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The Estimation of Property Tax Capitalisation in the Korean Taxation Context

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The difference between public services and property tax rates is capitalised into home values. The aim of this research is to estimate the property tax capitalisation rate under a different taxation context of Korea, using a repeat sales method with short-term data on housing prices and estimated tax payments. In the operation of the property taxation, there is complexity that needs to be considered in the estimation of the property tax capitalisation rate. In this research, 32,101 apartment samples in Seoul are used for the analysis. Given these unique institutional circumstances, as a result of the analysis, the property tax capitalisation rate in Seoul was between 73.7% and 82.8% in the analysis periods.

Keywords: Housing Prices; Property Tax; Gross Real Estate Tax (GRET); Capitalisation; Repeat Sales Model

Introduction

The difference between public services and property tax rates is capitalised in home values. This phenomenon is called a capitalisation effect (Yinger et al., 1988; Rosen & Gayer, 2007). Higher property tax payments lead to lower house values if all else being equal. Theoretically, housing prices drop by the discounted present value of property tax payments when the property taxes are imposed. This is called full or complete capitalisation. However, in the extensive study of Yinger et al. (1988), property taxes were partially capitalised. In spite of a simple concept of property tax capitalisation, it is challenging to estimate the degree of capitalisation (Yinger et al., 1988).

Different taxation policy contexts require different analysis methods. During the early 2000s, housing prices increased drastically in a selected few areas in Korea. According to a housing price index, housing prices in Seoul increased approximately 50% over the three years in the early 2000s. In response to the changes in the housing market, the Korean government utilised property taxation as a tool to stabilise housing prices and to improve housing affordability. The government announced more than 30 policies on property markets during the period 2003-7 (Jang, 2010: pp. 274-355). Nevertheless, little has been studied about the influence of the reinforced property taxes on housing prices in Korea.

Thus, the aim of this research is to estimate the property tax capitalisation rate under a different taxation context of Korea, using a repeat sales method with short-term data on housing prices and estimated tax payments. This study sheds light on the presence of the property tax capitalisation effect and proposes a new method to estimate that effect.

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Institutional Context

The Korean government has three hierarchies: the central government, metropolitan governments (*si*/*do*, e.g. Seoul, Busan or Gyeonggi), and local governments (*si*/*gun*/*gu*). Each government levies property taxes, respectively. In order to calculate property tax rates precisely, this section reviews the structure of property taxation in Korea currently being operated in the three levels.

Firstly, there are many types of property taxes as a form of a surtax imposed by different levels of governments. These taxes include "Property Tax"[1] and "Gross Real Estate Tax (hereafter GRET)" and there are other taxes, based on the same property, such as "City Planning Tax"[2], "Local Education Tax", "Facilities Tax", and "Special Tax for Rural Development". These taxes should be regarded as one of the property taxes because they are all levied to the same property using the same paying method. For example, when tax payers pay for the "Property Tax" to the local governments, they also have to pay for the "Facilities Tax" to the metropolitan government with the same tax bill. The "Local Education Tax" is additionally imposed to the owner with 20% of property tax payments. These taxes are included in one tax bill so that the governments may collect taxes easily. The collected money is distributed to each government. Likewise, the "Special Tax for Rural Development" is the surtax of 20% of the GRET. The GRET is imposed to expensive housing by the central government in order to stabilise housing prices, to recoup capital gains and to contribute to ba-

[1]In this study, the property tax as a general term is different from the "Property Tax" as one sort of property taxes in Korea; the property tax includes taxes based on land and property.
[2]City Planning Tax was incorporated into the part of "Property Tax" in 2011.

lanced development between regions. Accordingly, it is easy to underestimate effective property tax rates when tax payers only consider the legal tax rate described in the Local Tax Act. To be precise, all these taxes, thus, need to be regarded as the property taxes.

Secondly, the Korean property taxation is progressive by values. Higher tax rates are applied to expensive houses, while lower tax rates, inexpensive ones. Progressiveness was strengthened due to the enforcement of the "Gross Real Estate Tax Act" in 2006. For houses below 40 million WON[3], their "Property Tax" rate is only 0.15%. However, for houses more expensive than 600 million WON, their "Property Tax" rate becomes 1%. If the price is over 2 billion WON, the owner has to pay 2% of assessed housing prices. **Table 1** summarises the details of tax rates by housing price bands.

Thirdly, local governments have a limited influence in the decision of property tax rates. For the purpose of equity between regions, the "Local Tax Act" bans local governments from changing tax rates. The elastic taxation meant that local governments had the authority to adopt a different tax rate within 50% of flexibility; the elastic tax rates were only operated in 2005 and 2006. During these periods, a few local governments adopted lower property tax rates than standard tax rates presented in the "Local Tax Act". However, equity was considered significant and the implementation of elastic taxation ended in 2006. Basically, the central and metropolitan government support the deficit after local governments finance local taxes at given property tax rates. So, there is a discrepancy between burdens of tax payers and benefits from the local governments. Even though owners of expensive properties pay for a large amount of property taxes on a higher tax rate, they benefit from public services similar to those who pay less due to an inflexible tax rate system discussed above.

Besides, additional complexity exists in the taxation. A tax payment-cap policy is in operation. The purpose of this policy is to prevent a rapid increase in tax payments caused from sudden changes in the real estate market. For example, a property tax payment should not exceed over 105% of the last payment when the price of the property is within 300 million WON, 110% for its price is laid between 300 and 600 million WON, and 150%, over 600 million WON. In addition, the aggregate amount of the "Property Tax" and the GRET should not exceed three times of the property tax payments in relation to the corresponding period last year.

This complexity under Korean taxation contexts creates difficulties in estimating the property capitalisation rate. Thus, the principle of the repeat sales model is used to estimate the property taxation capitalisation.

Table 1.
Legal tax rates and tax base in Korea.

Tax title	Housing prices (million WON)	Tax rate (%)	Tax base
Property Tax	Below 40	0.15	Assessed housing prices
	40 - 100	0.3	
	Over 100	0.5	
Gross Real Estate Tax	Below 300	1.0	Assessed housing prices subtracted 600 million WON
	300 - 1400	1.5	
	1400 - 10,000	2.0	
	10,000	3.0	
City Planning Tax		0.15	The same to the property tax
Local Education Tax		20	The amount of property tax
Special Tax for Rural Development		20	The amount of global real estate tax

Source: The Local Tax Act and Gross Real Estate Tax Act.

Data and Method

Data

The Korean central government assesses housing prices of all housing in Korea for tax purpose on a yearly basis viaa government agency—Korea Appraisal Board (KAB). The appraised prices make it possible to calculate the amount of individual property tax payments.

The unit of the analysis in this research is an individual apartment (high-rise condominium). Extensive data for three years about housing (appraised) prices between 2006 and 2008 was used for this research. A sample consists of 32,101 apartments, which account for 2.6% of total apartment stocks in Seoul (see **Table 2**). Apartment is a major housing type in Seoul, accounting for 54.2% of the housing stock (Census in 2005). Almost new housing construction is composed of apartments, for example, 76.5% in 2006, and 100% of housing renewal projects were a form of high-rise apartments (Ha, 2010). Thus, the sample of this research is large enough to represent Seoul's housing market.

The average housing price was 222,375 thousand WON in 2006, 279,042 thousand WON in 2007 (a 25.5% increase in relation to 2006), and 290,946 thousand WON in 2008 (a 4.3% increase in relation to 2007). More details are in **Appendix**.

To calculate the amount of tax payments and effective tax rates, following four factors were considered in the Korean context: appraised apartment prices, tax-rate bands, the elastic tax rates in 2006, and the property tax payment cap[4]. These factors made the amount of property tax payments change every year. The effective tax rate is house's property tax payment divided by its market value (Yinger et al., 1988). The summary of calculated tax payment and their effective tax rates are presented in **Table 3**.

Based on aggregated tax payments and appraised prices, effective property tax rates were 2.059 mill in 2006, 1.990 mill in 2007, and 2.139 mill in 2008, respectively.

Methodology

This study takes advantage of the principle of a repeat sales model. The repeat sales model was developed by Bailey et al. (1963). Then, Case & Shiller (1987) used this model to estimate variations in housing prices and to create an housing price in-

[3]US $1 = 956 WON in 2006, 1103 WON in 2008.

[4]The "Local Tax Act" bans local governments from elastic tax rates across regions for the purpose of equity. The elastic taxation was that local governments had the authority to adopt a different tax rate within fifty per cent of flexibility; the elastic tax rates were only operated in 2005 and 2006. During this period, a few local governments adopted lower property tax rates than standard tax rates presented in the "Local Tax Act". The central and metropolitan government support the deficit after local governments finance local taxes.

Table 2.
Statistics of summary[1].

Variables	Mean	Standard deviation	Minimum	Maximum
The age of house in 2006	11.86	7.23	0.00	39.00
House net area (m^2)	72.70	24.29	23.70	244.97
Housing price in 2006[2]	222.38	164.21	38.00	2780.00
Housing price in 2007[2]	279.04	222.08	39.00	3856.00
Housing price in 2008[2]	290.95	208.57	48.00	3480.00

[1]Number of samples is 32101; [2]Million WON.

Table 3.
Estimated effective tax rates and tax payments by districts.

	Tax rates (mill)			Tax payment per house (thousand WON)		
	2006	2007	2008	2006	2007	2008
Gangnam	2.243	2.483	3.085	1360	2084	2660
Gangdong	2.189	2.078	2.286	616	754	827
Gangbuk	1.814	1.704	1.662	283	314	369
Gangseo	1.830	1.643	1.769	312	386	424
Gwanak	1.968	1.840	1.902	373	417	466
Gwangjin	2.517	2.318	2.535	739	914	1018
Guro	1.841	1.714	1.727	299	338	385
Geumcheon	2.106	1.967	2.014	337	370	409
Nowon	1.743	1.603	1.613	256	291	336
Dobong	2.058	1.944	1.926	325	357	406
Dongdaemun	2.059	1.997	2.020	424	459	517
Dongjak	2.181	1.981	2.091	538	629	714
Mapo	2.184	2.017	2.154	548	638	715
Seodaemun	2.310	2.219	2.250	454	490	546
Seocho	2.643	3.057	3.795	1,439	2285	2845
Seongdong	2.427	2.274	2.397	643	729	808
Seongbuk	1.993	1.928	1.945	386	419	473
Songpa	2.190	2.314	2.774	969	1414	1700
Yangcheon	1.991	1.870	2.166	545	825	954
Yeongdeungpo	2.129	2.058	2.210	585	769	890
Yongsan	2.658	2.828	3.196	1248	1918	2334
Eunpyeong	2.139	2.030	2.056	352	379	421
Jongno	1.999	1.965	2.014	428	490	565
Jung	1.959	1.902	2.079	558	652	719
Jungnang	2.062	1.946	1.974	311	340	378
Average (Seoul)	2.059	1.990	2.139	534	698	808

Note: Mill is 1/1000.

dex using transaction prices. Since Bailey et al. and Case & Shiller, the repeat sales model has been widely used in generating a housing price index and understanding property markets (McMillen, 2008). The principle of the repeat sales model is that, when one house is transacted, the price matches to the previous transaction price of the same house so that the difference between the two prices can be measured precisely. The changes in housing prices are estimated by a regression analysis. The rationale of this matching is to remove any expected biases. Every single house has its unique locational and structural characteristics. Accordingly, only when the house is compared to the same house without any structural alterations, can real changes of housing prices be correctly measured.

The repeat sales model adds time-variables to the hedonic price model used for a cross-sectional analysis. As the same house is compared in calculation of housing price changes, the repeat sales model rules out the effects of other variables, such as lot size, bedrooms, toilets, and garages, as long as the house was not renovated between the two transaction periods.

In the model of the initial repeat sales model by Bailey et al. (1963), a natural log was taken to calculate the changing rates of housing prices. The natural log makes left-sides directly a variation rate in housing prices. P_f is the first transaction and P_s is the second one in Equations (1) and (2) (Choi et al., 2010). γ_f and γ_s are the intercept composed of macro-economic factors, housing preferences and other factors that can influence housing prices.

$$\ln P_s = \sum_{i=1}^{K} \beta_{i,s} \ln X_{i,s} + \gamma_s + \varepsilon_s \quad (1)$$

$$\ln P_f = \sum_{i=1}^{K} \beta_{i,f} \ln X_{i,f} + \gamma_f + \varepsilon_f \quad (2)$$

where X_i is characteristic of the house.

β_i is coefficient.

ε_s and ε_f are error terms.

As Equation (1) subtracts Equation (2), the equation is simplified to conduct a regression analysis. In Equation (3), the explanatory variables in a general hedonic price model are deleted.

$$\ln \frac{P_s}{P_f} = \sum_{t=1}^{T} \beta_t D_t + \mathrm{v} \quad (3)$$

where, $\beta_1 = 0, \mathrm{v} = e_s - e_f$.

The left side is the rate of variations in housing prices; all individual housing characteristics are removed in the right side. This is the most advantageous feature in the repeat sales model simplifying model specification. D_t in Equation (3) is a dummy variable. It becomes one when transaction occurs, otherwise zero. β_t is the coefficient to be estimated by conducting a regression analysis. β_t can be transformed to a housing price index[5].

McMillen (2003) and Kim & Lee (2004, 2005) modify the repeat sales model. They divide variables into time-varying variables and time-fixed variables to discover how influence of the time-varying variables has changed, by estimating the coefficient of the time-varying variables, where time-fixed variables are eliminated. Likewise, this paper utilises the principle of the repeat sales model to estimate the property tax capitalisation effect under the Korean taxation context[6].

[5] $I_t = \exp(\beta_t) \times 100$.

[6]Although this research uses appraisal prices, the principle of the analysis relies on the repeat sales model that use transaction data.

When there are no property taxes, the hedonic price model can be specified like Equation (4).

$$\hat{P} = \alpha_0 + \sum_{k=1}^{K} \alpha_k X_t \quad (4)$$

where, $\hat{P}$ is the housing price before imposing the property tax.

X is attributes of the house.

α_0 is an intercept.

α_k is a coefficient.

When the effective property tax rate is τ, the amount of property taxes is $P \times \tau$. $P \times \tau$ should be divided by the discount rate (r) in order to acquire the total present value of property taxes. When the property tax is in operation, the hedonic price model can be expressed like Equation (5)[7].

$$P_t = \sum_{k=1}^{K} \alpha_k X_t - \beta\left(\frac{T_{t-1}}{r}\right) \quad (5)$$

In Equation (5), T_{t-1}/r is a net present value of property tax payments and β is a coefficient that indicates the capitalisation rate. If β equals one, property taxes are fully capitalised. Housing prices decrease by the present value of increased property taxes. On the other hand, ifequals zero, housing prices do not change regardless of newly added property taxes. In Equation (5), the period of the left side—the housing price (P)—is t while, on one of the right side—the amount of property tax (T)—is $t - 1$. P_t is closely tied to P_{t-1} as effective tax rates and the amount of total property taxes are decided by housing prices, causing an auto-correlation problem that creates difficulty in estimating by OLS. Due to the Korean taxation context discussed in the Section 2, one more step is required. In order to remove the auto-correlation problem, the repeat sales method is modified as suggested by McMillen (2003) and used by Kim & Lee (2005). In the period $t + 1$, housing prices including property taxes become Equation (6).

$$P_{t+1} = \alpha_{t+1} + \sum_{k=1}^{K} \alpha_k X_t - \beta\left(\frac{T_t}{r}\right) \quad (6)$$

If Equation (6) is subtracted from Equation (5), the attributes of the house are eliminated. It is possible when there have been no substantial physical changes to housing attributes between t and $t + 1$. Finally, Equation (7) can be reached to a simplified form to conduct a regression analysis.

$$P_{t+1} - P_t = \gamma_0 + \gamma_1\left(T_t - T_{t-1}\right) \quad (7)$$

γ_0 is $\alpha_{t+1} - \alpha_t$, and this intercept signifies changes of housing prices due to the socio-economic conditions such as income levels, the demand for or the supply of housing, public services and employment. These factors are not spatially specific, thus can be equally applied to all areas in Seoul. γ_1 is the coefficient that represents the change in housing prices caused by the changes of property taxes. γ_1 equals $-\beta/r$, therefore, β is calculated by $-\gamma_1 \times r$.

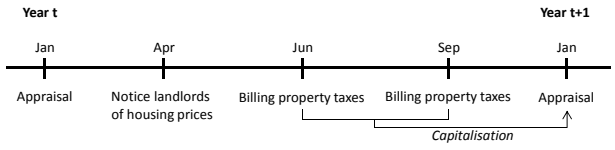
In addition to the changes in market trends such as the demand and the supply, local influences caused by location-specific changes in amenity, infrastructure, and accessibility, can differ between districts over the analysis period. For example, the construction of an outer circular highway around Seoul was completed in 2006. Due to the new highway, accessibility was improved in the northern part of Seoul, which influenced housing prices. Housing supply varies between districts. For example, while there was no new apartment construction in *Nowon*, 27,559 new apartments were built in *Songpa* in 2007-2008. Conditions of supply and demand in each region create a discrepancy in housing price movements. It is necessary to consider these effects are different in each district. Thus, district dummy variables are added to Equation (4) to measure the location-specific influence over time. For example, for *Seochogu*, only the *Seochogu*'s district dummy variable equals one, otherwise zero. District dummy variables explain time-varying effects between districts.

Result of Analysis

As a result of a regression analysis[8], almost all variables are statistically significant at the 95% confidence level (see **Table 4**). The intercept—17,537—plays an important role in interpreting the trend in the housing market. With taxation effects and location-specific differences controlled, the intercept explains that housing prices increased by 17,537 thousand WON on average between 2007 and 2008. When referring to the average housing price in 2007, the average change in housing prices over the one year was a 6.3% increase (=17.537/279.04). This is attributable to the provision of public goods, macroeconomic factors, and the demand for and the supply of housing.

Only four district dummy variables are not significant at the 5% significance level, but two of them are statistically significant at the 90% confidence level (see **Table 5**)[9]. Two districts, *Eunpyeong* and *Gwanak*, show that the dummy variable is not significant at the 10% of the significance level. This is due to variations in housing prices from house to house in *Eunpyeong* and *Gwanak* are so large that the statistics cannot conclude that the change in housing prices is different from the base district, *Gangnam*. For example, there have been redevelopment projects, called New Town Development, in *Eunpyeong*, since 2002. Thus the infrastructure provided concentrated on specific areas. This caused larger variations in housing prices in *Eunpyeong*. Housing prices in the new residential development in *Eunpyeong* increased much more than outside of the develop-

[7]Theoretically, capitalisation takes place at the time of the announcement of the tax change. However, one year time lag is necessary given the policy context. Property taxation is complicated enough to recognise because they consist of different kinds of taxes in Korea. In addition, the amount of property taxes is billed to home owners in June and September whereas appraising is done in January and noticing, in April. Thus, this study assumes that property taxes in year t have an influence on housing prices in year $t + 1$, taking a one-year time-lag in Equation (5). The assumption about the one-year time-lag is reasonable as far as processes of appraisal, notice, and billing are concerned.



[8]This model has 48.3% of explanatory power. The low R-square is the weakness of repeat sales model because the repeat sales model does not have other independent variables that can explain the variation in the dependent variable.

[9]The regression is based on housing prices changes from 2007 to 2008. Due to the one-year time-lag, changes from 2006 to 2007 were not analysed in this regression analysis.

Table 4.
Descriptive statistics of dependent and independent variables.

Variables	Mean	Standard Deviation	Minimum	Maximum
Tax payment (independent variable) $T_t - T_{t-1}$	163.7	502.0	−1,785.7	13,819.2
Housing price (dependent variable) $P_{t+1} - P_t$	11,904	25,801	−376,000	239,000

Note: Unit is thousand WON.

Table 5.
Result of a regression analysis.

	Coefficient	Standard Eerror	t-value	*p*-value
Intercept	17537.0	475.5	36.88	<.0001
ΔT	−21.9	0.2	−94.70	<.0001
Gangdong	−20226.0	647.7	−31.23	<.0001
Gangbuk	19625.0	846.6	23.18	<.0001
Gangseo	−15055.0	680.5	−22.12	<.0001
Gwanak	354.5	753.9	0.47	.6381
Gwangjin	−12842.0	886.5	−14.49	<.0001
Guro	6217.5	656.3	9.47	<.0001
Geumcheon	−2891.6	818.5	−3.53	.0004
Nowon	6328.7	531.9	11.90	<.0001
Dobong	7193.4	607.1	11.85	<.0001
Dongdaemun	8000.8	740.9	10.80	<.0001
Dongjak	2530.7	771.5	3.28	.0010
Mapo	−5103.7	810.4	−6.30	<.0001
Seodaemun	3538.1	783.6	4.52	<.0001
Seocho	−13922.0	724.6	−19.21	<.0001
Seongdong	−2322.8	700.2	−3.32	.0009
Seongbuk	7708.3	690.7	11.16	<.0001
Songpa	−24975.0	613.9	−40.68	<.0001
Yangcheon	−31276.0	684.4	−45.70	<.0001
Yeongdeungpo	1195.8	691.5	1.73	.0838
Yongsan	31316.0	1023.7	30.59	<.0001
Eunpyeong	483.0	958.8	0.50	.6144
Jongno	8174.7	1490.7	5.48	<.0001
Jung	−16302.0	1184.0	−13.77	<.0001
Jungnang	−1398.6	735.6	−1.90	.0573

*Dependent variable: $P_{t+1} - P_t$; **adj-R square: 0.4831; ***Notes: The unit is thousand WON, and Gangnam is the basement of district-dummy-variables.

ment area[10]. *Yongsan* has the highest dummy-variable coefficient. *Yongsan* is in the middle of the three central business districts in Seoul, but the quality of houses is in general not as good as other residential areas. Recently, there have been redevelopment projects all over the *Yongsan* area. The dummy variable reflects the effect of the projects on housing price changes in *Yongsan*. *Yangcheon* and *Songpa* show the biggest decrease in housing prices. These two districts including *Gangnam* belonged to the most expensive areas in Seoul. Housing prices on the expensive areas decreased the most between 2007 and 2008.

The coefficient $-\gamma_1$ is –21.868. This figure represents that housing prices decreased by 21.868 thousand WON when the property tax increased by one thousand WON. If there was no change in property tax payments, housing prices would increase by 17,537 (the intercept, γ_0) thousand WON. Housing prices decreased by 17,515 WON (17,537 – 21.868 × 163.7) on average due to the increase in property taxes.

The property tax capitalisation rate, β is estimated using estimated coefficient $-\gamma_1$. The capitalisation rate can be acquired by multiplying $-\gamma_1$ by the discount rate. The discount rate is an opportunity cost that the home-owners can accrue when they invest in other options instead of housing. Simply, the long-term interest rate could be used as the discount rate (DiPasquale & Wheaton, 1996: p. 207). However, deciding on a discount rate has been problematic in estimating the property tax capitalisation rate (Yinger et al., 1988). Some studies adopt a nominal discount rate instead of a real discount rate and some use higher rates than the real rates, thus making the capitalisation rate higher. A real discount rate needs to be used and income tax on interest and tax deduction should be considered when measuring the real discount rate (Yinger et al., 1988). According to the Bank of Korea, the long-term interest rate was 3.98% in 2006 and 4.47% in 2007. The income tax rate on interest income was 15.4%. Considering the income tax rate on the interest, the real discount rate becomes 3.37% and 3.78%, respectively. Accordingly, the capitalisation rate of the property taxes becomes 73.7% and 82.8%. Thus, it is reasonable to conclude that the degree of property tax capitalisation was somewhere between 73.7% and 82.8% (see **Table 6**). As studied by Yinger et al. (1988), the result shows partial capitalisation that means the effect could transfer to the future owner (Palmon & Smith, 1998) or to tenants thus resulting in an increase in rents.

Conclusion

This paper focuses on the property tax capitalisation effect under a unique Korean taxation context. The model employed in this research is simple but based on reasonable assumption in which the time-fixed variables can be eliminated. While a conventional hedonic price model includes locational and structural variables, the modified repeat sales model utilises variations in property tax payments, which simplifies model specification. The model in this research used three years data on housing prices and tax payments.

Given these unique institutional circumstances, as a result of the analysis, the property tax capitalisation rate in Seoul was between 73.7% and 82.8% in the period 2007-8. This is partial

[10]There are two residential new development plans in *Eunpyeong*. An increase in housing prices on average in the areas within the development is 11.2 (million WON) while outside of the development is 10.1 (million WON). This shows that there exists a heterogeneous housing market even in the same district.

Table 6.
Interest rates and capitalisation rate.

	2006	2007
[+]Long term interest rate (%)	3.98	4.47
Discount rate (%)	3.37	3.78
Capitalisation rate (%)	73.7	82.8

[+]The bank of Korea (http://ecos.bok.or.kr/).

capitalisation but larger than Yinger et al.'s estimation (1988). The inevitability of property taxes might result in higher property tax capitalisation. As there are few exceptions in implementing property taxation, home owners in Seoul are unable to avoid increased property taxes. Thus, home owners have to accept an increase in property taxes.

In terms of policy objectives, the increase in property tax rates is conducive to changes in housing prices and increases in public funds. However, there is a fundamental issue about the rationale for property taxes. The purpose of the property tax is to ensure public goods which enhance property values, not to depreciate home values as an intervention tool in the housing market. Bruekner (1979) suggested that an efficiency is in the point that a property tax locally financed supports house values sufficiently in that region. Although Korean property taxes finance public expenditure, it is difficult to regard that the Korean property taxation is efficient due to the lack of a close connection between property taxes and public expenditure. Equity concerns have been more emphasised than taxation efficiency in Korea.

This study contributes to evidence of property tax capitalisation in a different policy context using the principle of the repeat sales model. As a result of the analysis, it is obvious that additional property taxes are reflected in home values. Property tax capitalisation can be understood as a natural result in response to policy changes.

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Appendix. Summary of Statistics by Districts in Seoul

District	Area (km^2)	Population	Density (persons/km^2)	Sample	Average appraisal housing price (thousand WON)		
					2006	2007	2008
Gangnam	39.54	560,958	14,187	1737	456,353	603,216	604,914
Gangdong	24.58	464,546	18,899	1694	267,385	336,663	330,941
Gangbuk	23.60	345,478	14,639	698	149,592	178,074	214,552
Gangseo	41.42	560,424	13,530	1420	153,425	208,951	209,827
Gwanak	29.57	535,571	18,112	996	181,043	218,169	235,098
Gwangjin	17.05	376,572	22,086	602	271,824	348,909	349,781
Guro	20.11	420,542	20,912	1658	153,732	188,551	211,452
Geumcheon	13.01	249,108	19,147	771	151,669	179,289	193,218
Nowon	35.42	616,753	17,413	5780	132,584	165,231	188,325
Dobong	20.70	375,975	18,163	2374	141,795	165,311	189,337
Dongdaemun	14.20	376,421	26,509	1057	197,463	221,254	246,017
Dongjak	16.35	405,967	24,830	916	234,609	301,467	319,546
Mapo	23.87	392,650	16,450	787	237,512	298,539	308,995
Seodaemun	17.61	348,575	19,794	881	186,579	210,430	230,711
Seocho	47.00	405,969	8638	1055	482,405	622,950	608,045
Seongdong	16.85	333,535	19,794	1272	251,875	302,894	316,216
Seongbuk	24.57	469,973	19,128	1358	185,801	209,062	233,591
Songpa	33.88	623,876	18,414	1971	382,054	485,901	468,718
Yangcheon	17.40	503,650	28,945	1325	241,695	350,082	330,229
Yeongdeungpo	24.57	408,178	16,613	1301	240,287	303,849	318,542
Yongsan	21.87	235,832	10,783	405	400,306	530,141	564,346
Eunpyeong	29.71	459,196	15,456	495	158,012	180,048	197,485
Jongno	23.91	165,846	6936	172	197,849	224,000	248,343
Jung	9.96	130,044	13,057	291	276,117	330,732	329,893
Jungnang	18.50	427,071	23,085	1085	142,528	166,378	181,882
Total(Seoul)	605.25	10,192,710	16,840	32,101	222,375	279,042	290,946

Note: For appraisal housing price and sample, the sample of this study; Source: Ministry of Land, Transport and Marine Affairs.