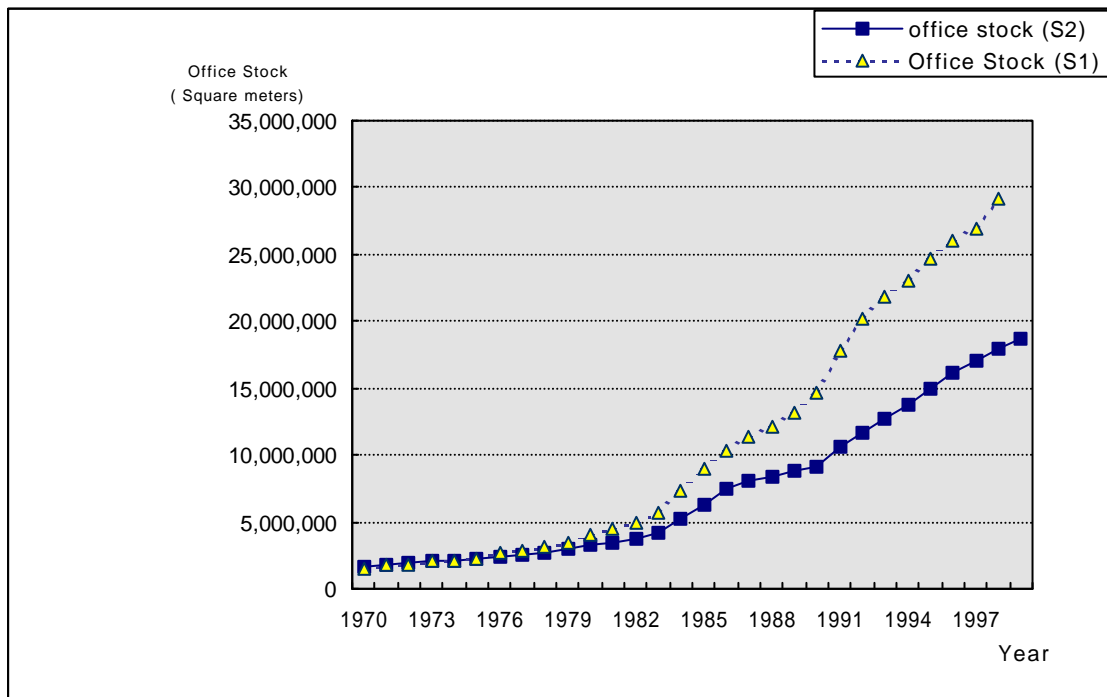
III. Time Series Analysis of the Stock and New Supply of Office Space

In this section, we estimate regression equations for the stock of office space and annual addition to the stock. The data we use were taken from Park (1998) and supplemented by data

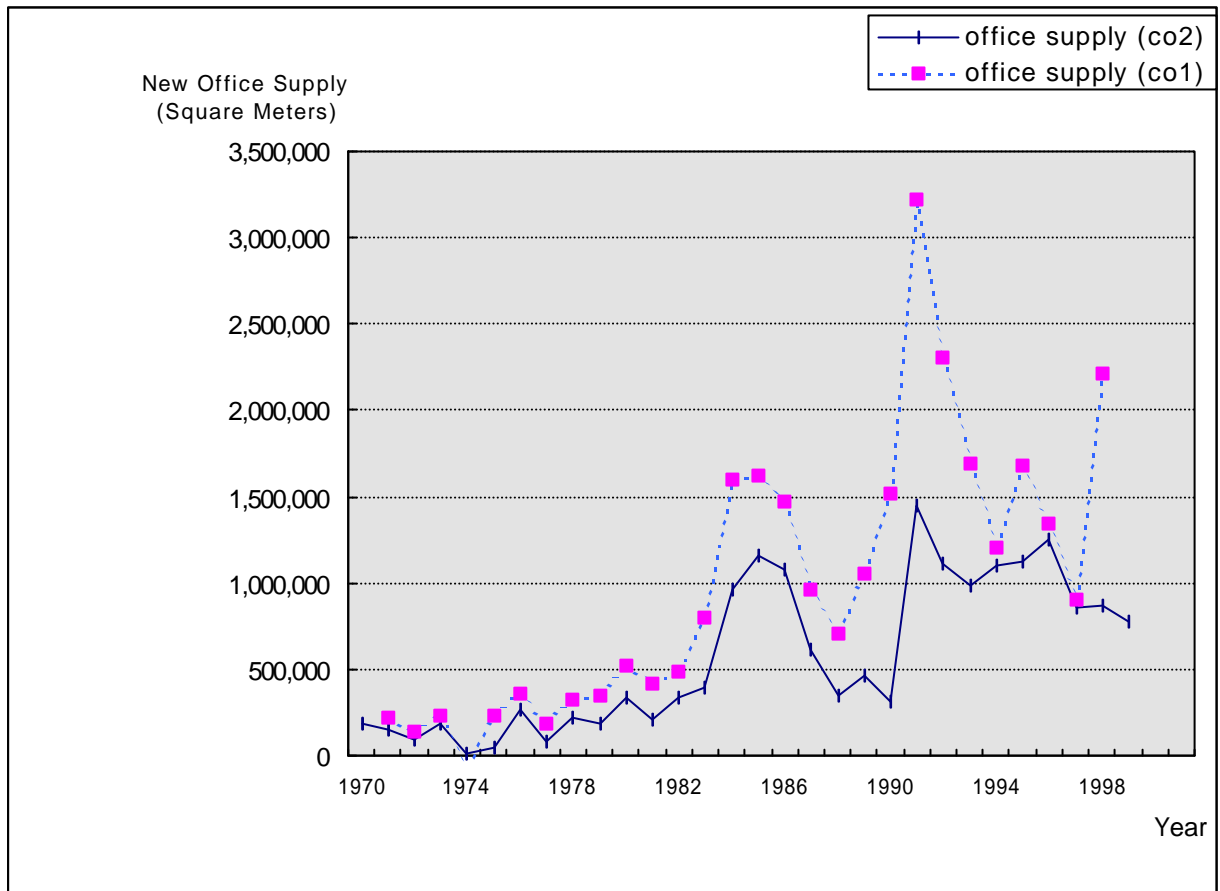
compiled the Korean Association of Fire Insurance Companies (KAFC). KAFC maintains data base on office buildings since all buildings of 6 stories or more had been required to subscribe to an insurance policy for which process they were required to report information on major characteristics of the buildings. Buildings with ten stories or less were relieved of the requirement as the regulation was amended in 1997.

Figure 1 and Figure 2 respectively illustrate the trend of the stock(S) of office space and the new supply (C) of office in Seoul since 1970. In each graph, two sets of data are plotted, the series labeled with number 1 represent the sample of buildings with six stories or more, while those with label 2 represent the sub-sample consisting of buildings with 10 stories or more. Figure 1 shows a clear time trend. Therefore, we first estimate a set of equations relating total office stock to time trend variables (T).

<Figure 1> Seoul's Office Stock : 1970-98



<Figure 2> New Supply of Office Space : 1970-98



The results are presented in Table 1. Linear, quadratic and cubic functions were estimated and each equation produced a remarkably good fit of adjusted R^2 over 0.99. DUM 1 represents a dummy variable that takes the value of 1 for those years during which construction was unusually active because of the impending introduction of the new tax on vacant land. The results were quite similar for the S1 equations and S2 equations.

<Table 1> Office Stock as a Function of Trend Variables

	Dependent Variable:S1			Dependent Variable:S2		
	Model 1	Model 2	Model 3	Model 1'	Model 2'	Model 3'
Constant	14.114 (30.33)	222540 (4.00)	357382 (4.15)	13.979 (79.75)	204189 (7.31)	230200 (5.65)
T	0.108 (5.91)	-28881 (-3.49)	-75487 (-3.27)	0.0957 (13.37)	-13577 (-3.24)	-23034 (-2.06)
T²		43126.4 (16.65)	80787.9 (4.76)		23928.2 (18.04)	31702.9 (3.79)
T³			-822.401 (-2.28)			-170.69 (-0.95)
DUM1		109163 (2.37)			246161 (0.99)	
AR(1)	0.909 (8.33)			0.840 (8.83)		
MA(1)		0.9386 (25.53)	0.9735 (33.12)		0.8275 (6.55)	0.8371 (7.10)
Adj R²	0.9966	0.9976	0.9975	0.9962	0.9977	0.9977
D-W	1.15	1.46	1.60	1.12	1.45	1.72

Note: Figures in parentheses are t- values.

Although the results presented in table 1 suggest that most of the variations in the office stock can be explained by time trend variables, we wanted to see whether a long-term relationship exists between the office stock and the total output of the city. Estimation results are summarized in Table 2. In the first set of regressions with logarithm of S1 as dependent variable, both GDP and GRP (Gross Regional Product) of Seoul carried significant positive coefficients. On the other hand, the results from the S2 equations were less satisfactory. Although the overall fit was still very good, the income variables were either insignificant or had the wrong sign. Finally, as it was true of regression equations reported in table 1, Durbin-Watson statistics pointed to positive serial correlation.

<Table 2> Office Stock as a Function of GDP (GRP)

	Dependent Variable :LOG(S1)				Dependent Variable: LOG(S2)			
	Model 1	Model 2	Model 3	Model 4	Model 1'	Model 2'	Model 3'	Model 4'
Constant	0.6424 (1.57)	7.8757 (20.99)	7.3953 (2.73)	11.527 (7.66)	3.4701 (9.582)	21.475 (10.19)	13.067 (4.61)	13.365 (9.76)
T			0.0589 (2.55)	0.0661 (2.45)			0.083 (3.41)	0.083 (3.38)
LnRGDP	1.5598 (37.08)		0.7716 (2.45)		1.2401 (33.32)		0.1208 (0.37)	
LnRGRP		1.3573 (22.68)		0.5623 (1.74)		-0.4694 (-1.91)		0.149 (0.50)
AR(1)						0.9483 (58.35)		
MA(1)	0.844 (8.50)		0.9897 (1137)	0.9442 (10.48)	0.7180 (5.49)		0.853 (9.87)	0.956 (11.62)
Adj R²	0.994	0.970	0.996	0.990	0.991	0.991	0.994	0.989
D-W	1.48	0.69	1.32	0.90	1.25	1.77	1.16	0.99

Note: Figures in parentheses are t- values.

Next, we explored relationships between new supply of office space and the relevant explanatory variables. According to the standard theory of the office markets, the level of desired construction is a function of the stock of office, vacant space, and absorption., i.e. the increase in space demand, with some lag. And annual completions at time t move proportionally to the difference between desired completions and those just undertaken. Finally changes in rents are proportional to the difference between the equilibrium rent and the previous year's rent, which in turn depends on the ratio between absorption and stock of space (DiPasquale and Wheaton 1996, ch. 12)

Without data on vacancy rates, we had to opt for a single equation for the new completions as in Park (1998). The estimation results are presented in table 3. The key explanatory variables were real rent (R) , nominal rent index divided by CPI as reported in Park (1998), the consumer price index, and changes in office employment (DE). We also considered the consumer price index (CPI) , changes in total money supply (DM2), and DUM1, dummy variable that captures the effect of the introduction of a new tax explained above.

<Table 3> New Office Supply Equation

	Dependent Variable: CO1			Dependent Variable: CO2		
	Model 1	Model 2	Model 3	Model 1'	Model 2'	Model 3'
Constant	-1316357 (-1.16)	367356 (1.62)	-2897921 (-2.60)	-8926932 (-1.09)	157905 (1.25)	-1430136 (-1.58)
CO(-1)		0.3198 (1.84)			0.5237 (3.31)	
R(-6)	16836.1 (1.90)		23533.1 (2.91)	10837.6 (1.69)		15256.7 (2.32)
DE(-6)	10.2424 (2.84)	6.0699 (2.24)	10.0583 (2.09)	6.7183 (2.58)	2.3916 (1.42)	0.9997 (0.26)
CPI(-6)			27996.6 (2.82)			3637.2 (0.45)
DM2(-6)			-103.87 (-1.83)			49.21 (1.07)
DUM1	1798411 (5.28)	1290858 (3.03)	1577567 (5.33)	696799 (2.83)	524072 (2.50)	682639 (2.84)
Adj R²	0.6201	0.6079	0.734	0.3421	0.5657	0.5886
D-W	1.87	1.81	2.20	1.03	2.03	1.24

Note: Figures in parentheses are t- values.

The first model reproduces the preferred equation reported in Park (1998). It suggests that new office supply increases with the real rent and the increase in office employment with a six-year lag, and the dummy variable had a significant impact. Although six years seems too long as lead-time in Korea, no other specification did better. Besides, there is no theory about the length of lead time. The second equation has the lagged dependent variable as an explanatory variable, but no trend variable and the lagged rent term. The fit was almost as good as in the first equation. The third equation has a few additional explanatory variables. We would have liked to include the cost of construction, but we did not have data covering the entire sample period. The positive sign of CPI (-6) could be indicative of the impact of the overall economic boom on construction activities. But M2(-6) had an unexpected negative sign. We have also tried the corporate bond yield as a variable representing the cost of financing, but the result was not good.

In summary, office stock can be explained by time trend variables together with GDP or GRP. On the other hand, new office supply appears to have been affected by real rent and growth of office employment with a lag and the introduction of the new land tax, but not by variables related to the financial market conditions such as the interest rate or money supply.

IV. Cross-section Analysis of Office Rents

The Data

In this section, we estimate hedonic regressions to identify the key determinants of market rents on office space in Seoul's three major business districts. The data we used were collected in collaboration with Bu-dong-san Bank Co in October 1999. A team of research assistants visited about 350 buildings with 5 stories or more, and collected relevant data from building management staff. Additional information was obtained from public registration record of land and building. The sample was not drawn following a random sampling procedure, but we have no reason to believe that it was biased. On the other hand, we found the managers of smaller buildings less forthcoming with data, and the information on the characteristics of tenants and vacancy was difficult to come by. Consequently, the number of usable observations was reduced to 238 observations in the hedonic analysis.

Effective Rent

Some adjustments need to be made to arrive at data on rents in a comparable format. As it was mentioned above, a typical lease contract of office space in Korea requires a lump sum deposit called chonseil or monthly rental payments with a security deposit. When only a chonseil deposit is paid, its monthly rent equivalent must be computed. In order to deal with this problem, data on rents was processed like the following. First, for 141 buildings on which data on both monthly rents and chonseil deposit were available, a conversion rate (r) was computed as monthly rent/(chonseil deposit-monthly rental deposit). Secondly, the computed conversion rate was regressed on a set of variables to produce:

$$r = 0.018583 + 0.001949*RG1 - 0.002944*RG2 - 0.001399*CD, \quad \text{adjusted } R^2 = 0.3753.$$

where RG1 and RG2 are dummy variables equal to 1 for the buildings located in the Kangnam sub-market and Mapo-Yoido sub-market, respectively, and CD is the amount of chonseil deposit

in million Won. Thirdly, the estimated conversion rate was applied to those buildings with chonsei deposit data alone to compute the monthly rent equivalent. Where office space is available on a monthly rent cum deposit base, 10 months' rent was assumed to be the monthly rental deposit. Finally, rental payment on each building was converted into a standard lease requiring a security deposit of 10 months' rents and monthly rental payments. And then the market yield on three-year corporate bond of 8.9% was multiplied to compute the monthly rent equivalent of the standardized security deposit.

<Table 4> Derivation of Effective Rent

Variable	Unit	Seoul		Kangnam		Mapo-Yoido		CBD	
		Mean (Std. dev.)	No. of obs	Mean (Std. dev.)	No. of obs	Mean (Std. dev.)	No. of obs	Mean (Std. dev.)	No. of obs
1) Survey result									
Chonsei deposit	W 1000/ pyong	3056.5 (1305.7)	201	2650.8 (518.7)	128	2909.4 (1095.4)	37	4650.1 (2072.4)	36
Security deposit	=	519.4 (374.6)	183	593.4 (404.6)	96	359.5 (478.1)	33	485.4 (152.8)	54
Monthly rent	=	37.57 (14.12)	178	34.18 (8.738)	93	27.75 (6.520)	31	48.85 (17.40)	54
2) Monthly rent computed									
Conversion rate bet'n Chonsei and monthly rent (survey)	ratio	.0150 (.00459)	141	0.0168 (.00415)	90	0.0120 (.00327)	21	.0119 (.00392)	30
estimated conv. rate	ratio	0.0146 (0.0040)	238	0.0169 (0.0035)	131	0.0117 (0.0025)	47	0.012 (0.003)	60
A. est. monthly rent with 10 mo. secu. deposit	W1000/ pyong	38.73 (12.20)	238	37.84 (7.4180)	131	28.71 (6.059)	47	48.52 (16.39)	60
B. interest on secu. dp. + A	=	41.60 (13.10)	238	40.64 (7.968)	131	30.84 (6.508)	47	52.12 (17.60)	60
3) Adjusting for service charge and free parking									
C. Value of free parking per pyong	=	2.0231 (2.606)	238	2.175 (3.363)	131	2.245 (0.5313)	47	1.518 (1.332)	60
D. Effective rent =B-C+ service charge	=	57.83 (16.95)	238	55.80 (9.704)	131	45.11 (7.427)	47	72.22 (23.57)	60

Unlike in the U.S. where the tenant pays rent inclusive of insurance premium, property tax and utilities for a standard package of services, the range of services provided in return for rents varies across buildings in Korea. For example, building security service or parking are included in the service charge that goes with monthly rent in some cases. On the other hand, some other buildings collect service charges for no additional services. Where free parking space is provided, the implicit premium was assessed and subtracted from the computed monthly rent. And finally, the service charge was added to the monthly rent to arrive at the effective monthly rent. The whole process described above is summarized in table 4. The mean of the effective rent was 578,300 per pyong (3.3 square meters) for the whole sample. The mean rent in Kangnam sub-market was 77.3 % of that in the CBD, whereas the mean rent in Mapo-Yoido sub-market was at 62.5 % level of the CBD.

Explanatory Variables

The three sub-markets considered in this paper represent the CBD and two subcenters of Seoul, and they are within 30 minutes of drive from each other. Therefore, there appears to be no substantial differences in terms of the overall economic activity or business environment. Nevertheless, the industrial structure might differentiate the three sub-markets. For example, CBD has a concentration of financial institutions, manufacturing and retail and trade industries, Mapo, Yoido sub-market is the center of financial institutions, telecommunications, and retail and trade industries, whereas Kang-nam sub-market has a heavy concentration of manufacturing, finance, and information and telecommunications industries. This means that the growth of particular industry can have a differential impact on demand for office space in different sub-markets. In order to analyze such impact, one needs data on the detailed characteristics of tenants of the office buildings, which were not available.

The other factor is that each sub-market was developed in different points in time and hence it differs in terms of building and facilities standards, construction technology applied, neighborhood characteristics, and the characteristics of tenants. CBD area was developed in the 1960s, Mapo-Yoido sub-market in the 1970s, followed by Kangnam area in the 1980s. During the last few years, a large number of new firms in the IT industry occupied office space in Kangnam area and one of the reasons of their locational decisions is that buildings in the sub-market are equipped with good information and telecommunications infrastructure. Although the buildings located in CBD are aged on average, some of them are well-recognized landmark and hence command a premium. We tried to capture the impact of the difference in the timing of development using a set of sub-market dummy variables after controlling for the physical

characteristics of the buildings, conditions of the roads, and the year of completion.

The next set of explanatory variables represents location attributes at the micro level such as neighborhood characteristics and access to public facilities and subways. We used dummy variables indicating whether or not a building is located within certain distance from a facility rather than the distance itself. It was because we believed that users of a facility would not value the distance per se as long as it is within some threshold, and we were interested in identifying the threshold.

Physical attributes of the buildings are the most important determinants of demand for office space and hence its rent. The rent tends to be higher the larger the total floor area and the number of floors in a building, the quality of building materials, the number of elevators, parking space, air-conditioning and heating, telecommunications facilities, and security arrangements. One problem in estimating the impact of these variables on office rent is that some of the variables are closely related with each other. On the other hand, the number of months since the completion of the building can be regarded as a proxy variable for the physical condition of the building.

The quality of services provided by an office building is also affected by operation and maintenance input. As was mentioned above, our effective rent is inclusive of service charge. By including the quality of air-conditioning and heating, as well as security service, we tried to identify the impact of service quality on rent. The types of premises that occupy office in a building could raise or lower the quality of service provided by the building. Bank branches and restaurants might have different impact on rent., for example. Finally, buildings owned by corporations or public sector institutions are likely to be better maintained than those owned by individuals because the latter have less resources than the former.

The final set of variables concerns the type of lease contracts. In empirical studies of U.S. office markets, special attention is paid to differences in the terms of lease contract (Mills 1993, Glascock et al 1990). In Seoul's office market, the typical lease period is two years and there is no cap on the rent adjustment at renewal. The main difference is between chonsei and monthly rent with a security deposit as was explained above. We include a dummy variable that represents the choices of lease types available for tenants.

Descriptive statistics of the explanatory variables described above are presented in table 5.

<Table 5> Summary Statistics of Explanatory Variables

Variable	Description	Seoul	Kangnam	Mapo-Yoido	CBD
1) Sub-market					
RG1	Kangnam =1	0.5504 (0.4985)	1.000 (0)	0 (0)	0 (0)
RG2	Mapo-Yoido=1	0.1975 (0.3989)	0 (0)	1.000 (0)	0 (0)
2) neighborhood					
SUBWY1	subway station within 100m=1	0.1345 (0.3419)	0.0534 (0.2258)	0.2128 (0.4137)	0.2500 (0.4367)
SUBWY2	subway station within 200m=1	0.3361 (0.4734)	0.2901 (0.4555)	0.2979 (0.4623)	0.4667 (0.5031)
SUBWY3	subway station within 300m=1				
TRANSIT	transit station=1	0.1429 (0.3507)	0.0305 (0.1727)	0.1277 (0.3373)	0.4000 (0.4940)
WIDEROAD	road 6 lanes or wider=1	0.2227 (0.4169)	0.1527 (0.3611)	0.2553 (0.4408)	0.3500 (0.4810)
BIGRETL2	large retailer within 200m=1	0.0840 (0.2780)	0.0458 (0.2099)	0.0851 (0.2821)	0.1667 (0.3758)
BIGRETL3	large retailer within 300m=1	0.1008 (0.3018)	0.0611 (0.2404)	0.1064 (0.3117)	0.1833 (0.3902)
ADOFFI3	major gov't office within 300m=1	0.1345 (0.3419)	0.0382 (0.1923)	0.1489 (0.3599)	0.3333 (0.4754)
3) Physical characteristics of building					
LAREA	log(building size)	9.450 (0.8560)	9.260 (0.7285)	9.856 (0.8539)	9.548 (0.9920)
FAR	floor-area ratio	8.510 (3.101)	8.704 (3.288)	8.348 (2.813)	8.214 (2.905)
LAGE	log(age)	4.581 (0.778)	4.458 (0.566)	4.858 (0.541)	4.636 (1.196)
4) Building service					
EAT	no. of restaurants	0.4790 (0.9577)	0.1069 (0.3340)	1.085 (1.332)	0.8167 (1.157)
EATDUM	restaurant within building=1	0.2731 (0.4465)	0.0992 (0.3001)	0.4893 (0.5052)	0.4833 (0.5040)
FINC	no. of financial institution branches	0.4748 (0.9217)	0.1756 (0.5332)	0.5319 (0.8810)	1.083 (1.267)
FINDUM	financial inst. within building=1	0.2941 (0.4566)	0.1298 (0.3373)	0.3404 (0.4790)	0.6167 (0.4903)
INDICOOL	individual cooling=1	0.0336 (0.1806)	0.0229 (0.1502)	0.0426 (0.2040)	0.0500 (0.2198)
ENTAIN	entertainment facility within building=1	0.1261 (0.3326)	0.2290 (0.1502)	0.2340 (0.4280)	0.2667 (0.4459)
RESTING	resting area within building=1	0.1681 (0.3747)	0.0916 (0.2896)	0.2766 (0.4521)	0.2500 (0.4367)
INDIOWN	owned by individual=1	0.2017 (0.4021)	0.2672 (0.4442)	0.0638 (0.2470)	0.1667 (0.3759)
5) Lease contract type					
CONTT1	monthly rental only =1	0.1555 (0.3631)	0.0229 (0.1502)	0.2128 (0.4137)	0.4000 (0.4940)
CONTT2	Chonsej only=1	0.2521 (0.4351)	0.2901 (0.4555)	0.3404 (0.4790)	0.1000 (0.3025)
CONTT3	both options possible=1	0.5924 (0.4924)	0.6870 (0.4655)	0.4468 (0.5025)	0.5000 (0.5042)

Results of Hedonic Regressions

We ran a set of hedonic regressions for logarithm of effective rent as a linear function of the set of explanatory variables listed in table 5. The results are presented in table 6.

<Table 6> Estimation Results of Hedonic Regressions

Model Expl. Vars	(1)	(2)	(3)	(4)
Constant	10.13(55.5)**	10.18(57.32)**	10.16(56.74)**	10.2(57.56)**
RG1	-0.217(-5.19)**	-0.183(-4.50)**	-0.168(-4.29)**	-0.172(-4.45)**
RG2	-0.44(-9.90)**	-0.415(-9.799)**	-0.414(-10.01)**	-0.406(-9.89)**
SUBWAY3	0.055(1.91)*			
SUBWAY2		0.0717(2.40)**		0.0726(2.49)**
SUBWAY1			0.024(0.532)	
TRANSIT	-0.022(-0.496)	-0.041(-0.95)		
WIDEROAD	0.067(1.85)*	0.0533(1.52)^	0.059(1.683)*	
BIGRTL3	0.088(1.86)*			0.097(2.145)**
BIGRTL2		0.0846(1.175)*	0.090(1.802)*	
ADOFFI3	-0.054(-1.215)			
LAREA	0.085(4.586)**	0.079(4.339)**	0.080(4.367)**	0.076(4.183)**
VRATIO	0.007(1.61)^	0.0074(1.63)^	0.0072(1.605)^	0.007(1.587)^
LAGE	0.027(1.49)^	0.022(1.228)	0.025(1.366)	0.023(1.308)
FINC		0.0356(1.996)**	0.036(1.986)**	0.041(2.366)**
FINDUM	-0.0047(-0.122)			
EAT				
EATDUM	-0.076(-1.86)*	-0.091(-2.34)**	-0.093(-2.380)**	-0.082(-2.133)**
ENTAIN	-0.0746(-1.62)^	-0.078(-1.740)*	-0.068(-1.492)^	-0.085(-1.909)*
RESTING	-0.039(-0.879)	-0.0656(-1.511)^	-0.0588(-1.306)	-0.070(-1.613)^
INDICOOOL	-0.081(-1.037)	-0.091(-1.218)	-0.089(-1.177)	-0.124(-1.666)*
CONTT1	0.097(2.248)**	0.099(2.383)**	0.104(2.479)**	0.101(2.437)**
CONTT2	0.0017(0.051)			
R ²	0.503	0.513	0.500	0.509

Note: 1) Figures in parentheses are t-values.

2) **, *, ^ are significant at 5%, 10%, 15% level, respectively.

Estimation results suggest that the magnitude and the level of statistical significance of the coefficients of the explanatory variables are very stable across various specifications. The R^2 value was around 0.5 for most regression equations, and a relatively small number of explanatory variables proved to be the key determinants of rent. As long as the sub-market dummy variables RG1 and RG2, and a few other variables are included, adding other explanatory variables did not improve the goodness of fit.

To be more specific, RG1 and RG2 were significant in every equation at 1 % level. Rent on comparable buildings located in Kangnam area was at 80~85 % of that in CBD, while the figure for Mapo, Yoido sub-market was 64~67 % of the CBD counterpart. The implied differences in rents across the sub-markets are somewhat smaller than those in effective rents reported in table 4. This might be attributable to the overall quality difference in favor of the two sub-markets relative to the CBD.

As for the variables representing location attributes, rent on an office building located within 300 meters (SUBWY3) and 200 meters (SUBWY2) from the subway stations was 5.7 % and 7.4 % higher than that on a building that is identical in every other respect. However, the buildings within 100 meter from the subway stations carried no premium, and neither did the buildings located within 500 meters from the stations although the results were not reported in table 6. Whether or not a subway station is a hub of multiple subway lines was found to have no impact on office rent nearby. On the other hand, the rent on buildings sited in front of a road of six lanes or more (WIDEROAD) was 5.5~6.9 % higher than otherwise.

Proximity to major facilities had some impact on rent. Office space located within 300 meters (BIGRTL3) and 200 meters (BIGRTL2) from major retail premises rented at about a 9 % premium. The rent on buildings located within 500 meters from the retail premises was not substantially higher. On the other hand, proximity to major public facilities did not perform well. For example, the coefficient of ADOFFI3, which equals 1 for office space located within 300 meters (ADOFFI3) had a negative sign and statistically insignificant.

Among the building characteristics, total floor area (LAREA) was significant at a 1 % level in all regressions. To be more specific, rent per square meter of office rises by 0.076~0.085 % as the total floor area of the building increases by 1 %. Since the mean and the standard deviation of total floor area was 18,418 square and 19,364 square meters respectively, the difference in rents on two buildings that differ in size by the standard deviation is 8~9 %. The floor-area ratio (FAR) was positive and significant at a 15 % level. It is a reasonable result in that larger FAR

means more parking space or open space, other things being equal. However, the coefficient was too small to be considered meaningful. The age of the building (LAGE) carried a positive sign., contrary to our expectation, although statistically insignificant in many cases. This might be because older buildings have recognition premium that could outweigh the disadvantages of being obsolete. Finally, the number of stories (A12) was insignificant when included together with the three variables mentioned above.

As for the types of premises occupying the building, financial institutions had a positive impact on rent whereas eatery had a negative impact. The coefficient of the dummy variable indicating whether or not a financial institution is situated in the building (FINDUM) was not significant. On the other hand, the number of financial institutions (FINC) had a significant and positive sign, and each additional financial institution raised the rent by 3.6~4.2 %. This finding could be indicative of the synergy effect of the co-existence of multiple financial institutions in a building in providing quality service. Quite the opposite was true of restaurants. Whereas the number of premises (EAT) was insignificant, the existence of eatery (EATDUM) carried a negative sign. Similarly, each entertainment premise (ENTAIN) and resting facility (RESTING) depressed rent by 6.6~8.2 %, and 6.4~6.8 % , respectively, at a 15 % significance level.

Most other variables representing the quality of service were insignificant. The provision of central security service (CENTSECU), and the private ownership (INDIOWN) were insignificant in all regressions. On the other hand, the rent on buildings that have no central air-conditioning and hence require individual air-conditioning (INDICOOL) proved to be 11.7% lower than otherwise.

Finally, the type of lease contract had some impact on rent. Compared with the rent on a building for which both chonseil and monthly rental leases were available, the rent on a building which is rented only on a chonseil deposit was not significantly different. However, a building which is rented on a monthly rental base alone was 10.2~10.6 % higher. This could be interpreted as a discount on rent commensurate with the advantages associated with a chonseil contract from the landlord' s viewpoint.

V. Summary and Conclusions

In this paper, we conducted an empirical analysis of Seoul' s office market using both time series and cross-section data. Major findings can be summarized as follows.

Time series analysis suggests that

- 1) Seoul's total office stock can be explained by time trend variables and GDP or GRP, and
- 2) new office supply is determined by real rent and growth of office employment with a lag and the introduction of the new land tax, but not by variables representing financial market conditions such as the interest rate or money supply.

Hedonic regression analysis suggests that

- 1) rent per square meter of comparable office space varies across sub-market
- 2) total floor area, proximity to subways and major retail premises, the floor-area-ratio, and the number of financial institutions located in the building tend to raise rent
- 3) siting of restaurants, resting premises and small stores depresses rent
- 4) buildings available on a monthly rental base only command higher rent
- 5) whether or not the nearest subway station is a hub, proximity to public facilities, and building age has no significant impact on rent
- 6) lack of central air-conditioning depresses rent in some equations.

These findings are consistent with our expectations to a great extent and are not substantially different from the previous studies on the office markets in Seoul and the U.S. For example, the finding that larger building commands higher rent per square meter is consistent with the result reported in Glascock et al (1990) and Mills (1993). The finding that rent varies across types of lease is similar to the conclusions of Benjamin et al (1992).

This study leaves room for improvement.

- 1) On the data side, more reliable time series data are required on rent, vacancy rates and construction cost. Cross section data on sub-markets also need further refinement. Once a representative sample is established and systematic data collection process is established, index of office rent and return can be constructed.
- 2) Our cross-section analysis was limited to hedonic regressions on rent., but further analysis is needed on the impact of tenant characteristics and the changes in industrial structure on rent in different sub-markets.
- 3) Hedonic regressions do not tell us whether the impact of the various characteristics on rent works through supply or demand. For example, rent rises with total floor area but it could be either because large buildings are more costly to build and maintain, or because they offer greater benefits to tenants. A structural equations approach is needed to address this and other interesting questions.

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