Why does the Jeonse-to-Price ratio affect residential property returns?

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Abstract

We analyze the effects of the Jeonse-to-Price ratio on the property returns in Korean residential property market. According to our pricing model for residential properties with "Jeonse," a form of lease contracts to be paid by only a deposit without monthly rent, an increase in the Jeonse-to-Price ratio raises the property returns only when the interest rate is larger than the dwelling benefits. From the empirical analysis, we find that the positive relationship between property return and the Jeonse-to-Price ratio is no longer significant after the financial crisis in 2007. Further, the recent decrease in the interest rate is the main contributor to reduce the effect of the Jeonse-to-Price ratio on property returns, which is consistent with our pricing model. Our results imply that the current high Jeonse-to-Price ratios are likely to increase property prices when the interest rate increases in the near future.

JEL Classification: G12, R31
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Ⅰ. INTRODUCTION

The Jeonse-to-Price ratio is widely thought to be a leading indicator of the house price due to the demand migration from renting to buying when the ratio increases (Lee, 2000; Kim, 2012; Park, 2012)[1]. According to this view, the recent upsurge in the Jeonse-to-Price ratio indicates that the house price would soon increase. For example, Park (2012) suggests that renting demand tends to be converted to buying demand when the Jeonse-to-Price ratio becomes over 60% in Seoul. Some studies, however, suggest a negative relationship between the Jeonse-to-Price ratio and house price (Kim, Song, and Rhee, 1998; Lee and Lim, 2010), or an insignificant relationship after the recent financial crisis of 1998, often referred to as the sub-prime mortgage crisis that began in 2007 (Kim, 2012).

In this study, we revisit the effects of the Jeonse-to-Price ratio on residential property returns in order to investigate in what conditions the Jeonse-to-Price ratio drives property prices. In particular, we investigate as to whether changes in macroeconomic conditions are responsible for why property prices are not affected by the Jeonse-to-Price ratio recently. For the analysis, we use property returns, which include dwelling benefits as well as capital gains, each of which represents the characters of residential properties as a consumption good and as an investment vehicle, respectively. Capital gains alone do not properly represent the total returns of residential properties. Therefore, our approach is consistent with previous studies, such as Grossman and Laroque (1990), Piazzesi, Schneider, and Tuzel (2006), Flavin and Nakagawa (2008), and Kim and Jeong (2012), who consider these two aspects of residential properties.

[1] Jeonse is a form of lease contracts to be paid by only a deposit without monthly rent, and is very popular in the Korean residential property market. The Jeonse-to-Price ratio is defined as Jeonse (=the deposit amount) divided by the sales price of the residential property.

Our study differs from previous studies in several ways. First, we focus as to why the relationship between the Jeonse-to-Price ratio and property return changes over time. Kim (2012) suggests an empirical evidence, that the Jeonse-to-Price ratio does not necessarily move together with property prices after the sub-prime mortgage crisis, whereas most other studies find evidence that the Jeonse-to-Price ratio is a leading indicator of property price. However, these studies do not clearly show what drives the relationship between the Jeonse-to-Price ratio and property prices. Second, our study provides an in-depth analysis from the perspective of investors, who consider both capital gains and any cash flows from their investment. The existing literature focuses on the effect of changes in Jeonse on capital gains only, overlooking the characteristics of residential properties as consumption goods[2], despite the fact that Jeonse reflects the dwelling benefits. Third, we propose a theoretical model that specifies the relationship between the Jeonse-to-Price ratio and property returns.

According to our consumption-based pricing model for residential properties[3], the relationship between the Jeonse-to-Price ratio and the expected property return would vary depending on a few variables, such as the interest rate and the expected dwelling benefits. More specifically, the sensitivity of the expected property return with respect to the Jeonse-to-Price ratio has a positive relationship with the interest rate, whereas it has a negative relationship with the expected dwelling benefits. The sensitivity indicates that the relationship between the Jeonse-to-Price ratio and the expected property return is dynamic rather than

[2] Jung (2006), Kim and Jeong (2012), who investigate the effect of liquidity or interest rate on house prices, would be examples of research that consider the characteristics of a house as a consumption good.

[3] There are several studies that investigate housing markets using the CAPM (Capital Asset Pricing Model). For example, Jang and Yoo (2013) use the CAPM in order to analyze whether the apartment price change in Seoul is explained by the market return. The effect of the market return appears to be different depending on the location of apartments; further, its explanatory power is high during bullish period in the early 2000s, but low during the bearish period between 2006 and 2007. However, these studies focus on whether returns in the housing market are explained by the traditional CAPM, which employs the market return as an explanatory variable.

static: *ceteris paribus*, property returns increase with the Jeonse-to-Price ratio when the interest rate is high (e.g., before the financial crisis), whereas property returns do not change or decrease with the Jeonse-to-Price ratio when the interest rate is low (e.g., after the financial crisis). The dynamic relationship between the Jeonse-to-Price ratio and the expected property return differs from the negative relationship proposed by Kim, Song and Rhee (1998).

The results can be interpreted as follows. The Jeonse-to-Price ratio increases with the expected returns when the interest rate is higher than the dwelling benefits. In this period, householders earn interest revenues in excess of the dwelling benefits from Jeonse when renting out rather than occupying their properties. Thus, the Jeonse-to-Price ratio increases with the expected returns because a higher Jeonse-to-Price ratio would be more profitable to the landlords. On the contrary, the Jeonse-to-Price ratio reduces the expected return when the interest rate is less than the dwelling benefits. The lower interest rate makes householders experience losses from Jeonse because interest revenues earned from Jeonse are less than their dwelling benefits given up by renting out their properties. In this situation, as the Jeonse-to-Price ratio increases, the losses increase because the opportunity costs from renting out the properties increase.

Our empirical results support that the recent low interest rate is responsible for why the Jeonse-to-Price ratio does not affect property returns. We first show that the positive relationship between property returns and the Jeonse-to-Price ratio holds before the financial crisis, but is no longer statistically significant after the financial crisis. Among several macroeconomic variables that we consider for the relationship between the Jeonse-to-Price ratio and property returns, the two variables, i.e., low inflation and lower interest rates, appear to be statistically significant for the effects of the Jeonse-to-Price ratio on property returns

(and also capital gains). Further, our analysis indicates that among these two variables, the decrease in the interest rate is the main contributor that makes the Jeonse-to-Price ratio less important for property returns recently. As predicted by our model, the sharp increase in the Jeonse-to-Price ratio does not lead to a property price appreciation after the financial crisis when the interest rate is kept low.

An important implication from our study is that the current high Jeonse-to-Price ratio may cause a significant price appreciation in property prices when economic situations change. Profits from investing a Jeonse amount would increase as interest rate increases, and thus, *ceteris paribus*, property prices increases. As far as interest rate is kept low, the Jeonse-to-Price ratio is not expected to contribute property price appreciation.

The rest of this paper is organized as follows. Section 2 suggests a property pricing model that includes the dwelling benefits and leverage by Jeonse. Section 3 presents the empirical results on the effect of the Jeonse-to-Price ratio on property returns based on the pricing model; finally, section 4 concludes.

Ⅱ. Residential property pricing model with leveraging by Jeonse

Most previous studies conclude that the residential property price has a positive relationship with the Jeonse-to-Price ratio (e.g., Lee, 2000; Kim, 2012, Park, 2012).[4] Some others, on the contrary, find that certain types of properties, such as small-sized apartments in Seoul, are negatively related with the Jeonse-to-Price ratio (Lee and Lim, 2010), or report an

[4] Kim (2012) analyzes the relationship between Jeonse and residential property investment returns by using the data from March 1993 to December 2011. He reports a positive relationship between the residential property price and Jeonse-to-Price ratio before the financial crisis via "cost-cutting effects in purchasing residential properties by Jeonse," defined as the interest rate times the Jeonse-to-Price ratio. However, the relationship is not significant any more after the financial crisis.

insignificant relationship between the property price and Jeonse-to-Price ratio after the financial crisis in 2007 (Kim, 2012). These studies, however, do not fully consider the changes in economic conditions and/or landlords' opportunity costs from renting their properties. Hence, in this paper, we propose a pricing model that considers dwelling benefits forgone by renting out properties as the homeowners' opportunity costs. The economic intuition of dwelling benefits is similar to dividends in equities and thus, dwelling benefits should be considered as an important part of property returns.

As in a typical consumption based asset pricing, the representative agent (household) lives for and trades in single period from *t* to *t+1*, and derives utility from consumption at each time. The expected utility of the representative household can be described as follows:

$$E_t[U(C_t, C_{t+1})] = U(C_t) + \psi E_t[U(C_{t+1})], \quad (1)$$

where C_t and C_{t+1} represent the consumptions at time *t* and *t*+1 respectively, ψ is the subjective discount factor, and $E_t[\cdot]$ is an expectation operator. After the household decides on how much to consume at time *t*, the remaining are used to invest in properties for future consumption.

Suppose that the household receives income of k_t and k_{t+1} at each time. Suppose that the price of the residential property per square meter is P_t at time *t*, and that the square meter of the property in which the household invests is represented by w. Then the consumption at time *t* decreases by wP_t. When Jeonse is used to fund households' investments in residential properties (e.g., Lee, Chung, and Lee, 2002; Lee, 2012), the consumption at time *t* increases as much as the value of renting out ($w\varphi_t J_t$), where φ_t represents the ratio of the rented space to the properties ($1 \geq \varphi_t \geq 0$). As a result, the consumption at time *t* decreases by

$w(P_t - \varphi_t J_t)$, which is the net investment in properties. At time *t*+1, the household enjoys an increase in consumption from the investment at time *t*, i.e., $w(P_{t+1} - \varphi_t J_t)$, as well as in the dwelling benefits from the untenanted space. The dwelling benefits are an important argument in the household's utility function in a similar way to the literature on pricing owner-occupied houses (e.g., Piazzesi, Schneider, and Tuzel, 2006; Flavin and Nakagawa, 2008; Kim and Jeong, 2012). When dwelling benefits are proportional to property prices, as in Fisher, Geltner, and Pollakowski (2007), we represent the proportion at time *t* by d_t. Therefore, the consumption increase from the dwelling benefits appears as $w(P_t - \varphi_t J_t)d_{t+1}$.

Summarizing the results, we have consumptions at time *t* and *t*+ 1 as follows:

$$C_t = k_t - w(P_t - \varphi_t J_t), \tag{2}$$

$$C_{t+1} = k_{t+1} + w(P_{t+1} - \varphi_t J_t) + w(P_t - \varphi_t J_t)d_{t+1}. \tag{3}$$

Therefore, the household's problem is

$$\text{Max. } V(C_t, C_{t+1}) = U(C_t) + \psi E_t[U(C_{t+1})], \tag{4}$$

$$\text{s.t. } C_t = k_t - w(P_t - \varphi_t J_t), \tag{5}$$

$$C_{t+1} = k_{t+1} + w(P_{t+1} - \varphi_t J_t) + w(P_t - \varphi_t J_t)d_{t+1}. \tag{6}$$

Let j_t^M be the Jeonse-to-Price ratio of the entire property market ($j_t^M = J_t^M / P_t^M$). If we assume that the marginal rate of substitution of the representative household has a linear relationship with property return ($r_{t+1}^M + (1 - \varphi_t^M j_t^M)d_{t+1}^M$) (Brown and Gibbons, 1985; Dittmar, 2002), we obtain the following pricing model.

$$E_t[r_{t+1}^*] = \beta^* E_t\left[r_{t+1}^{M^*}\right], \tag{7}$$

where $r_{t+1}^* = r_{t+1} + (1 - \varphi_t j_t)(d_{t+1} - \mathrm{r}_{t+1}^{\mathrm{f}})$, $r_{t+1}^{M^*} = r_{t+1}^M + (1 - \varphi_t^M j_t^M)(d_{t+1}^M - \mathrm{r}_{t+1}^{\mathrm{f}})$, and β^* is defined as

$$\beta^* = \frac{\mathrm{Cov}(r_{t+1}^M + (1-\varphi_t^M j_t^M) d_{t+1}^M,\ r_{t+1} + (1-\varphi_t j_t) d_{t+1})}{\mathrm{Var}(r_{t+1}^M + (1-\varphi_t^M j_t^M) d_{t+1}^M)}. \quad (8)$$

(Refer to the Appendix for proof.) The left-hand side of equation (7) expresses the expected excess return of a household, whose property is rented out as much as φ_t in the form of Jeonse. The expected excess return consists of capital gains and dwelling benefits.

The expected return is determined by the conventional systematic risk as well as the betas related to the dwelling benefits. To see this, we further decompose the systematic risk, β^*, in equation (8) into the following four betas:

$$\beta^* = \beta_1 + \beta_2 + \beta_3 + \beta_4, \quad (9)$$

$$\beta_1 = \frac{\mathrm{Cov}[\, r_{t+1},\ r_{t+1}^M]}{\mathrm{Var}(r_{t+1}^M + (1-\varphi_t^M j_t^M) d_{t+1}^M)}, \quad (10)$$

$$\beta_2 = (1-\varphi_t j_t) \frac{\mathrm{Cov}[\, d_{t+1}, r_{t+1}^M]}{\mathrm{Var}(r_{t+1}^M + (1-\varphi_t^M j_t^M) d_{t+1}^M)} = (1-\varphi_t j_t) b_2, \quad (11)$$

$$\beta_3 = (1-\varphi_t^M j_t^M) \frac{\mathrm{Cov}[\, r_{t+1},\ d_{t+1}^M]}{\mathrm{Var}(r_{t+1}^M + (1-\varphi_t^M j_t^M) d_{t+1}^M)} = (1-\varphi_t^M j_t^M) b_3, \quad (12)$$

$$\beta_4 = (1-\varphi_t j_t)(1-\varphi_t^M j_t^M) \frac{\mathrm{Cov}[\, d_{t+1},\ d_{t+1}^M]}{\mathrm{Var}(r_{t+1}^M + (1-\varphi_t^M j_t^M) d_{t+1}^M)} = (1-\varphi_t j_t)(1-\varphi_t^M j_t^M) b_4, \quad (13)$$

where $b_2 = \frac{\mathrm{Cov}[\, d_{t+1}, r_{t+1}^M]}{\mathrm{Var}(r_{t+1}^M + (1-\varphi_t^M j_t^M) d_{t+1}^M)}$, $b_3 = \frac{\mathrm{Cov}[\, r_{t+1},\ d_{t+1}^M]}{\mathrm{Var}(r_{t+1}^M + (1-\varphi_t^M j_t^M) d_{t+1}^M)}$, and $b_4 = \frac{\mathrm{Cov}[\, d_{t+1},\ d_{t+1}^M]}{\mathrm{Var}(r_{t+1}^M + (1-\varphi_t^M j_t^M) d_{t+1}^M)}$.

The first beta, β_1, represents the effect of the covariance between the capital gains of an individual property and the property market returns; thus, it is equivalent to the conventional CAPM beta, which increases with the expected return. It is clear that the conventional systematic risk (β_1) includes the leverage risk of Jeonse (Lee, 2012) because β_1 increases as the Jeonse-to-Price ratio (j_t^M) rises in equation (10).

The remaining three betas represent the dwelling benefit-related risks. The second beta, β_2, shows that the expected return increases with the co-variation between the dwelling benefits of an individual property and the property market return. This effect comes from property owners, who ask for higher returns for properties whose dwelling benefits decrease during a property market recession. The third beta, β_3, suggests that the covariance between capital gains of the property and market dwelling benefits raises the expected return in property. Property owners are willing to accept lower expected returns on properties whose capital gains increase when the market dwelling benefits decline, because holding these properties reduce the risk. Lastly, β_4 shows that the expected return increases with the covariance between the dwelling benefits of the property and the market because property owners want to be compensated for holding their properties, whose dwelling benefits decrease when the market dwelling benefits decline. It is interesting that β_2 and β_4 decrease when the property is rented out. This is because the dwelling benefit-related risks decrease with the ratio of renting out ($\varphi_t j_t$) due to the fact that the property owners do not enjoy the dwelling benefits from tenanted space.

Our model provides a theoretical explanation for how the Jeonse-to-Price ratio affects the expected return. In order to evaluate the effects of the Jeonse-to-Price ratio on the expected return, we take a partial derivative of the left-hand side in equation (7) with respect to the Jeonse-to-Price ratio:

$$\frac{\partial E_t[r^*_{t+1}]}{\partial j_t} = \frac{\partial E_t\left[r_{t+1} + (1-\varphi_t j_t)(d_{t+1} - \mathrm{r}^{\mathrm{f}}_{t+1})\right]}{\partial j_t}$$

$$= (1-\varphi_t j_t)E_t[d'_{t+1}] + \varphi_t E_t\left[\mathrm{r}^{\mathrm{f}}_{t+1} - d_{t+1}\right], \qquad (14)$$

where $E_t\left[d'_{t+1}\right] = \partial E_t[d_{t+1}]/\partial j_t > 0$, because the dwelling benefits increase with the

Jeonse-to-Price ratio. Equation (14) suggests that the expected difference between the interest rate and dwelling benefits has an effect on changing the sensitivity of the expected property return to the Jeonse-to-Price ratio.

The sign of $\partial E_t[r^*_{t+1}]/\partial j_t$ is likely to depend on the relatively volatile interest rate rather than on the dwelling benefits. The dwelling benefits do not show any trend and are relatively stable for the past several decades in the US property market (Davis, Lehnert, and Martin, 2008); moreover, a similar pattern is also found in the Korean property market (we return to this issue later). Likewise, the sensitivity of the expected dwelling benefits to the Jeonse-to-Price ratio, $E_t[d'_{t+1}]$, is always positive and stable over time. Therefore, when $E_t\left[\mathrm{r}^{\mathrm{f}}_{\mathrm{t+1}}\right]$ is greater than $E_t[d_{t+1}] - (1-\varphi_t j_t)E_t[d'_{t+1}]/\varphi_t$, the property price increases as the Jeonse-to-Price ratio increases. On the contrary, when the interest rate decreases, such that $E_t\left[\mathrm{r}^{\mathrm{f}}_{\mathrm{t+1}}\right]$ is less than $E_t[d_{t+1}] - (1-\varphi_t j_t)E_t[d'_{t+1}]/\varphi_t$, the property price decreases even if the Jeonse-to-Price ratio increases.

When the interest rate is higher than the dwelling benefits, householders earn the difference between the interest rate and the dwelling benefits by renting out a property rather than occupying their properties. Thus, in the case of a higher interest rate, the expected return increases with the Jeonse-to-Price ratio because a higher Jeonse-to-Price ratio would give more profits to the landlords. On the contrary, when the interest rate is lower than the dwelling benefits, householders experience losses from Jeonse because interest revenues earned from Jeonse is less than their dwelling benefits given up by renting out their properties. In this situation, as the Jeonse-to-Price ratio increases, the losses increase because the opportunity costs from renting out the properties increase, and thus, the expected return

decreases.

Unlike our model, Kim, Song, and Rhee (1998) reveal that the relationship between the expected price change and the Jeonse-to-Price ratio is always negative. The main difference comes from the inclusion of the dwelling benefits in our model: Kim, Song, and Rhee (1998) do not consider the dwelling benefits as a component of the property return. In terms of the relationship between the rent-price ratio (dwelling benefits) and property return, however, our model is consistent with the existing literature. For example, the rent-price ratio has a theoretically positive relationship with the expected return because the rent-price ratio works similar to the dividend yields (e.g., Plazzi, Torous, and Valkanov, 2010), which is also supported empirically (e.g., Engsted and Pedersen, 2012). In particular, a partial derivative of the left-hand side in equation (7) with respect to dwelling benefits is always positive, as in $\partial E_t[r^*_{t+1}]/\partial d_{t+1} = 1 - \varphi_t j_t > 0$.

Ⅲ. Empirical analysis

In this section, we empirically analyze the relationship between the Jeonse-to-Price ratio and property returns (dwelling benefits and capital gains) using the model that we proposed in the previous section.

Ⅲ.1 Data

In order to empirically analyze the effect of the Jeonse-to-Price ratio on property returns, we need the time series of property price, the Jeonse-to-Price ratio, the rental yield to measure the dwelling benefits, and the owner occupying ratio to calculate the proportion of rental properties. We obtain the monthly data from April 1991 to March 2013, which is then divided

into two sub-periods, before and after July 2007, as in Kim (2012) and Yu and Choi (2010), in order to compare the housing markets before and after the global financial crisis.[5] Apartments are used for residential properties, considering their popularity in Korea: i.e., apartments consist of approximately 60% of residential properties in 2010.

A. Monthly rental yield

The monthly rental income reflects the dwelling benefits because it can be interpreted as the agreed price of dwelling between the landlords and tenants (Chun and Park, 2012). For our analysis, we calculate the monthly rental yield as follows:

dwelling benefits (= monthly rental yield)

$$= \frac{\text{Monthly rent}}{\text{Propeprty price}}$$

$$= \frac{\text{Monthly rent}}{\text{Jeonse}} \times \frac{\text{Jeonse}}{\text{Property price}}$$

$$= \frac{\text{The conversion rate}}{12} \times \text{Jeonse-to-Price ratio,} \qquad (15)$$

where the conversion rate is defined as the annual rental income divided by the Jeonse amount – a deposit for rent. The conversion rate is provided by Kookmin Bank for the period from August 2001 to May 2011, and then by Korea Appraisal Board after May 2011.

The conversion rate before August 2001 is estimated using a regression model specified for the period from August 2001 to March 2013. Considering that the conversion rate is defined by the rental income and Jeonse, we need to consider the variables that affect these two components. Kim (2012) reports that Jeonse has statistically significant relationships with economic variables, such as inflation, money supply, house price, economic growth and

[5] Yu and Choi (2010) find that the shocks from the foreign financial markets have long and persistent effects on the domestic financial markets during the financial crisis period after July 2007. Kim (2012) employs the criteria of Yu and Choi (2010), i.e., July 2007, in order to explain the relative movements of Jeonse to house price.

interest rates. Hence, our regression model is estimated as follows:

$$CR_t = 1.398 - 0.702 \times NPI_t + 0.021 \times CD_t + 0.222 \times FX_t - 0.379 \times IP_t - 0.508 \times CPI_t,^{6} \quad (16)$$

where CR represents the conversion rate, NPI means the National apartment price index, CD is the Certificate of Deposit (CD) rate, FX is the foreign exchange (thousand Won per US dollar), IP is the industrial production (whole industries, seasonal adjustment), and CPI is the consumer price index (whole country).[7] The adjusted R^2 value of the regression model is fairly high, i.e., 0.96, and therefore, these estimates are used to calculate the conversion rate before August 2001.

Figure 1 presents the conversion rate, the monthly rental yield and CD rate for the entire period. The CD rate shows a distinct downward trend, and rises sharply during the foreign exchange crisis in 1997. Since then, the low interest rate by the recent expansionary monetary policy continues at the level of 0.25% per month. The conversion rate shows a downward trend in general, and co-moves with the CD rate. However, the monthly rental yield that is calculated by multiplying the conversion rate to the Jeonse-to-Price ratio is relatively stable, showing a slight upward trend until August 2001, and then a downward trend. After 2008, it stays at around 0.5% per month.

B. The proportion of rental properties

We calculate the proportion of rental properties (φ_t) by "1-owner occupying ratio" from the survey data with regard to the property tenure status, which are publicly available from "Population and Housing Census" before 2005, and then from "Investigation on Housing

[6] Standard errors of the estimated coefficients are 0.102 (Constant), 0.128 (NPI), 0.005 (CD), 0.034 (FX), 0.056 (IP) and 0.237 (CP1).

[7] The dependent variable in equation (16) is stationary, whereas all explanatory variables are I(1) processes. However, we find that the residuals follow the I(0) process and thus, there is a co-integrated relationship between house price, Jeonse, inflation and interest rate (Song, 2012).

Condition".[8] In the case where the regional data on apartment tenure status are not available (entire area in 2012, Ulsan in 1990, 1995, and 2010), we replace them with the owner occupying ratios of the entire area.

Figure 2 presents the trends of the owner occupying ratios of apartments. They show upward trends until 2008, and then decline sharply. In the case of Seoul, the owner occupying ratio reaches its peak at 63.5% in July 2006, and then falls sharply to 42.4% in March 2013. The recent decrease of the owner occupying ratio reflects the changes in people's attitude toward house ownership.[9]

C. Property prices and Jeonse-to-Price ratios

In order to minimize the adverse effects from using different types of properties (differences in liquidity, size, quality, etc.), we use the price and Jeonse-to-Price ratio data of apartments among the various types of houses reported by Kookmin Bank. The return of the national apartment price index is used as the market return; eight areas, i.e., North Seoul, South Seoul, Busan, Daegu, Incheon, Gwangju, Daejeon, and Ulsan, are analyzed in order to investigate the regional differences. We divide Seoul into two areas, i.e., North and South Seoul, because of the differences in property markets between these two areas: South Seoul is the richest and best-educated region and thus, is one of the most popular regions in Korea.

[8] "Population and Housing Census" has been surveyed by the Korea National Statistical Office every five years since 1985, and "Investigation on Housing Condition" has been conducted by the Ministry of Land, Infrastructure and Transport every two years since 2006.

[9] According to the "2012 Investigation on Housing Condition" announced by the Ministry of Land, Infrastructure and Transport, the owner occupying ratio for low income households increases from 46.9% in 2010 to 50.4% in 2012. However, those for middle and high income households decrease from 54.0%, 69.5% in 2010 to 51.8%, 64.6% in 2012, respectively. The Ministry of Land, Infrastructure and Transport explains that the reasons for the change in the owner occupying ratio may be influenced by the conversion from the demand for buying a house to the demand for renting in the households who have the ability to purchase a house due to the housing market recession. In the case of an attitude and values for housing, in addition, the portion of people who think "I will purchase a house at any cost" is investigated in order to decrease from 83.7% to 72.8%, and thus, we believe this change of awareness would be one of the reasons for diminishing the owner occupying ratio.

Figure 3 shows the trends of property price indices, Jeonse indices, and Jeonse-to-Price ratios of apartments in South Seoul, North Seoul, and throughout the country. In panel A, apartment prices generally increase after 2001. South and North Seoul show upward trends until December 2006 and September 2008, respectively, and then become bearish. The national apartment price index, on the other hand, still shows a steady upward trend up to the end of the sample period. Jeonse indices in panel B also tend to increase throughout the sample period, faster than price indices. More specifically, the national apartment price index and Jeonse index increase by 69.0% and 131.9% before July 2007 and 17.1% and 41.2% after July 2007, respectively. This suggests that Jeonse rises faster than the property price over the sample period, and the relative increase of Jeonse to property price has been accelerated after the financial crisis. Finally, in panel C, the Jeonse-to-Price ratios show steep upward trends until 2002, despite a sharp decrease during the foreign exchange crisis in 1997. After 2002, they decrease until 2009, and then, begin to rise up until the end of the sample period. The ratios range between 40% and 70% during our sample period.

Panel A of Table 1 shows that the average price appreciation of South Seoul is greater than those of the other areas due to the sharp increase in the price before the financial crisis. Since then, however, the price in this area shows the biggest drop than those in the other areas. Panel B of Table 1 describes the statistical properties of property returns (including dwelling benefits) from investing in apartments. Interestingly, property returns are higher in local areas, such as Gwangju, Deajeon, and Ulsan, rather than in South Seoul. This is because high owner occupying ratios and high monthly rental yields in local cities contribute significantly to property returns according to equation (7). Therefore, although the properties in South Seoul look attractive when capital gains alone are considered, the properties in local areas perform

better than those in the capital city.

D. Macroeconomic variables

For an in-depth analysis on the effects of the Jeonse-to-Price ratio on property prices, we use several macroeconomic variables in order to control the factors that affect property markets. The literature finds that money supply, price indices, interest rates and stock price indices affect property prices (e.g., Son, 1991; Park, 2007; Kim and Jeong, 2012). Thus, we include a 3-month CD rate, money supply (M1, average balance, seasonal adjustment), Consumer Price Index, and KOSPI (month-end closing price).[10] These macroeconomic variables are first differenced, except for the CD rate.

Ⅲ.2 The effects of Jeonse-to-Price ratio on property returns

A. The effects of Jeonse-to-Price ratio on property returns

We first investigate whether an increase in the Jeonse-to-Price ratio raises property returns. In order to focus on this question, we use the approach proposed by Brennan, Chordia, and Subrahmanyam (1998), where the risk-adjusted returns are regressed on the variables of interests. We estimate the following equation based on equation (7):

$$r^*_{it+1} - \hat{\beta}_{i1} r^{M^*}_{t+1} = \alpha_i + \lambda_{i1} j^M_t + \lambda_{i2}(j_{it} - j^M_t) + \sum_{k=1}^{K} \pi_{ik} f_{kt+1} + \lambda_{i3} Y_{it} + \varepsilon_{it+1}, \quad (17)$$

where $r^*_{it+1} = r_{it+1} + (1 - \varphi_{it} j_{it}) d_{it+1} - (1 - \varphi_{it} j_{it}) r^f_{t+1}$, r_{it+1} is the price change in i area at time $t+1$, $r^{M^*}_{t+1} = r^M_{t+1} + (1 - \varphi^M_t j^M_t) d^M_{t+1} - (1 - \varphi^M_t j^M_t) r^f_{t+1}$, $Y_{it} = r^*_{it} - \hat{\beta}_{i1} r^{M^*}_t$, d_{t+1} is the dwelling benefits, r^f_{t+1} is a risk-free rate, φ_t is the proportion of rental property,

[10] We have considered the industrial production (entire industry, seasonal adjustment), an exchange rate (to US dollar, average of closing price) in addition to our control variables. However, these two variables are excluded in our study because they are not significant. Kim (2012) also reports a similar result. These macroeconomic variables are obtained from the Bank of Korea.

j_t is the Jeonse-to-Price ratio, and f_{kt+1}s represent macroeconomic variables. One month lagged dependent variable (Y_{it}) is included as an explanatory variable in order to control the persistence of property returns. We also consider other macroeconomic variables that may affect the market risk-adjusted returns.

As in Brennan, Chordia, and Subrahmanyam (1998), the left-hand-side of the equation represents the market risk-adjusted return that is calculated using the estimated market beta, i.e., $\hat{\beta}_{i1}$. This method allows us to focus on the impact of the Jeonse-to-Price ratio on the market risk-adjusted property return because λ_{i1} and λ_{i2} include only the dwelling related risks rather than the systematic risk. Note that the effects of the market-wide Jeonse-to-Price ratio on the risk-adjusted return depend on λ_{i1}, whereas λ_{i2} represents the area specific effects.

Table 2 reports the pooled regression results for the entire period from April 1991 to March 2013 along with the two sub-periods divided by July 2007.[11] In the entire period, the Jeonse-to-Price ratios positively affect future property returns. The magnitude of the effects is as much as 0.28% (=0.005*55.9%) per month for the average market-wide Jeonse-to-Price ratio of 55.9%.[12] The regional Jeonse-to-Price ratios, excluding the market-wide Jeonse-to-Price ratio, $j_{it-1} - j_{t-1}^{M}$, also positively affect property returns. However, the magnitude of the effects varies significantly depending on the regional Jeonse-to-Price ratios. For example, the monthly returns of South Seoul is negatively affected by its Jeonse-to-Price ratio, i.e., -0.21% (=0.024*(47.3%-55.9%)), whereas those of Gwangju increase by 0.25% (=0.024*(66.2%-

[11] Using the pooled regression including all individual areas, we estimate the coefficients on the dummy variables for each of the eight areas in order to reflect the regional characteristics. However, we do not report the results in order to conserve space.

[12] In the entire sample period, the average Jeonse-to-Price ratios for the entire market, South Seoul and North Seoul are 55.9%, 47.3% and 53.5%, respectively.

55.9%)) per month by the Jeonse-to-Price ratio. Considering the market-wide and regional effects simultaneously, the Jeonse-to-Price ratio increases the property returns during our sample period.[13] However, the macroeconomic variables do not appear to be significant; yet, the autocorrelation coefficient is large, as reported in many studies in real estate, e.g., Geltner (1993), Bond and Hwang (2007), and Bond, Hwang, and Marcato (2012). The sub-periods, however, show different patterns: the Jeonse-to-Price ratio has a significant positive relationship with the property returns before the financial crisis, whereas the relationship becomes insignificant after the financial crisis, as in Kim (2012). Thus, the Jeonse-to-Price ratio no longer leads property returns.

B. Sensitivity of property return to Jeonse-to-Price ratio

In this subsection, we investigate if the partial derivatives in equation (14) support what we have found in the previous subsection, i.e., the Jeonse-to-Price ratio has a significant positive relationship with property returns only before the financial crisis. The estimated partial derivatives of the property return with respect to the Jeonse-to-Price ratio in panel A of figure 4 show that the sensitivity of property return to the Jeonse-to-Price ratio tends to decrease in all areas. The regional sensitivities decline until 2001, and then, they increase to the end of 2008. After the financial crisis, however, the sensitivities sharply drop and show distinct downward trends. These results indicate that the property return increases with the Jeonse-to-Price ratio before the financial crisis, whereas the relationship disappears or becomes even negative after the financial crisis.

[13] We also estimate the regression model in (17) for each of the eight regions. The regional results also show positive relationships between the Jeonse-to-Price ratios and property returns. Region-specific Jeonse-to-Price ratios have stronger relationships with property returns compared to the market-wide Jeonse-to-Price ratio. The results can be obtained from the authors by request.

It is the second component, i.e., interest rate relative to dwelling benefits ($\varphi_t E_t[\mathrm{r}^{\mathrm{f}}_{t+1} - d_{t+1}]$), that drives the downward trend of the sensitivities. Panel B of figure 4 shows that the movement of the second component is very similar to the trends of sensitivities in panel A, and also similar to the decreasing trend of the interest rate in Figure 1. On the other hand, the first component, i.e., $(1 - \varphi_t j_t)E_t[d'_{t+1}]$, is relatively stable over time. Therefore, the average values of the first and second components are 0.088% and 0.002% before the financial crisis, respectively, whereas they are 0.061% and -0.097% after the financial crisis, respectively. The sharp decline of the second element makes the sensitivity of property returns to the Jeonse-to-Price ratio close to zero.

Ⅲ.3 Why doesn't Jeonse-to-Price ratio affect property returns?

Our theoretical results suggest that the relationship between the Jeonse-to-Price ratio and property returns is positive only when the interest rate is relatively higher than the dwelling benefits. Our empirical results indicate that positive relationships prevail prior to the financial crisis, whereas little evidence of positive relationships exists after the financial crisis.

In this subsection, we directly investigate what drives the relationship between the Jeonse-to-Price ratio and property returns. The dynamic relationship between the Jeonse-to-Price ratio and property return is analyzed using a time-varying model, where the coefficients of the Jeonse-to-Price ratio are allowed to change over time. We investigate both property returns, r^*_{it}, and capital gains, r^c_{it}, of apartments. The former reflects the landlords' total return, including the dwelling benefits, whereas the latter reflects what most people connect with the Jeonse-to-price ratio. The time-varying model is explained below with respect to property returns, but the same model is applied for capital gains.

A. The time-varying model

Following Cho, Hwang, and Lee (2014), the time-varying model is specified as follows:

$$r_{it}^{*} = \mu_{it} + \omega_{it} j_{it-1} + \theta_{it} r_t^{M^*} + \gamma_{it} r_{it-1}^{*} + \sigma_{it} \xi_{it}, \tag{19}$$

where $E(\xi_{it}) = E(\xi_{it}\xi_{jt}) = E(\xi_{it} j_{it-1}) = E(\xi_{it} r_t^{M^*}) = E(\xi_{it}\xi_{i\tau}) = 0 \ (i \neq j, t \neq \tau)$, and $E(\xi_{it}^2) = 1$. The time-varying coefficient, ω_{it}, represents the effect of the regional Jeonse-to-Price ratio on the property return. The market property return, $r_t^{M^*}$, is used as a control variable, and one-month lagged property return is added as an explanatory variable to control the autocorrelation of error terms due to the persistence of property returns (for example, Bond, Hwang, and Marcato, 2012).

As in Primiceri (2005) and Cho, Hwang, and Lee (2014), random walks are assumed for the coefficients of market property return and one-month lagged Jeonse-to-Price ratio, whereas a first-order autoregressive process is assumed for the coefficient of one-month lagged returns in order to ensure the stationarity of r_{it}:

$$\mu_{it} = \mu_{it-1} + \upsilon_{\mu it}, \tag{20}$$

$$\omega_{it} = \omega_{it-1} + \upsilon_{\omega it}, \tag{21}$$

$$\theta_{it} = \theta_{it-1} + \upsilon_{\theta it}, \tag{22}$$

$$\gamma_{it} = c_{\gamma_i} + \phi_{\gamma_i} \gamma_{it-1} + \upsilon_{\gamma it}, \tag{23}$$

where $|\phi_{\gamma_i}| < 1$ and $\upsilon_{\bullet it} \sim N(0, \sigma_{\bullet}^2)$. The idiosyncratic error follows a stochastic volatility process proposed by Hull and White (1987):

$$h_{it} = h_{it-1} + \upsilon_{h_{it}}, \tag{24}$$

where $h_{it} = \ln(\sigma_{it}^2)$ and $\upsilon_{h_{it}} \sim N(0, \sigma_{hi}^2)$.

To estimate the model in (19), we estimate the latent processes $(\mu_{it},\ \omega_{it},\ \theta_{it},\ \gamma_{it})$ together with the hyperparameters $(c_{\gamma_i},\ \phi_{\gamma_i},\ \sigma^2_{\mu_i},\ \sigma^2_{\beta_i},\ \sigma^2_{\theta_i},\ \sigma^2_{\gamma_i},\ \sigma^2_{hi})$ using the Markov Chain Monte Carlo (MCMC) Gibbs sampling. The first step of MCMC Gibbs sampling in our model is to generate the processes $\left(\tilde{\mu}_{it},\ \tilde{\omega}_{it},\ \tilde{\theta}_{it},\ \tilde{\gamma}_{it}\right),\ t = 1, 2, \dots, T$, conditional on the observed data $(r_{it}, j_{it-1}, r_{it-1}, r_t^M)$ as well as on the hyperparameters $(c_{\gamma_i},\ \phi_{\gamma_i},\ \sigma^2_{\mu_i},\ \sigma^2_{\omega_i},\ \sigma^2_{\theta_i},\ \sigma^2_{\gamma_i},\ \sigma^2_{hi})$ by using Carter and Kohn's (1994) multi-move sampling approach. In the second step, we generate the hyperparameters $(\tilde{c}_{\gamma_i},\ \tilde{\phi}_{\gamma_i})$, conditional on both the data $(r_{it}, j_{it-1}, r_{it-1}, r_t^M)$ and the generated processes $\left(\tilde{\mu}_{it},\ \tilde{\omega}_{it},\ \tilde{\theta}_{it},\ \tilde{\gamma}_{it}\right)$. Next, we draw $(\tilde{\sigma}^2_{\mu_i},\ \tilde{\sigma}^2_{\omega_i},\ \tilde{\sigma}^2_{\theta_i},\ \tilde{\sigma}^2_{\gamma_i},\ \tilde{\sigma}^2_{hi})$ from the inverse Wishart distribution as the conjugate prior, conditional on the generated processes and hyperparameters as well as the data. In the last step, we draw $\tilde{h}_{it}$ by using the multi-move sampling. These sequential steps are repeated until convergence. The detailed explanation can be found in Cho, Hwang, and Lee (2014). In this study, we take 10,000 draws after 10,000 burn-in iterations. Then, the model is estimated for each of the eight regions in order to obtain the regional time-series of $\tilde{\omega}_{it}$.

B. The dynamics of the effect of Jeonse-to-Price ratio on property returns

In order to investigate what drives the disappearance of the positive relationship between the Jeonse-to-Price ratio and property returns after the financial crisis, we use a pooled regression for the time-varying coefficients on the Jeonse-to-Price ratio, i.e., $\tilde{\omega}_{it}$. As the explanatory variables, we add the interest rate as well as other macroeconomic variables that affect the property markets in order to identify the economic conditions, where the positive relationship between the Jeonse-to-Price ratio and property return disappears. The macroeconomic variables include the money supply change (R_M1), consumer price index change (R_CPI), industrial production change (R_IP), exchange rates (FX), and unemployment rate (UNE).

Thus, we consider monetary policy, inflation, real economic growth, the conditions for imports and exports and a factor that affects property demands. We include one-month lagged time-varying coefficients $\widetilde{\omega}_{it-1}$ in order to control the persistence that is typical in asset pricing models (Ang and Chen, 2007), and also allow a first-order autoregressive process for the error term to control the persistence created by taking the average values of the 10,000 draws (Gourieroux and Monfort, 1997):[14]

$$\widetilde{\omega}_{it} = \alpha_i^{\omega} + \sum_{k=1}^{K} \pi_k^{\omega} f_{kt} + \delta_i \widetilde{\omega}_{it-1} + \varepsilon_{it}^{\omega}, \quad (25)$$

$$\varepsilon_{it}^{\omega} = \phi^{\omega} \varepsilon_{it-1}^{\omega} + \eta_{it}^{\omega}. \quad (26)$$

A significant positive coefficient on the interest rate is expected from the estimation.

Panel A of table 3 reports the pooled regression results of the time-varying coefficients on macroeconomic variables. It is shown that the interest rate and inflation significantly affect the relationship between the Jeonse-to-Price ratio and property returns, whereas the other macroeconomic variables do not appear to be significant. The positive sign on the interest rate and inflation imply that $\widetilde{\omega}_{it}$ decreases by the recent low interest rate and inflation. The low interest rate by the recent expansionary monetary policies and the controlled inflation after the financial crisis reduce the effects of the Jeonse-to-Price ratio on the property return. This is consistent with our theoretical and empirical results the we obtain with the asset pricing model.

The effects of these macroeconomic variables on $\widetilde{\omega}_{it}$ (the effects of the Jeonse-to-Price ratio on property return) can be analyzed using the following equation derived from equation (25):

$$\bar{\omega}_{it} = \frac{\hat{\alpha}_i^{\omega}}{1-\hat{\delta}_i L} + \sum_{k=1}^{K} \frac{\hat{\pi}_k^{\omega} f_{kt}}{1-\hat{\delta}_i L}, \quad (27)$$

[14] Any time-series aggregated by the cross-sectional average of an autoregressive process shows a stronger autocorrelation (pp. 442~444, Gourieroux and Monfort (1997)).

where L is the lag operator. Using the equation, we compare the coefficients of the Jeonse-to-Price ratios between July 2007 and March 2013, which are the last time points of each sub-period in order to measure the contributions of the two significant variables (CD and R_CPI) to the changes in $\bar{\omega}_{it}$ before and after the financial crisis.

The results in panel B of table 3 show that it is the interest rate that reduces the effect of the Jeonse-to-Price ratio on the property return. The value of $\bar{\omega}_{it}$ formed by the two significant macroeconomic variables (i.e., interest rate and inflation) decreases from 0.0062 in 1995 to 0.0017 in 2013. The monthly property returns contributed by the Jeonse-to-Price ratio through the two variables decreases from 0.35% per month (=0.0062*55.9%[15]) in 1995 to just 0.10% per month (=0.0017*55.9%) in 2013. Of the two variables, the decrease in the interest rate contributes 95% of the changes in $\bar{\omega}_{it}$ during this period. Although inflation is statistically significant (panel A), it appears to have a limited impact on the relationship between the Jeonse-to-Price ratio and property returns.

Householders may be interested in capital gains without considering the dwelling benefits. Thus, we follow the same procedure for capital gains (r_{it}^{c}) in order to obtain the time-varying coefficient of the Jeonse-to-Price ratio ($\tilde{\omega}_{it}^{c}$), which is then analyzed with the macroeconomic variables. Panel A of Table 3 confirms what we find with the total property return above: the interest rate and inflation appear to be significant. Panel C shows that the decrease in the interest rate is the main contributor to the decrease in the effect of the Jeonse-to-Price ratio on the capital gains. This is consistent with the previous results in terms of property returns.

Our result implies that the monetary policy to maintain a low interest rate is the most

[15] 55.9% means the average Jeonse-to-Price ratios for the entire market in the entire sample period.

important factor for stable house price in spite of the sharp increase in the Jeonse-to-Price ratio. Consequently, as far as the interest rate and inflation is kept low, the Jeonse-to-Price ratio would have a limited impact on property prices. The current higher Jeonse-to-Price ratio, however, would increase property prices when the interest rate increases, money supply decreases, and inflation is expected to increase in the near future.

Ⅳ. Conclusions

In this study, we propose a consumption-based pricing model for residential properties, which specifies the relationship between the Jeonse-to-Price ratio and property returns. Our pricing model considers the dwelling benefits as the opportunity costs of landlords for renting out a house, because dwelling benefits are one of the important sources of revenues from owning a residential property, along with capital gains. Our model suggests that a decrease in the interest rate reduces the effect of the Jeonse-to-Price ratio on property returns. Based on our model, we analyze how the Jeonse-to-Price ratio affects property returns and why the effect of the Jeonse-to-Price ratio on property returns disappears by estimating the time-varying coefficient of the Jeonse-to-Price ratio with the Markov Chain Monte Carlo Gibbs sampling.

Our empirical results confirm that the positive relationship between property returns and the Jeonse-to-Price ratio becomes no longer significant after the financial crisis. We find that macroeconomic conditions, such as the recent low inflation and interest rate, contribute to the reduction of the effect of the Jeonse-to-Price ratio on capital gains as well as on property returns. Among the two macro-factors, the decrease in the interest rate appears to be the main contributor that makes the Jeonse-to-Price ratio less important for future house prices, which is consistent with the intuition of our pricing model.

Our results imply that the current high Jeonse-to-Price ratios may have a significant price pressure on property prices when economic situations change. For example, the current higher Jeonse-to-Price ratio would lead to an increase in the house price when the interest rate increases, money supply decreases or inflation increases. In particular, when the Jeonse-to-Price ratio is already high, property prices may respond sensitively to a slight increase in interest rates.

Appendix Residential property pricing model with leveraging by Jeonse

Household's optimization problem in the property market is

$$\text{Max. } V(C_t, C_{t+1}) = U(C_t) + \psi E_t[U(C_{t+1})], \tag{A.1}$$

$$\text{s.t.} \quad C_t = k_t - w(P_t - \varphi_t J_t), \tag{A.2}$$

$$C_{t+1} = k_{t+1} + w(P_{t+1} - \varphi_t J_t) + w(P_t - \varphi_t J_t)d_{t+1}. \tag{A.3}$$

We obtain the first order condition for w by substituting the constraints into the objective function and taking the first derivative with respect to w.

$$\frac{\partial \mathrm{V}}{\partial \mathrm{w}} = U'(C_t)(-P_t + \varphi_t J_t) + \psi E_t[U'(C_{t+1})(P_{t+1} - \varphi_t J_t + (P_t - \varphi_t J_t)d_{t+1})] = 0. \tag{A.4}$$

or

$$1 = \varphi_t j_t + E_t[m](1 - \varphi_t j_t) + E_t[m]E_t[r_{t+1} + (1 - \varphi_t j_t)d_{t+1}] + Cov(m,\ r_{t+1} + (1 - \varphi_t j_t)d_{t+1}), \tag{A.5}$$

where $j_t = \frac{J_t}{P_t}$, which represents the Jeonse-to-Price ratio, and $m_{t+1} = \psi \frac{U\prime(C_{t+1})}{U\prime(C_t)}$ is the discount factor, the so-called pricing kernel, the expected value of which is the reciprocal of the risk-free rate (Cochrane, 2005).

$$\frac{1}{1+\mathrm{r}^{\mathrm{f}}_{\mathrm{t+1}}} = E_t[m_{t+1}]. \tag{A.6}$$

If we incorporate (A.6) into (A.5), we can express the expected return of a house as follows:

$$E_t\left[r_{t+1} + (1 - \varphi_t j_t)d_{t+1} - (1 - \varphi_t j_t)\mathrm{r}^{\mathrm{f}}_{\mathrm{t+1}}\right] = -\frac{\mathrm{Cov}(m_{t+1},\ r_{t+1}+(1-\varphi_t j_t)d_{t+1})}{E_t[m_{t+1}]}. \tag{A.7}$$

Following the procedure similar to the above, the return of the market portfolio can be presented as follows:

$$E_t\left[r^M_{t+1} + (1 - \varphi^M_t j^M_t)d^M_{t+1} - (1 - \varphi^M_t j^M_t)\mathrm{r}^{\mathrm{f}}_{\mathrm{t+1}}\right] = -\frac{Cov(m_{t+1},\ r^M_{t+1}+(1-\varphi^M_t j^M_t)d^M_{t+1})}{E_t[m_{t+1}]}. \tag{A.8}$$

Incorporating (A.8) into (A.7) yields

$$E_t[r^*_{t+1}] = \frac{\mathrm{Cov}(m_{t+1},\ r_{t+1}+(1-\varphi_t j_t)d_{t+1})}{\mathrm{Cov}(m_{t+1},\ r^M_{t+1}+(1-\varphi^M_t j^M_t)d^M_{t+1})} E_t\left[r^{M^*}_{t+1}\right], \tag{A.9}$$

where $r^*_{t+1} = r_{t+1} + (1 - \varphi_t j_t)d_{t+1} - (1 - \varphi_t j_t)\mathrm{r}^{\mathrm{f}}_{\mathrm{t+1}}$, $r^{M^*}_{t+1} = r^M_{t+1} + (1 - \varphi^M_t j^M_t)d^M_{t+1} -$

$(1-\varphi_t^M j_t^M)\mathrm{r}_{t+1}^{\mathrm{f}}$.

The assumption of a representative agent in a static setting allows consumption to be equivalent with aggregate wealth; thus, the pricing kernel can be expressed as a function of aggregated wealth, $\frac{\mathrm{U}\prime(W_{t+1})}{\mathrm{U}\prime(W_t)}$ (Brown and Gibbons, 1985; Dittmar, 2002). As dwelling benefits as well as market return compose an aggregate wealth change in our framework, the pricing kernel can be expressed as a linear function of the return on aggregate wealth by using a Taylor series expansion as (A.10), if we assume that the marginal rate of substitution of the representative household has a linear relationship with the property return on property investment (Harvey and Siddique, 2000; Dittmar, 2002):

$$m_{t+1} = a_0 + a_1 \frac{U\prime\prime}{U\prime}(r_{t+1}^M + (1-\varphi_t^M j_t^M) d_{t+1}^M). \quad \text{(A.10)}$$

Incorporating (A.10) into (A.9), we obtain the property pricing model as follows:

$$E_t[r_{t+1}^*] = \beta^* E_t\left[r_{t+1}^{M^*}\right], \quad \text{(A.11)}$$

where $r_{t+1}^* = r_{t+1} + (1-\varphi_t j_t) d_{t+1} - (1-\varphi_t j_t)\mathrm{r}_{t+1}^{\mathrm{f}}$, $r_{t+1}^{M^*} = r_{t+1}^M + (1-\varphi_t^M j_t^M) d_{t+1}^M - (1-\varphi_t^M j_t^M)\mathrm{r}_{t+1}^{\mathrm{f}}$, and $\beta^* = \frac{\mathrm{Cov}\left(r_{t+1}^M + (1-\varphi_t^M j_t^M) d_{t+1}^M,\ r_{t+1} + (1-\varphi_t j_t) d_{t+1}\right)}{\mathrm{Var}\left(r_{t+1}^M + (1-\varphi_t^M j_t^M) d_{t+1}^M\right)}$.

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Figure 1 Trends of the conversion rate, monthly rental yield, and CD rate

This figure presents the monthly conversion rates from Jeonse to rent, monthly rental yield, and CD rates for the entire period. The conversion rate is provided by Kookmin Bank for the period from August 2001 to May 2011, and then by the Korea Appraisal Board after May 2011. Before August 2001, however, the conversion rate is estimated using a model specified for the period from August 2001 to March 2013. As explanatory variables, we use variables such as inflation, money supply, house price, economic growth, and interest rates. The monthly rental yield is calculated by the conversion rate times the Jeonse-to-Price ratio announced by Kookmin Bank. The 3 month CD rate is obtained from the Bank of Korea.

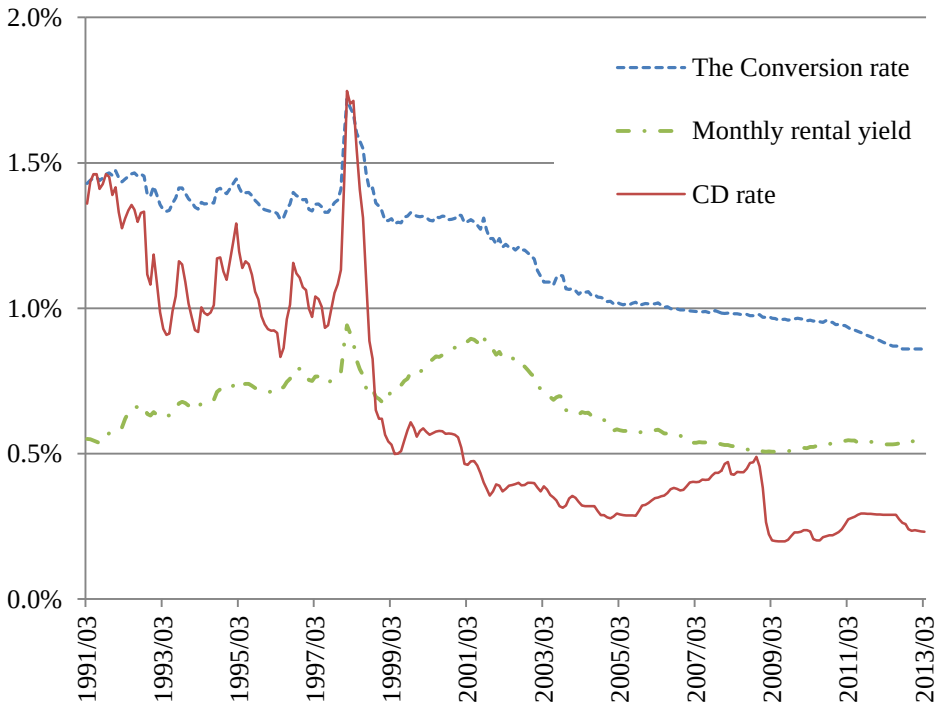


Figure 2 The trends of the owner occupying ratios of apartments

This shows the trends of the owner occupying ratios of apartments. The regional owner occupying ratios come from the survey data with regard to the property tenure status, which are publicly available from “Population and Housing Census” before 2005, and then from “Investigation on Housing Condition”.

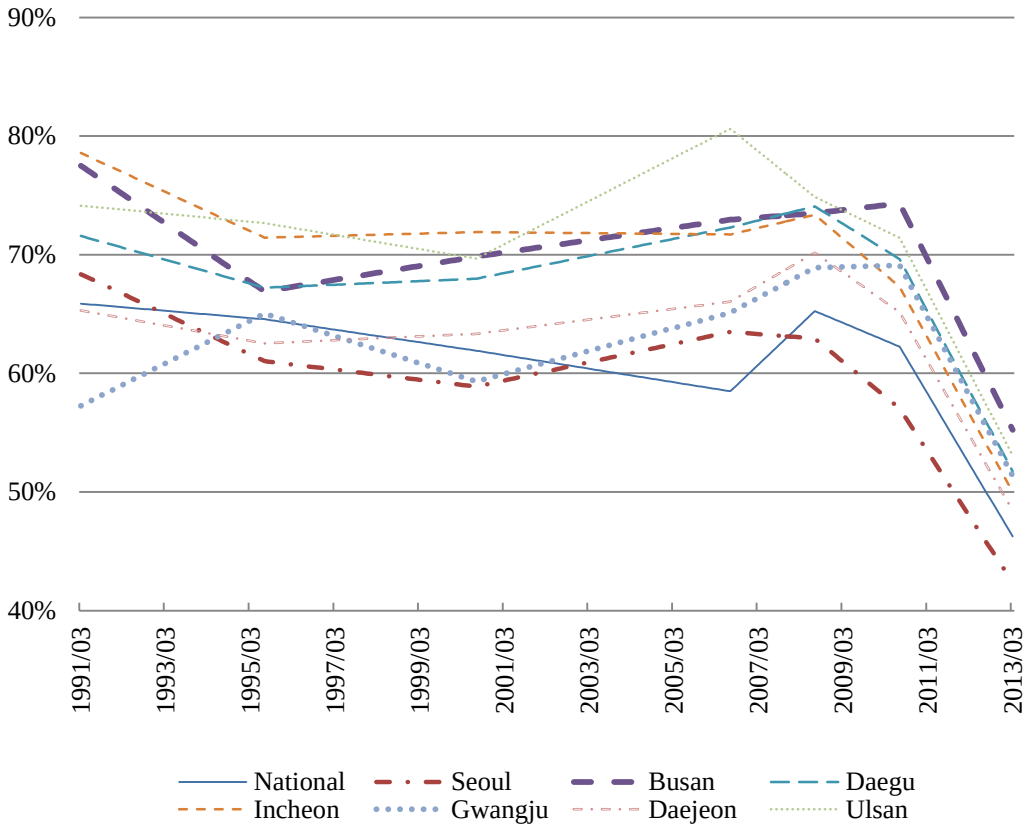


Figure 3 Apartment prices, Jeonse prices and Jeonse-to-Price ratios

Figure 3 shows the trends of house price indices, Jeonse indices, and Jeonse-to-Price ratios of apartments in South Seoul, North Seoul, and throughout the entire country. All monthly data are reported by Kookmin Bank and the initial apartment price index and Jeonse index on March 1993 are set to 100.

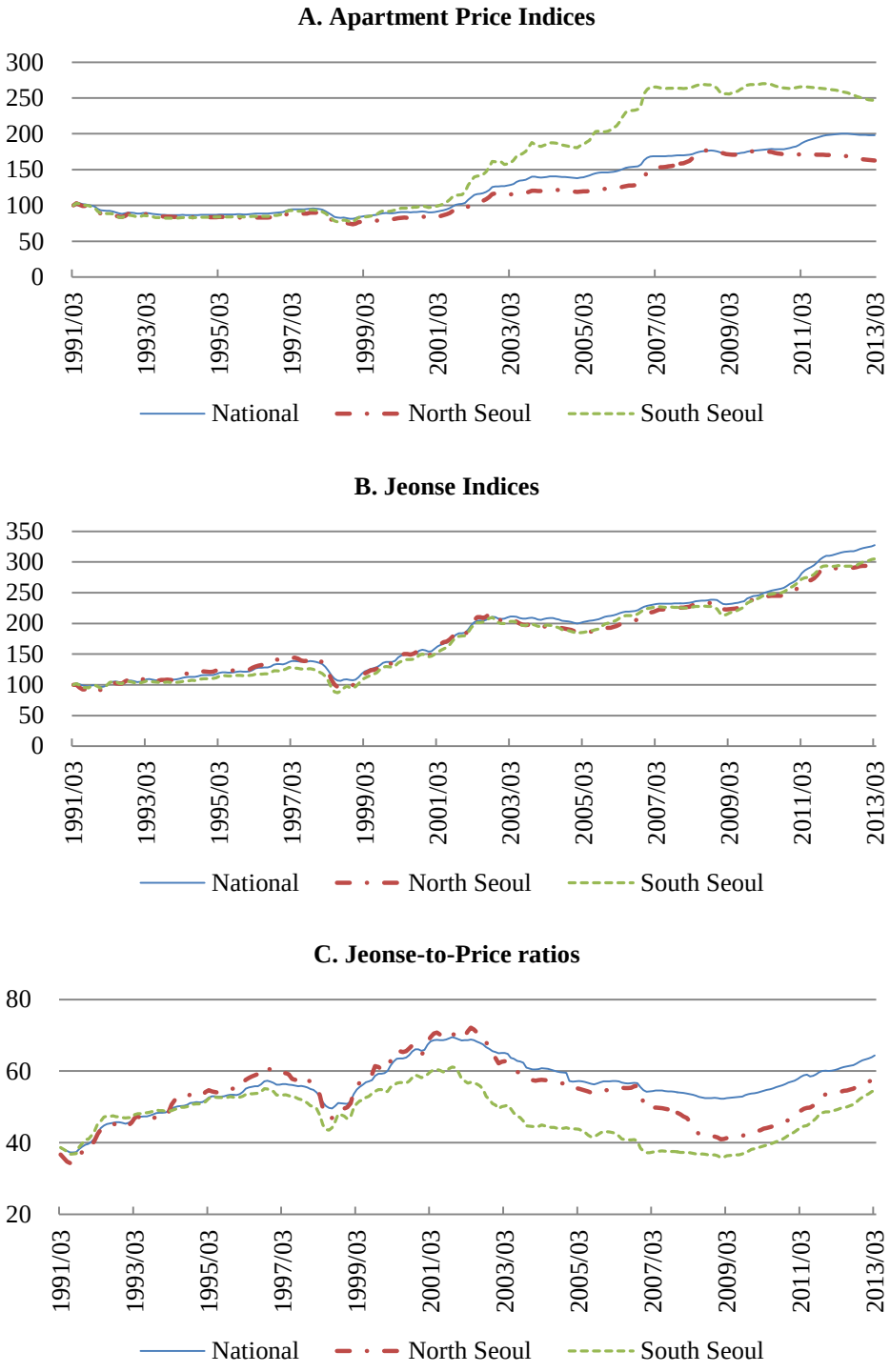
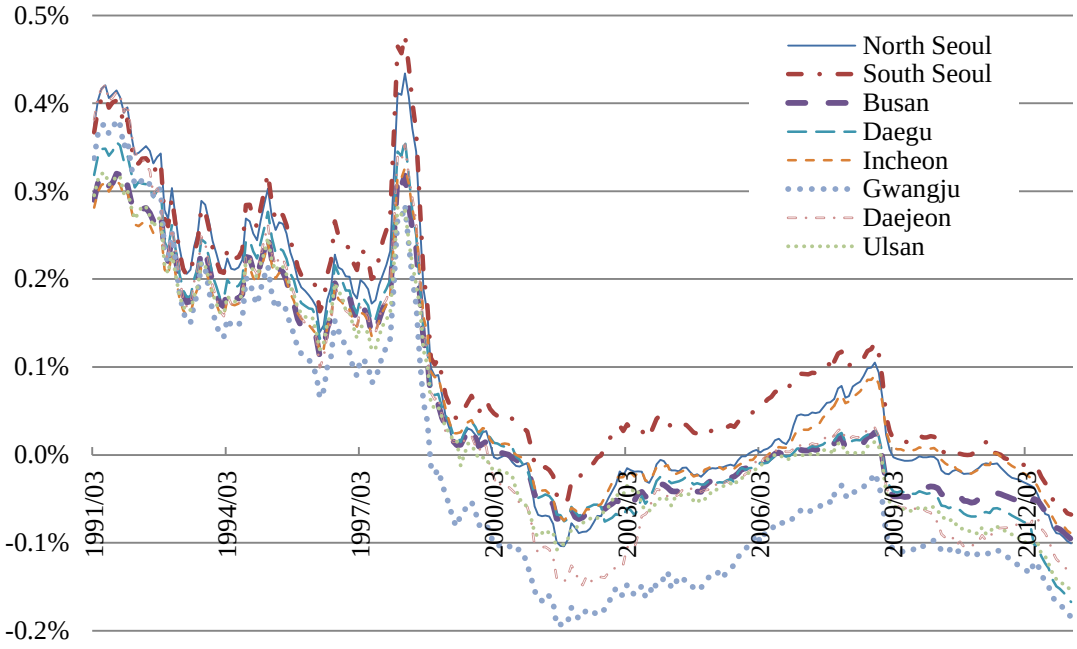


Figure 4 Sensitivity of property return with respect to Jeonse-to-Price ratio

Panel A demonstrates the estimated sensitivities of property returns with respect to the Jeonse-to-Price ratios, which are defined as in equation (14). In order to estimate the sensitivities, the regional conversion rates are used for the partial derivatives of dwelling benefits with respect to the Jeonse-to-Price ratio, i.e., $E_t[d'_{t+1}]$, based on equation (15). Panel B shows the simple average of the two components in eight regional sensitivities, i.e., the first component $\left((1-\varphi_t j_t)E_t[d'_{t+1}]\right)$ and the second component $\left(\varphi_t E_t\left[r^f_{t+1}-d_{t+1}\right]\right)$.

A. Regional sensitivities



B. Average of the first and second components of regional sensitivities

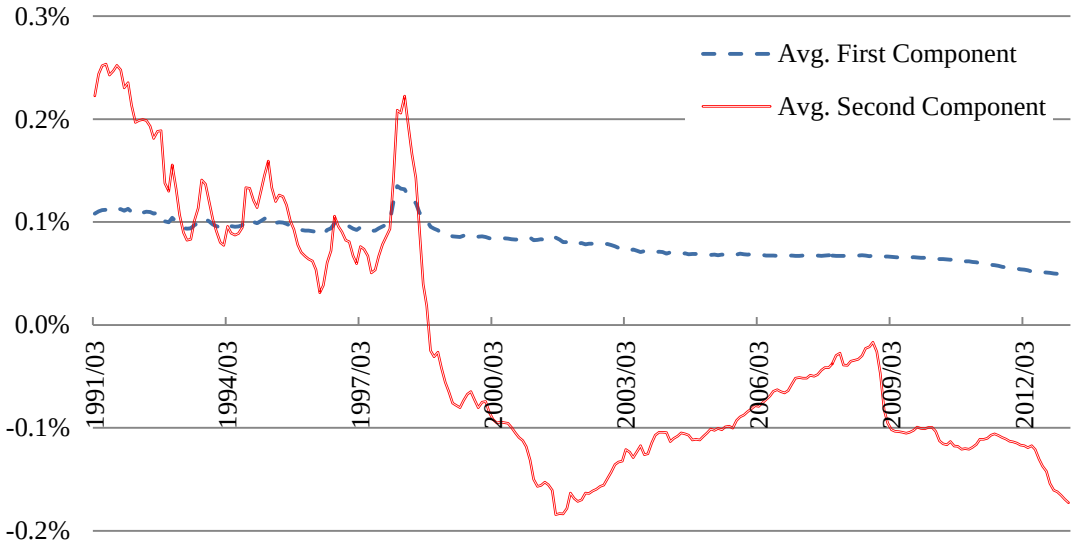


Table 1 Apartment price changes (=capital gains) and property returns

Panel A shows the basic statistical properties of capital gains of apartments before and after the financial crisis. Panel B describes the statistical properties of property returns (sum of capital gains and dwelling benefits) in excess of the risk-free rate.

A. Apartment price changes (=capital gains)

	Entire period (199104~201303)					Before the financial crisis (199104~200707)					After the financial crisis (200708~201303)				
	Mean (A)	Std. Dev. (B)	Skew-ness	Kurt-osis	Sharpe ratio =(A)/(B)	Mean (A)	Std. Dev. (B)	Skew-ness	Kurt-osis	Sharpe ratio =(A)/(B)	Mean (A)	Std. Dev. (B)	Skew-ness	Kurt-osis	Sharpe ratio =(A)/(B)
North Seoul	0.19%	1.19%	0.71	5.88	0.16	0.23%	1.32%	0.52	4.63	0.17	0.08%	0.69%	2.49	9.59	0.11
South Seoul	0.35%	1.54%	0.90	4.33	0.23	0.51%	1.73%	0.61	2.84	0.29	-0.10%	0.50%	-0.39	3.39	-0.20
Busan	0.17%	0.94%	0.01	2.32	0.18	0.00%	0.92%	-0.16	2.56	0.00	0.66%	0.81%	1.18	1.05	0.82
Daegu	0.14%	1.00%	-0.74	10.74	0.14	0.09%	1.10%	-0.66	9.33	0.08	0.29%	0.59%	0.26	-0.08	0.49
Gwangju	0.13%	0.78%	-2.28	31.88	0.17	0.01%	0.75%	-4.42	45.49	0.01	0.49%	0.78%	2.20	4.76	0.63
Daejeon	0.27%	1.18%	0.90	6.47	0.23	0.20%	1.30%	0.95	5.79	0.15	0.46%	0.72%	1.26	0.74	0.64
Incheon	0.27%	1.14%	1.38	4.79	0.24	0.35%	1.26%	1.15	3.55	0.28	0.04%	0.60%	1.55	2.39	0.06
Ulsan	0.23%	0.97%	-2.12	17.66	0.24	0.15%	1.05%	-2.21	16.25	0.15	0.44%	0.64%	1.28	1.46	0.69
Average	0.22%	1.09%	-0.15	10.51	0.20	0.19%	1.18%	-0.53	11.30	0.14	0.29%	0.66%	1.23	2.91	0.41

B. Property returns of an apartment ($= r_{t+1} + (1 - \varphi_t j_t) d_{t+1} - (1 - \varphi_t j_t) \mathrm{r}^{\mathrm{f}}_{t+1}$)

	Entire period (199104~201303)					Before the financial crisis (199104~200707)					After the financial crisis (200708~201303)				
	Mean (A)	Std. Dev. (B)	Skew-ness	Kurt-osis	Sharpe ratio =(A)/(B)	Mean (A)	Std. Dev. (B)	Skew-ness	Kurt-osis	Sharpe ratio =(A)/(B)	Mean (A)	Std. Dev. (B)	Skew-ness	Kurt-osis	Sharpe ratio =(A)/(B)
North Seoul	0.13%	1.33%	0.18	4.96	0.10	0.12%	1.50%	0.12	3.58	0.08	0.17%	0.66%	2.50	10.23	0.26
South Seoul	0.24%	1.66%	0.60	4.00	0.14	0.34%	1.90%	0.40	2.47	0.18	-0.05%	0.50%	-0.52	4.35	-0.10
Busan	0.22%	1.16%	-0.38	1.83	0.19	-0.02%	1.17%	-0.42	1.80	-0.01	0.92%	0.84%	1.09	0.68	1.09
Daegu	0.17%	1.19%	-0.94	7.56	0.14	0.04%	1.31%	-0.73	6.27	0.03	0.52%	0.61%	0.16	-0.34	0.86
Gwangju	0.32%	0.92%	-1.92	22.38	0.35	0.15%	0.90%	-3.13	28.57	0.17	0.83%	0.78%	2.23	4.86	1.07
Daejeon	0.33%	1.33%	0.47	5.29	0.25	0.21%	1.46%	0.61	4.77	0.14	0.69%	0.76%	1.12	0.33	0.91
Incheon	0.30%	1.28%	0.86	3.81	0.24	0.34%	1.45%	0.70	2.51	0.24	0.19%	0.55%	1.51	2.64	0.34
Ulsan	0.37%	1.16%	-1.59	10.64	0.32	0.24%	1.26%	-1.48	9.17	0.19	0.75%	0.65%	1.12	1.09	1.16
Average	0.26%	1.25%	-0.34	7.56	0.22	0.18%	1.37%	-0.49	7.39	0.13	0.50%	0.67%	1.15	2.98	0.70

Table 2 Regression results on property returns

This table reports the estimation results regarding the effect of the Jeonse-to-Price ratio on the property returns of apartments. The dependent variable is the market risk-adjusted property return (=capital gains + dwelling benefits), which is deducted from market property return times $\hat{\beta}^1$. The Jeonse-to-Price ratio that is used as an explanatory variable is decomposed into the ratios for the entire market (j_{t-1}^M) and the regions ($j_{it-1} - j_{t-1}^M$). Lagged dependent variable (Y_{it-1}) and macroeconomic variables, such as CD rate (CD), money supply change (R_M1), CPI change (R_CPI) and KOSPI index change (R_KOSPI), are considered as control variables. The table reports the results of the least-squares dummy variable model for the entire period from April 1991 to March 2013 and for the two sub-periods divided by July 2007. To conserve space, the estimates on the dummy variables for the eight regions are not reported. The numbers in parentheses are t-statistics based on the coefficient covariance using the White cross-section method.

	Entire period (1991.4~2013.3)	Before the financial crisis (1991.4~2007.7)	After the financial crisis (2007.8~2013.3)
j_{t-1}^M	**0.0050**	**0.0065**	0.0001
	(2.06)	**(1.99)**	(0.03)
$j_{it-1} - j_{t-1}^M$	**0.0244**	**0.0249**	0.0086
	(7.41)	**(5.08)**	(1.21)
CD	-0.0075	-0.0075	-0.0079
	(-1.96)	(-1.32)	(-1.23)
R_M1	0.0073	0.0098	**-0.0188**
	(0.67)	(0.92)	**(-2.17)**
R_CPI	0.0418	0.0508	-0.0273
	(1.55)	(1.6)	(-1.33)
R_KOSPI	-0.0014	-0.0007	-0.0022
	(-0.84)	(-0.37)	(-1.51)
Y_{it-1}	0.4412	0.3398	0.8317
	(8.82)	(6.95)	(12.28)
Adj. R2	0.3155	0.1921	0.7566

Table 3 The dynamics of the time-varying coefficients on the Jeonse-to-Price ratio

This table shows which macroeconomic variables affect the coefficient of the Jeonse-to-Price ratio on property returns or capital gains. For this analysis, we estimate the time-varying coefficients by using the Markov Chain Monte Carlo Gibbs (MCMC) sampling. Panel A reports the pooled regression results of the time-varying coefficients on the Jeonse-to-Price ratio. We consider industrial production change (R_IP) for real economic growth, unemployment rate (UNE) to affect property demand, and exchange rates (FX) for import and export conditions besides the CD rate (CD), money supply change (R_M1), and Consumer Price Index change (R_CPI). We include one-month lagged time-varying coefficients $\widetilde{\omega}_{it-1}$ to control the persistence of property returns, and also allow a first-order autoregressive process for the error term in order to control its persistence due to taking the average values of the 10,000 MCMC draws. To conserve space, we do not report the estimates on the dummy variables for the eight regions. Panels B, C, and D report the regional regression results during the entire period and the two sub-periods. The numbers in parentheses are t-statistics from the White cross-section method. Panel B (or C) reports the contributions of macroeconomic variables in order to reduce the relationship between the Jeonse-to-Price ratio and property returns (or capital gains). Using equation (27), we calculate the values of the estimated relationship, which is formed by the two significant variables, i.e., CD rate and R_CPI. Then, we compare the coefficient values in December 1995, December 1995, July 2007 and March 2013 in order to measure the contributions of the two variables (CD and R_CPI) to the changes in the coefficient values before and after the financial crisis.

A. Pooled regression for the time-varying coefficients on the Jeonse-to-Price ratio

Dependent variable / Explanatory variables	The time-varying coefficients of the Jeonse-to-Price ratio on property returns	The time-varying coefficients of the Jeonse-to-Price ratio on the capital gains
CD	**0.00278**	**0.00297**
	(2.88)	**(2.78)**
R_M1	-0.00177	-0.00156
	(-1.22)	(-0.98)
R_CPI	**0.01031**	**0.01616**
	(1.99)	**(2.93)**
R_KOSPI	0.00044	0.00032
	(1.4)	(0.95)
FX	-0.00001	0.00000
	(-0.1)	(0.09)
R_IP	0.00164	0.00136
	(1.51)	(1.43)
UNE	0.00278	-0.00384
	(0.68)	(-0.88)
$\widetilde{\omega}_{it-1}$	0.92654	0.93533
	(55.62)	(59.01)
$\varepsilon_{it-1}^{\omega}$	0.48977	0.51408
	(13.85)	(15.29)
Adjusted R-squared	0.9983	0.9987

B. Contribution for change of the time-varying coefficients on the Jeonse-to-Price ratio on property returns

	December 1995	December 2000	July 2007	March 2013
CD	0.0057	0.0034	0.0020	0.0014
R_CPI	0.0005	0.0003	0.0003	0.0003
Total	0.0062	0.0038	0.0024	0.0017

C. Contribution for change of the time-varying coefficients on the Jeonse-to-Price ratio on the capital gains

	December 1995	December 2000	July 2007	March 2013
CD	0.0068	0.0042	0.0024	0.0017
R_CPI	0.0010	0.0006	0.0006	0.0005
Total	0.0078	0.0049	0.0030	0.0022