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How Are Property Investment Returns Determined?*

— Estimating the Micro-Structure of Asset Prices, Property Income, and Discount Rates —

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Abstract

How exactly should one estimate property investment returns? Investors in property aim to maximize capital gains from price increases and income generated by the property. How are the returns on investment in property determined based on its characteristics, and what kind of market characteristics does it have? Focusing on the Tokyo commercial property market and residential property market, the purpose of this paper was to break down and measure the micro-structure of property investment returns in as much detail as possible. In Japan, the characteristics of property suitable for investment are dubbed "*kin-shin-dai*" (close, new, and large). That is, investors believe that investment returns are high for properties that are very convenient in terms of transportation (close to the city center), new buildings (relatively new properties), and large-scale real estate (large design or floor space). Therefore, this paper first measured how the asset prices, income, and asset price-income ratios (discount rate) that comprise property investment returns change based on differences in these property characteristics. Second, the reliability/distortion of information that can be observed on the property investment market was measured. Much of the information available on the property investment market is property price information determined by property appraisers. However, it is known that property appraisal prices are unable to appropriately reflect actual property market trends. Therefore, using enterprise value data for REIT investment management companies comprised of REIT investment unit prices (share prices) available on capital markets, this paper proposed a method of estimating property investment returns corresponding to changes in capital markets, as well as clarifying the distortion in property investment returns that are formed based on property appraisal prices. Looking at the results obtained, for commercial property, as building floor space increased, it had the effect of raising both the income and price while lowering the discount rate. In particular, compared to residential property, the results showed that a higher investment return can be obtained from commercial property by investing in larger-scale properties. Building age lowered the asset price and income for both commercial and residential property, but the effect was especially strong for residential property. Furthermore, there was a significant divergence between discount rates and risk premiums formed

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by asset markets and those formed by capital markets, and the results showed that a greater difference was generated while the market was shrinking. This finding suggests that looking at property investment returns that are estimated based on asset market information alone could lead to erroneous investment decisions.

Key Words: Present Value Model; discount rate; quality-adjusted price index; hedonic approach; heterogeneity; Tobin's q; Risk premium

JEL Classification: E3; G19

1 Introduction

How exactly should one estimate property investment returns?

Investors in the stock market are preoccupied with trends in daily share prices. Investors in securities such as government bonds look at price stability and the rate of return.

Do investors in property pursue capital gains in the same manner as stock investors, or do they instead pursue income generated by property in the same manner as securities investors? Based on the investment characteristics of property, this issue has been the subject of much debate. While possessing the characteristics of investment goods, property also possesses the characteristics of consumer goods, since production activities are conducted, housing services are consumed and such, depending on its use. As a result, property differs significantly from stocks and securities in that its economic value exists based on its use (Lee et al., 2010)[20].

One could say that property investors pursue both capital gains and rate of return. To put it more precisely, among property investors, there are investors who pursue only capital gains over a short-term investment period in the same manner as stock investors, there are investors who focus on the rate of return in the same manner as securities investors, and there are also investors who specify a long-term investment period and act in order to maximize both asset price increases and income generated by the property in a well-balanced manner.

For investors seeking to maximize capital gains, the optimal strategy is to buy property at the lowest price possible and sell it off at the highest price possible. Among such investors, even if the market is heating up and they are unable to buy at relatively low prices, it is not unusual for them to make investments if even a slight price increase is anticipated.

However, investors trying to maximize income generated by property focus on balancing the income generated by the property and the asset price to select property that will enable them to maximize the income the property generates over the investment period.

If trying to define "property investment returns" and measure them using data obtained from the actual market, it is necessary to understand the micro-structure – i.e., how are the asset price and rental revenue-based income that comprise the capital gains and rate of return representing the income-asset price ratio (the discount rate) determined?

Focusing on the commercial property market and residential property market in Tokyo's wards, this paper will break down the micro-structure of property investment returns and perform estimations using actual data in as much detail as possible. Then, it will clarify how the various indicators of property investment returns that were analyzed change amid the dynamic fluctuations of the property investment market.

In broad terms, this paper is comprised of two empirical analyses. First, after defining property investment returns based on a neoclassical present value model combining the formulations of Marshall and Hicks, it will clarify changes in investment returns according to property characteristics.

In Japan, the phrase *kin-shin-dai* (close, new, and large) describes the characteristics of property suitable for investment. It is believed that investment returns are high for property close to the city center (unlike locations such as the suburbs, where transportation access is poor), relatively new buildings, and large-scale properties.

As a result, the majority of investment properties are concentrated in Tokyo, and investment is centered on relatively new buildings. The focus on building age in particular may be considered a common characteristic of Asian property investment markets, where the useful lifespan of buildings is relatively short, as well as being related to earthquake-resistance (Chau, Wong, and Yiu, 2005[3]). Therefore, this paper will clarify how asset price, income, and the ratio representing the link between asset price and income (the income-asset price ratio or discount rate) change based on differences in the aforementioned characteristics.

Secondly, this paper will focus on the reliability or distortion of information that can be observed on the property investment market. Much of the information available on the property investment market is property price information determined by property appraisers. Even for actual sale prices, property appraisal prices are referred to in determining sale prices for listed real estate investment trust funds (REITs) in particular, as well as private-placement funds and private-placement REITs. Furthermore, if an attempt is made to buy a property at a price that diverges significantly from the property appraisal price, the transaction will still be influenced by the property appraisal price, since an explanation of the reason for the divergence will be strongly requested.

However, it is known that property appraisal prices are unable to appropriately reflect actual property market trends. For example, Geltner (1989)[15], Clayton, Geltner, and Hamilton (2002)[5], and Shimizu and Nishimura (2006)[25] have pointed out that price evaluation errors exist in property appraisal prices, and if property investment returns are calculated using these variations, the returns will be subject to smoothing and it will not be possible to appropriately estimate returns or risk amounts.

This issue has been dubbed "property appraisal evaluation risk," and methods for correcting it have also been proposed.[*1] If attempting to estimate investment returns on the property investment market using asset price, income, and discount rate data generally available on asset markets, there is a strong possibility that it will lead to distortion in the estimated values.

Accordingly, focusing on changes in REIT management company enterprise values comprised of REIT investment unit prices (share prices) available from capital markets (stock markets), this paper will propose a method of estimating the potential return on property investment. In addition, by comparing with property investment returns that can be obtained using the property market and conducting analysis, it will clarify the distortion that exists in property investment returns that are formed based on property appraisals.

This paper is comprised of four sections. The second section will outline a theoretical framework for asset prices. The third section will construct an empirical model using actual data, as well as perform estimates with it and elucidate its micro-structure. In conclusion, the fourth section will summarize this paper's ideas about property investment returns.

[*1] In terms of correction methods, two methods have been proposed. There is the method of "unsmoothing" property appraisal indexes (Barkham and Geltner, 1994[1]; Horrigan, Case, Geltner, and Pollakowski, 2009[13]), and there is the method of creating a new index using information available on capital markets such as the REIT market, as proposed by Bokhari and Geltner (2010)[2].

2 Theoretical Framework and Estimation Model

2.1 Determination of Asset Price/Investment Income

According to a neoclassical economic model combining the formulations of Marshall and Hicks, asset price is considered to be the "net present value" of future income streams. The theoretical framework for this is easily formulated and, what's more, quantitative models developed from the theory have been constructed (e.g., Diewert, 1974[7]).

However, this does not necessarily mean that rigorous estimation models have been constructed for performing estimations using data observed on the actual market. Therefore, this paper will make formulations relating to property investment income based on a Hicks-Marshall-type neoclassical asset price determination model and break down the micro-level elements of asset price as much as possible.

"Net present value," which is also known as "fundamental value," is determined according to the basic formulae of capital theory. As such, it is possible to break down asset price into "income" and "discount rate." And this income changes depending on the purpose, location characteristics (e.g., transportation convenience), and building characteristics (e.g., size, age, etc.) of individual properties.

Furthermore, as shown by Gordon (1959)[17], discount rate is determined based on judgments involving other assets. Specifically, it is known that when taking the discount rate of what is considered the safest asset as a starting point, it is possible to break down the anticipated growth rate of the asset's future income and its inherent risk premium. As such, the risk premium can also be differentiated based on a building's purpose, structure, size, transportation convenience, etc. in the same manner as asset price and income.

In other words, if one focuses on the micro-structure of asset price, the return on property investment can be broken down into complex elements. And since it will be possible to accurately identify the factors that cause property investment returns to fluctuate if the micro-structure can be elucidated, making accurate property investment decision-making and risk management possible.

Here, V_ν^t is the asset price at the start of period t, for which ν years have elapsed since production, while y_ν^t is the income corresponding to this. The lifetime of the asset is assumed to be m years. When the outlay paid at the end of the period t for an asset for which ν years have elapsed since production is taken as O_ν^t, i^t is the anticipated nominal interest rate t determined as a result of judgments involving alternative assets or the anticipated investment earning rate forecast as being obtainable at the time when investment was made in the asset. Here, the anticipated value is considered to be the value determined at the start of period t.

Based on this type of hypothesis, the asset price for the period t may be formulated as in Equation 1 (Diewert and Nakamura, 2009[8]; Jorgenson, 1963[18]; LeRoy and Porter, 1981[21]; Shimizu et al., 2012b[29]).

$$\begin{aligned} V_\nu^t = {} & \frac{y_\nu^t}{1+i^t} + \frac{y_{\nu+1}^{t+1}}{(1+i^t)(1+i^{t+1})} + \cdots + \frac{y_{m-1}^{t+m-\nu-1}}{\prod_{i=t}^{t+m-\nu-1}(1+i^i)} \\ & - \frac{O_\nu^t}{1+i^t} - \frac{O_{\nu+1}^{t+1}}{(1+i^t)(1+i^{t+1})} - \cdots - \frac{O_{m-1}^{t+m-\nu-1}}{\prod_{i=t}^{t+m-\nu-1}(1+i^i)} \end{aligned} \tag{1}$$

Moreover, when temporal factors are added in order to incorporate discrete dynamic factors, it is possible to obtain the expenses for one year's ownership (user costs) or the investment earning rate.

Extrapolating from Equation 1, it is also possible to formulate the opportunity cost (user cost) based on one year's ownership or the investment return.

Here, the asset price when one year has elapsed following t years of investment (asset price when $t+1$ year has elapsed) is as shown in Equation 2.

$$\begin{aligned} V_{\nu+1}^{t+1} = & \frac{y_{\nu+1}^{t+1}}{1+i^{t+1}} + \frac{y_{\nu+2}^{t+2}}{(1+i^{t+1})(1+i^{t+2})} + \cdots \\ & + \frac{y_{m-1}^{t+m-\nu-1}}{\prod_{i=t+1}^{t+m-\nu-1}(1+i^i)} - \frac{O_{\nu+1}^{t+1}}{1+i^{t+1}} - \cdots - \frac{O_{m-1}^{t+m-\nu-1}}{\prod_{i=t+1}^{t+m-\nu-1}(1+i^i)} \end{aligned} \tag{2}$$

When both sides of Equation 2 are divided by $(1+i^t)$ and Equation 1 is subtracted, one obtains Equation 3.

$$V_\nu^t - \frac{V_{\nu+1}^{t+1}}{1+i^{t+1}} = \frac{y_\nu^t}{1+i^t} - \frac{O_\nu^t}{1+i^t} \tag{3}$$

Then, when Equation 3 is multiplied by $(1+i^t)$ and each term is organized, one obtains Equation 4 expressing the user expenses, or user cost, for the period t.

$$y_\nu^t = i^t V_\nu^t + O_\nu^t - (V_{\nu+1}^{t+1} - V_\nu^t) \tag{4}$$

In other words, the income generated by an asset (rent in the case of property) is equivalent to the investment return on the asset price ($i^t V_\nu^t$) plus the management expenses (O_ν^t) minus the capital gains ($V_{\nu+1}^{t+1} - V_\nu^t$).

That being the case, the investment earning rate for the period t or property investment return can be arranged as in Equation 5.

$$i^t = \frac{y_\nu^t - O_\nu^t}{V_\nu^t} + \frac{V_{\nu+1}^{t+1} - V_\nu^t}{V_\nu^t} \tag{5}$$

It is equivalent to the net income/asset price ratio (hereafter considered as r^t and referred to as the "discount rate") obtained by dividing the expenses-deducted net income ($y_\nu^t - O_\nu^t$, hereafter considered as Y_ν^t and referred to as the "net income") by the asset price (V_ν^t) added to the capital gain earning rate $(V_{\nu+1}^{t+1} - V_\nu^t)/V_\nu^t$.

2.2 Estimation Model

The asset price and the dynamic investment earning rate (i.e., the property investment return) is the discount rate (r^t) added to the capital gain earning rate.

Accordingly, if one attempts to elucidate its micro-structure using actual data able to be observed on the market, one can see that along with elucidating the asset price (V), one should be able to elucidate the net income (Y) and discount rate (r).

However, in performing actual estimations, one is often faced with data limitations. This paper uses asset price data that can be obtained on the listed real estate investment trust (REIT) market, which has been growing rapidly in recent years, especially in leading developed nations. The significance of using this data is considerable. In the REIT market, it is possible to directly observe the asset prices (V), net income (Y), and discount rates (r) of individual properties owned by investment companies in combination with various property characteristics. Furthermore, since REIT equity is listed on stock markets, it is possible to obtain the market value of these investment companies on capital markets. In other words, market data can be acquired on both asset markets and capital markets.

In general, when it comes to quantitative models focusing on economic markets, it is assumed that the processes that generate observable data on the market are efficient. However, since information is not complete and transaction costs are considerable for asset markets (especially the property market), they are known as incomplete markets. Conversely, publicly listed stock markets are said to be one of the most efficient types of market. It is perhaps natural therefore to consider trying to use investment unit price (share price) information on the REIT market within the asset price determination mechanism.

Based on eliminating data limitations in this manner, it is possible, as shown below, to construct estimation models for asset price (V), net income (Y), and discount rate (r), respectively.

First, the asset price (V), net income (Y), and discount rate (r) will be broken down according to asset characteristics.

Asset price and net income are determined as the sum of various characteristic vectors. This method of breaking down price into characteristic vectors is an economic theory known as the hedonic approach.

The hedonic approach is a method that treats the price of a given product as an aggregation (bundle of characteristics) of the values of various capacities and functions, and estimates the product price using statistical regression analysis techniques.[*2]

In traditional price theory, the law of one price is a valid supposition when conducting market analysis, but as Lancaster (1966)[19] has analyzed, this supposition is extremely problematic in theoretical terms when dealing with differentiated products (and also when performing empirical analysis). Rosen (1974)[23] has therefore elucidated in theoretical terms the type of market mechanisms that generate price data for products considered as bundles of characteristics.[*3]

Specifically, with regard to asset price or income, he focused on qualities that change based on the characteristics (Z) of the asset. Taking a typical example, in the case of property, the fact that price and income vary according to convenience-related characteristics such as the distance to the nearest station (DS) and distance to the city center (DT) is a phenomenon that may be viewed as common to all countries. In addition, rent and price will vary when building age (A) and size (S) vary, even if the location is the same.

Therefore, based on the fact that these kinds of characteristics change property investment returns, this paper will specify a model for the purpose of simultaneously estimating the three parameters (asset price, income, and discount rate) (Ching, 2004[4]).

Taking the net income (Y_{it}^n) generated by property i in period t for purpose n ($n = 1$: commercial property, 2: residential property), the corresponding asset price (V_{it}^n), the j characteristic vectors for the property $Z_{ijt} = (Z_{i1t}, \ldots, Z_{iJt})$, and a temporal dummy absorbing the time effect as ($D_t : t = 1, \ldots, T$), the asset price and net income can be expressed as in

[*2] With regard to the estimation of property price indexes using a hedonic function, please refer to Shimizu et al. (2010b)[27].

[*3] As Quigley (1982)[22] has pointed out, research also existed prior to Rosen that tried to analyze differences between general products and products such as housing that are comprised of bundles of characteristics, but in light of the descriptions of the data generation process, it may be said that the hedonic price function was not understood properly in said research. Rosen's paper can be positioned as research that develops a market equilibrium theory for products differentiated based on propositions by Tinbergen (1959)[30].

Equation 6 and Equation 7.

$$\ln V_{it}^{n} = \beta_0 + \sum_{j}^{J} \beta_j Z_{ijt} + \sum_{t}^{J} \xi_t D_t + \varepsilon_{Vit} \tag{6}$$

$$\ln Y_{it}^{n} = \alpha_0 + \sum_{j}^{J} \alpha_j Z_{ijt} + \sum_{t}^{J} \nu_t D_t + \varepsilon_{yit} \tag{7}$$

That being the case, the discount rate (r_{it}^{n}) that converts net income (Y_{it}^{n}) into asset price (V_{it}^{n}) can be expressed in terms of logarithmic difference, as in Equation 8.

$$\ln r_{it}^{n} = (\alpha_0 - \beta_0) + \sum_{j}^{J} (\alpha_j - \beta_j) Z_{ijt} + \sum_{t}^{J} (\nu_t - \xi_t) D_t + (\varepsilon_{yit} - \varepsilon_{Vit}) \tag{8}$$

ξ_t estimated with Equation 6 is the quality-adjusted property price index, while ν_t estimated with Equation 7 is the quality-adjusted rent index.

Furthermore, the discount rate (r) that converts income generated by property into price can also be estimated as $(\alpha_j - \beta_j)$ as it changes based on property characteristics, and quality-adjusted temporal changes can be estimated as $(\nu_t - \xi_t)$.

3 Empirical Analysis

3.1 Data

This paper estimates the micro-structure of asset price (V), net income (Y), and discount rate (r) using published information*4 from the Japanese real estate investment trust market (hereafter referred to as the "J-REIT market") in the Tokyo area.

This data includes the transaction price when an investment corporation listed on the J-REIT market makes a purchase or sale and the property appraisal price calculated once every six months. Furthermore, with regard to asset price, the corresponding rental revenue (Y), expenses such as property tax and non-life insurance premiums (O)*5, and net income after deducting expenses*6 have been calculated.

In terms of property-related characteristic data, land area (L: m^2), rentable floor space representing a source of income (S: m^2)*7, age of building (A: years), number of stories (H: stories), nearest station, leasehold format (LHD: right of ownership, standard leasehold, or fixed-term leasehold), and so forth are surveyed by property appraisers.*8 In addition, with

*4 Data from Nikkei Inc.'s R-Square is used in this paper. With regard to supplying the data, assistance was provided by Nikkei Digital Media Inc., Toshihiro Doi, Naoto Otsuka, and Yasuhito Kawamura.

*5 Accounting-related depreciation costs are excluded in the calculation of these expenses.

*6 In published information on J-REITs, taxes and public dues for the year the property is acquired are not recorded as expenses in order to balance taxes and public dues paid when the property is acquired. Accordingly, in the data-set used in this analysis, the actual value of taxes and public dues were obtained from accounting data for the year following the property's acquisition, and NOI was calculated by using this data as a substitute for the taxes and public dues in the year the property was acquired.

*7 Rentable floor space refers to the amount of the building floor space within the transacted building that represents a source of generating income. Shared areas such as the entrance and areas of the building which were not covered by the transaction are eliminated from this.

*8 These property characteristics are surveyed by property appraisers for the purpose of performing property appraisal. Building-related data is surveyed separately in the form of building engineering reports by research organizations aimed at architects and the like.

respect to location, since an accurate address exists, it is possible to obtain the longitude and latitude coordinates,[*9] and as a result, it is possible to calculate the distance to the nearest station (DS: m) and distance to the city center (Tokyo Station) (DT: m).[*10] Even for the same asset, there is a strong possibility that the price formation will vary depending on the investing party.[*11] Therefore, an investment corporation dummy (FD) has been added in order to differentiate transacting parties.

An overview of the data is provided in Table 1.

Table. 1 List of Variables

Symbols	Variables	Contents	Unit
V	Property Value	Property Value in J-REIT market.	million yen
Y	Net Operating Income	Rent income (y) $-$ Operating expenditure (O).	million yen
r	Rent-Price ratio	Rent income after deducting expense (Y) $\div$ Property value (V).	%
L	Land area	Land area of building	m^2
RS	Rentable floor space	Rentable floor space of building	m^2
A	Age of building	Age of building at the time of transaction/appraisal	years
H	Number of stories	Number of stories in the building	stories
FSR	Floor Space Ratio	Floor Space Ratio	%
DS	Distance to the nearest station	Distance to the nearest station.	meters
DT	Distance to central business district	Distance to Tokyo Station.	meters
SRC	SRC Dummy	SRC structure $= 1$, other structure $= 0$.	$(0, 1)$
CD	Commercial dummy	Commercial(Retail) use $= 1$ Office use $= 0$.	$(0, 1)$
FD_k	Investment corporation dummy	kth Investment corporation $= 1$, other Investment corporation $= 0$. ($k = 0, \ldots, K$)	$(0, 1)$
LD_l	Location dummy	lth area $= 1$, other district $= 0$. ($l = 0, \ldots, L$)	$(0, 1)$
D_t	Time dummy (quarterly)	tth quarter $= 1$, other quarter $= 0$. ($t = 0, \ldots, T$)	$(0, 1)$

In this research, two data-sets were created focusing on the Tokyo area: for non-residential property, a data-set was created relating to the commercial property market (office market and commercial facility market), while for residential property, a data-set was created relating to the residential property market in which investments are made in rental housing. The

[*9] With regard to obtaining latitude and longitude coordinates, the University of Tokyo Center for Spatial Information Science's address matching service was used.

[*10] This data is calculated as the day-time average travel time and excludes the time during morning and evening commutes. It is updated once per six months based on changes in transportation schedules. The present data was created by Val Laboratory.

[*11] Rosen (1974)[23]'s hedonic model is extrapolated from the buyer's valuation function. As a result, in such estimations, as Ekeland et al. (2004)[11] have shown, it is possible that omitted variable bias will occur with respect to the estimated value if the transacting party's characteristics are not taken into account.

collection period was from the first quarter of 2003 to the fourth quarter of 2011.

This period includes a sub-period that was moving toward recovery from the sustained downward phase in asset prices that accompanied the collapse of the 1990s bubble. What's more, from the start of the 2000s, with the development of financial technologies and increase in cross-border transactions of investment funds, investment funds flowed into the property investment market and a mini-bubble dubbed the "fund bubble" occurred, which was centered on large urban areas. The Lehman Brothers collapse then triggered a reversal in the increase in asset prices accompanying this fund bubble. In this sense, the period covers one asset price cycle, from the downward phase in asset prices to the period of increasing prices and then to the downward period following the collapse of the fund bubble.

For the commercial property data-set, 5,124 items were collected, and for the residential property data-set, 6,208 items were collected. The summary statistics for these are outlined in Table 2.

First, net income (Y) is an average of ¥404 million for commercial property and an average of ¥86 million for housing, and asset price (V) is an average of ¥8.563 billion for commercial property and ¥1.689 billion for residential property, so in both cases, the figure for commercial property is around five times greater. For both land area (L) and rentable floor space (S), there was a divergence of around the same extent as the net income and asset price differential. However, there was no significant difference in the discount rate (r), which was 5.18% for commercial property and 5.30% for residential property.

With regard to building age, the average was 17 years for commercial property and 8.08 years for residential property, so residential property was concentrated on newer properties, and even for commercial property, one could say that there was a bias toward newer buildings when compared to commercial property inventory. Concerning transportation convenience, the distance to the nearest station (DS) was $337m$ for commercial property and $438m$ for residential property, while the distance to Tokyo Station (DT) was approximately $5,400m$ for commercial property and $7,400m$ for residential property, which shows that commercial property is situated in more convenient locations.

3.2 Hedonic Function Estimation Results

Using the data-sets constructed as explained above, a hedonic function was estimated for asset price (V), income (Y), and discount rate (r) based on Equation 6, 7, and 8. The estimation results are outlined in Table 3.

Looking at the estimated results, one can see that, as shown in Equation 8, the regression coefficient estimated with the discount rate function (model r) is estimated as the difference ($\alpha - \beta$) between the regression coefficient estimated based on the income function (α) and the regression coefficient estimated based on the asset price function (β). That is, it can be understood that asset price, income, and discount rate change in accordance with property characteristics (Z).

Here, in keeping with the first objective of this paper, let us consider the micro-structure of property investment returns and property characteristics based on the hedonic function estimation results.

Table. 2 Summary Statistics for Key Variables

Commercial

	Mean	Std. Dev	Min	Max
	NOI, Appraisal price and NOI Price ratio			
Y: Net Operating Income (Rent (y) − Operating Expenditure (O))	404.57	481.94	1.00	4,862.05
V: Property Value (million yen)	8,563.79	11,390.55	323.00	111,500.00
r: Y/V ratio	0.0518	0.0117	0.0012	0.1841
L: Land area (m^2)	3,391.97	7,504.01	79.33	60,364.89
RS: Rentable floor space (m^2)	7,881.14	11,131.20	318.82	95,697.03
FSR: Floor Space Ratio	584.63	184.90	100.00	1,300.00
y/RS (million yen)	0.06	0.03	0.00	0.30
p/RS (million yen)	1.27	0.83	0.08	9.44
A: Age of Building (years)	17.30	9.14	0.00	52.26
H: Number of stories (stories)	10.82	6.91	1.00	54.00
DS: Distance to the nearest station (m)	337.38	185.19	18.00	1,108.00
DT: Distance to Central Business District (m)	5,435.11	4,203.69	96.00	19,801.00
Number of observations:	5,124			

Residential

	Mean	Std. Dev	Min	Max
	NOI, Appraisal price and NOI Price ratio			
Y: Net Operating Income (Rent (y) − Operating Expenditure (O))	86.73	116.39	2.11	1,932.00
V: Property Value (million yen)	1,689.43	2,409.49	133.00	39,500.00
r: Y/V ratio	0.0530	0.0092	0.0030	0.2722
L: Land area (m^2)	968.01	2,830.50	93.74	60,364.89
RS: Rentable floor space (m^2)	2,358.71	3,743.18	278.36	81,995.81
FSR: Floor Space Ratio	400.74	166.05	80.00	800.00
y/RS (million yen)	0.04	0.01	0.00	0.35
p/RS (million yen)	0.72	0.22	0.18	1.94
A: Age of Building (years)	8.08	6.61	0.91	43.48
H: Number of stories (stories)	9.31	4.53	3.00	48.00
DS: Distance to the nearest station (m)	438.05	267.89	9.00	2,228.00
DT: Distance to Central Business District (m)	7,384.38	4,337.12	92.00	19,811.00
Number of observations:	6,208			

Table. 3 Hedonic Function Estimation Results - Income, Price, and Discount Rate

	Model.Y			Model.V			Model.r			
	β: Coef	std err		α: Coef	std err		Coef	std err		$\alpha - \beta$
Commercial Model: Number of Observations = **5,124**										
Constant	-2.027	1.602	***	0.922	1.085		-2.667	1.106	**	-2.950
RS: Rentable floor space (m^2)	0.024	0.009	**	0.070	0.007	***	-0.046	0.007	***	-0.046
A: Age of Building (years)	-0.088	0.014	***	-0.156	0.009	***	0.068	0.013	***	0.068
FSR: Floor Space ratio (%)	0.000	0.000	**	0.0002	0.000	***	0.00004	0.000		0.000
DS: Distance to the nearest station (m)	0.008	0.024		-0.009	0.016	*	0.017	0.021		0.017
DT: Distance to central business district (m)	-0.357	0.162	**	-0.328	0.109	***	-0.029	0.103		-0.029
SRC: SRC Dummy	-0.053	0.019		-0.027	0.014		-0.026	0.014		-0.026
CD: Commercial Dummy	0.292	0.031	***	0.303	0.023	***	-0.011	0.022		-0.011
FD_k ($k = 0, \ldots, K$)	Yes			Yes			Yes			-
LD_l ($l = 0, \ldots, L$)	Yes			Yes			Yes			-
D_t ($t = 0, \ldots, T$)	Yes			Yes			Yes			-
Adjusted R square:	0.942			0.819			0.457			
Residential Model: Number of Observations = **6,208**										
Constant	1.153	0.534	***	-2.394	0.724	**	-3.546	0.660	***	3.546
RS: Rentable floor space (m^2)	0.0004	0.008		0.0031	0.005		-0.003	0.007		-0.003
A: Age of Building (years)	-0.109	0.010	***	-0.116	0.005	***	0.007	0.008		0.007
FSR: Floor Space ratio (%)	0.0002	0.000	***	0.0002	0.000	***	0.0000	0.000		0.0000
DS: Distance to the nearest station (m)	0.002	0.013		0.026	0.008	***	-0.024	0.011	**	-0.024
DT: Distance to central business district (m)	-0.081	0.076	**	-0.170	0.055	***	0.089	0.070		0.089
SRC: SRC Dummy	-0.020	0.016		-0.054	0.008	***	0.034	0.014	**	0.034
FD_k ($k = 0, \ldots, K$)	Yes			Yes			Yes			-
LD_l ($l = 0, \ldots, L$)	Yes			Yes			Yes			-
D_t ($t = 0, \ldots, T$)	Yes			Yes			Yes			-
Adjusted R square:	0.969			0.799			0.490			

* $P < 0.1$, ** $P < 0.05$, *** $P < 0.01$

Note: The dependent variable in each case is the log of the price, rent and discount rate.

First, with regard to building floor space (S), when it increased by one unit, for commercial property income rose by 0.021 and the price by 0.066, which had the effect of lowering the discount rate ($-0.045 = 0.021 - 0.066$). For residential property as well, income rose by 0.001 and asset price by 0.004, which had the effect of lowering the discount rate (-0.003). When the effect of increasing floor space is compared for commercial and residential property, one can see that commercial property had a stronger effect on asset price, income, and discount rate alike. In other words, since the effect of increasing floor space was to raise both income and asset price while lowering the discount rate, one can see that asset price was raised by the effect of both income increases and discount rate decreases.

Concerning building age (A), when it increased by one unit, income decreased by 0.096 and asset price by 0.161. As a result of this, the discount rate increased by 0.065 ($-0.161-[-0.096]$) based on a year's increase. For residential property, income decreased by 0.1103 and asset price by 0.1098, while the discount rate remained more or less unchanged ($-0.0004 = -0.1103 - [-0.1098]$). For commercial and residential property alike, the effect of increasing age was that it lowered asset price and income, but this effect was particularly strong for residential property. For commercial property, since the price-lowering effect due to increasing age was greater than the income-lowering effect, the discount rate increased. For residential property however, since the price-lowering effect due to increasing age and the income-lowering effect were at similar levels, the effect was neutral with respect to the discount rate. This means that compared to commercial property, the income-lowering effect due to increasing age was greater for residential property in terms of both absolute value and relative difference from the price-lowering effect.

Finally, in terms of transportation convenience, when the distance to the city center (Tokyo Station) (DT) increased by one unit, income (-0.357) and asset price (-0.328) decreased, as a result of which the discount rate decreased by -0.029 ($-0.357 - [-0.328]$) based on a one-unit increase. In other words, asset price decreased as one moved further away from the city center, but it can be seen that this was brought about by an income-lowering effect and was not due to the discount rate changing based on changes in the risk premium, etc. For residential property, income (-0.100) and asset price (-0.170) decreased, and the discount rate increased ($0.070 : -0.100 - [-0.170]$). One can see that for residential property, asset price decreased as the distance to the city center (DT) increased, but this was brought about by both income decreases and discount rate increases.

Based on the models estimated in this manner, temporal changes in the quality-adjusted price ($\hat{V}_t^n$), quality-adjusted income ($\hat{Y}_t^n$), and discount rate ($\hat{r}_t^n$) can be calculated as follows.

$$\hat{V}_t^n = \exp(\xi_t) \tag{9}$$

$$\hat{Y}_t^n = \exp(\nu_t) \tag{10}$$

$$\hat{r}_t^n = \exp(\nu_t - \xi_t) \tag{11}$$

Based on the estimation results, temporal changes in the asset price, income, and discount rate are shown for the commercial property market ($n = 1$: commercial property) in Figure 1 and for the residential property market ($n = 2$: residential property) in Figure 2.

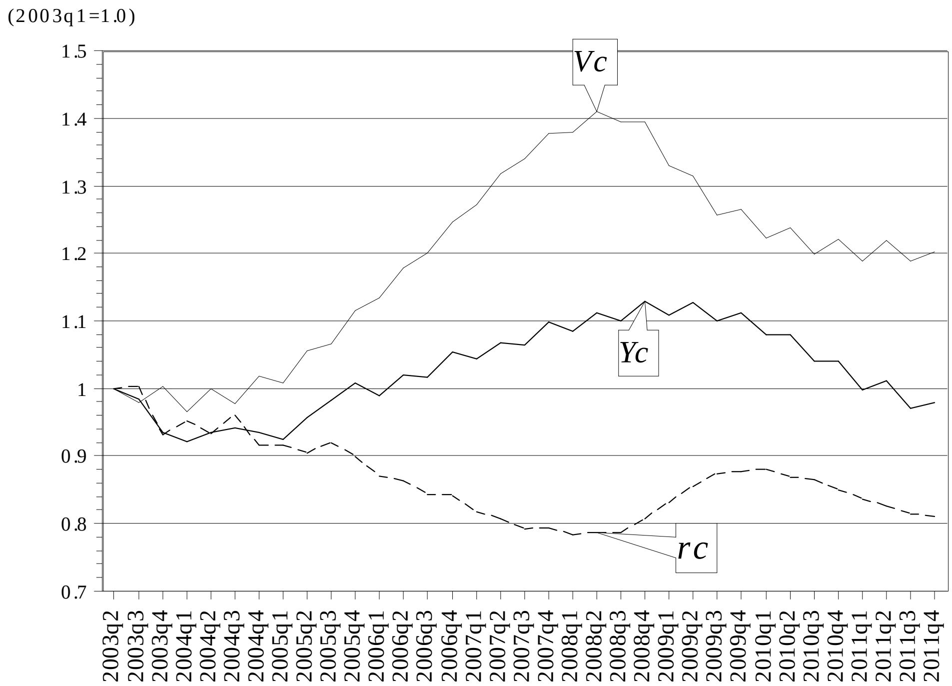

Fig. 1 Changes in Asset Price (V), Income (Y), and Discount Rate (r) – Commercial Property Market

Looking at the estimation results, one can see that for both commercial property price V^c and residential property price V^r, increases in asset price (V) were brought about by increases in income (Y) and decreases in discount rate (r), while conversely, decreases in asset price were brought about by decreases in income (Y) and increases in discount rate (r). This result is consistent with Equation 1.

Furthermore, there was a one-year lag – for example, although commercial property reversed direction and began to increase in the third quarter of 2004, residential property reversed direction and began to increase in the fourth quarter of 2005. Moreover, although a simultaneous increase in income and decrease in discount rate occurred for the increase in commercial property asset prices, concerning housing, there was a lag of approximately two years, with income reversing direction and starting to increase in the third quarter of 2007. One can see that from 2005 to 2007, the increase in housing asset prices was brought about by a decrease in discount rates, not by changes in net income based on the supply-demand structure.

In addition, it can be understood from Figure 1 and Figure 2 that for commercial and residential property alike, the changes in income were not significant, and the ups and downs of rising and falling asset prices were brought about by changes in discount rates. In other words, as Shimizu et al. (2010a[26], 2012a[28]) have made clear, payment-based housing rents and office rents alike have a high degree of stickiness, and it takes some time until prices change based on the supply-demand structure. The most significant reason for this is that rental price revisions are not realized until the lease is renewed, and even when the lease is renewed, a price revision is not necessarily implemented in response to market conditions.

Therefore, it is clear that the discount rate has an extremely significant effect on fluctuations in asset prices.

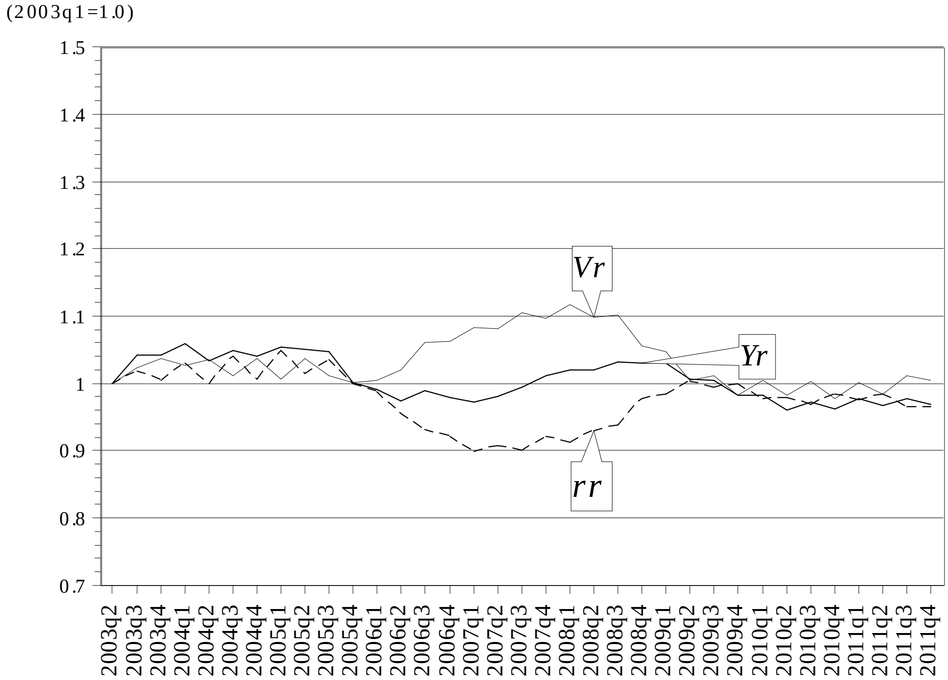

Fig. 2 Changes in Asset Price (V), Income (Y), and Discount Rate (r) – Residential Property Market

3.3 Capital Market-Based Discount Rate and Risk Premium

It is understood – as was also made clear by the line of analysis in the preceding section – that when determining asset price based on a present value model, asset price changes are based on income (Y) and discount rate (r), and the discount rate has a major effect on this determination.

However, in the case of actual estimations, since exact actual values are used in the calculation of income, no significant errors are generated no matter what organization makes the calculations.[*12] Furthermore, for this projected income, there is not much dispersal in the distribution of anticipated values. That said, there is considerable difficulty involved in determining the discount rate. When one looks at actual market changes, as is clear from Figure 1 and Figure 2, one can see that it changes only gradually, even on the commercial property market. In other words, one can infer that with respect to determination of asset prices on the commercial property market, it is possible that determination of the discount rate is not being performed efficiently by this market.

What kind of distortion therefore is present in discount rates determined on the actual market? And how should one determine discount rates on asset markets?

Discount rates take into account comparisons between property, stocks, and securities and are determined based on judgments involving these. However, it has frequently been pointed

[*12] Present and past income are not random variables but fixed variables. Precise definitions for calculating income and expenses are indicated in Japanese property appraisal standards.

out that in comparison to other asset markets, discount rates determined on the property market are based on an inefficient market, due to information being incomplete in comparison to other asset markets, transaction costs being considerable, and so forth.

The stock market, however, is said to be one of the most efficient capital markets. It is perhaps natural therefore to consider investigating the possibility of incorporating information available on capital markets and stock markets into property investment return measurement. Geltner (1997)[16] and Bokhari and Geltner (2012)[2], for example, have proposed using changes in published share prices for property stocks or REITs in order to observe changes in asset markets.

This paper focuses on listed investment unit prices (share prices) of REITs on the stock market and the relevant investment corporation's Tobin's q. Tobin's q is the value obtained by dividing the enterprise value (Q_{kt}) estimated on the stock market by the capital reacquisition price.*13 For J-REIT investment companies, since they are more or less identical in the sense of all their facilities being property, the total price of the property assets owned by an investment corporation and the enterprise value calculated as the sum of that investment corporation's total share prices and total liabilities may be considered as equivalent. That being the case, the conditions under which Tobin's q is 1 are when the total price of assets owned by the investment corporation matches the total share values and liabilities in investment units, which is the enterprise value.*14

With regard to stocks, since prices change from moment to moment due to daily transactions on publicly listed stock markets, enterprise values corresponding to owned property also change in accordance with the changes in share prices. As such, if one applies the theory of Tobin's q, for J-REIT investment corporation units, it is possible to obtain a discount rate that reflects changes in share prices on capital markets by taking the total of Y_{it} as the numerator and dividing it by the investment corporation's enterprise value. Here, taking r^s_{kt} as the discount rate of REIT k for the period t, the discount rate estimated via capital markets may be expressed as in Equation 12.

$$r^s_{kt} \equiv \frac{\sum_{i \in X_{kt}} Y_{it}}{Q_{kt}} \tag{12}$$

This shall be referred to below as the "capital market-based discount rate (r^s)."*15

Furthermore, based on Gordon (1959)[17], the discount rate may be broken down as follows:

$$r = b + \rho - \delta \tag{13}$$

b signifies the investment rate of return on safe assets, ρ the risk premium for property investment, and δ the anticipated growth rate.

Among these, the investment rate of return on government bonds, which is used as the investment rate of return on safe assets, can be observed directly on the market as a fixed variable. As such, if the investment rate of return on government bonds is subtracted from

*13 Ignoring minor costs, this is the ratio of the enterprise value – comprised of the total value of shares estimated by the stock market and total value of liabilities, assuming the enterprise is dissolved and ownership changed completely at the present time – to the total amount of all costs involved in replacing the capital currently owned by the company (Tobin, 1969)[31]. Hayashi and Inoue (1991)[12] have measured Tobin's q by expressly introducing property market values using Japanese company data.

*14 In the balance sheets of an investment company managing J-REITs, property owned by the investment company represents 90% or more of the assets section. To be precise, the latest enterprise value = total share amount + preferred shares + minority shareholders' interest + short- and long-term payables − cash and cash equivalents − nominal liability amount included in the value.

*15 In the properly investment field, this is known as the implied cap rate.

the discount rate $(r - b)$, it is possible to obtain the statistic of the anticipated growth rate subtracted from the risk premium $(\rho - \delta)$. In the property investment field, this is known as the yield gap. With respect to measuring the anticipated growth rate (δ), it is common for it to be substituted by the GDP anticipated growth rate. When one considers that Japan's GDP growth rate has been close to 0 in recent years, one may consider $(\rho - \delta)$ as being able to approximate the risk premium ($\rho - \delta : \delta \cong 0$).

Figure 3 looks at changes in the yield gap or risk premium calculated from commercial and residential property and capital market-based discount rates based on this type of hypothesis.*16

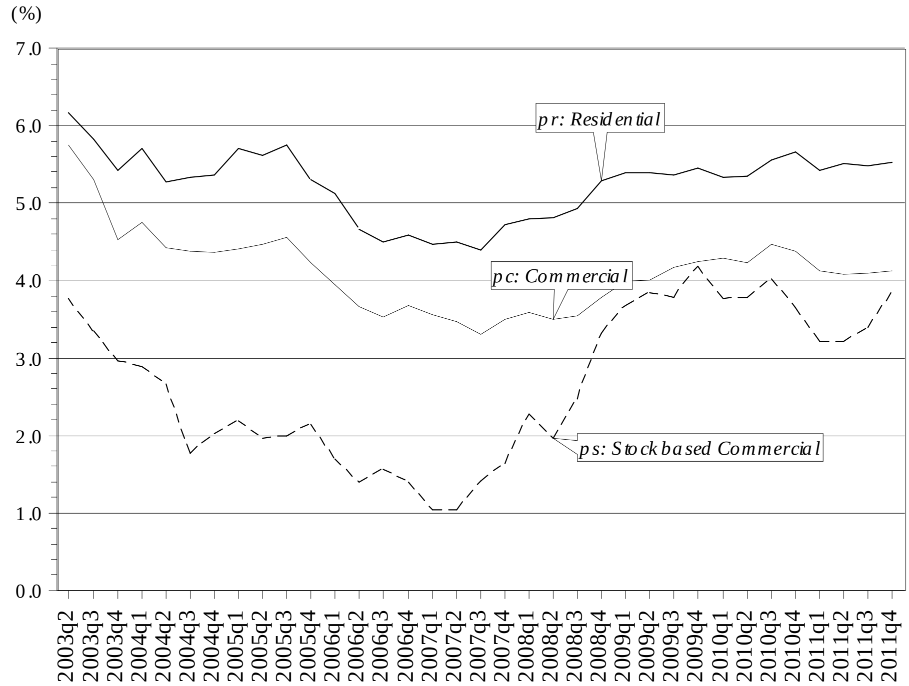

Fig. 3 Changes in Risk Premiums

First, although a certain spread exists between the commercial property risk premium determined on asset markets (ρ^c) and the residential property risk premium (ρ^r), no major difference exists in terms of macro-level changes.

On the other hand, with respect to (ρ^c) and (ρ^r) and the commercial property capital market-based discount rate (ρ^s), (ρ^s) declines significantly from 2003 until 2008, when the Lehman Brothers collapse occurred. The divergence between the two means that Tobin's q is not 1. In other words, in the period when (ρ^s) dropped below (ρ^c), since enterprise values determined by the stock market were estimated at a higher level than asset prices estimated by the property market, the capital market-based discount rate (ρ^s) was estimated as being low.

Furthermore, looking at changes over time, the capital market risk premium (ρ^s) increased abruptly while prices were in a downward phase. However, for asset markets, both (ρ^c) and

*16 The return on 10-year Japanese government bonds was used for the return on safe assets i.

(ρ^r) changed only slightly.

Looking at the form of this change, both the commercial property risk premium formed by the asset market (ρ^c) and residential property risk premium (ρ^r) decreased rapidly while prices were increasing but increased only slowly when prices were in a downward phase. On the other hand, risk premiums calculated from the capital market-based discount rate (ρ^s) increased rapidly while prices were decreasing, which makes it clear that there was strong sensitivity to risk.

In order to understand the characteristics of the different risk premiums, Figure 4 looks at the difference between residential property risk premiums (ρ^r) and commercial property risk premiums (ρ^c) and the difference between commercial property risk premiums (ρ^c) and risk premiums calculated from capital market-based discount rates (ρ^s).

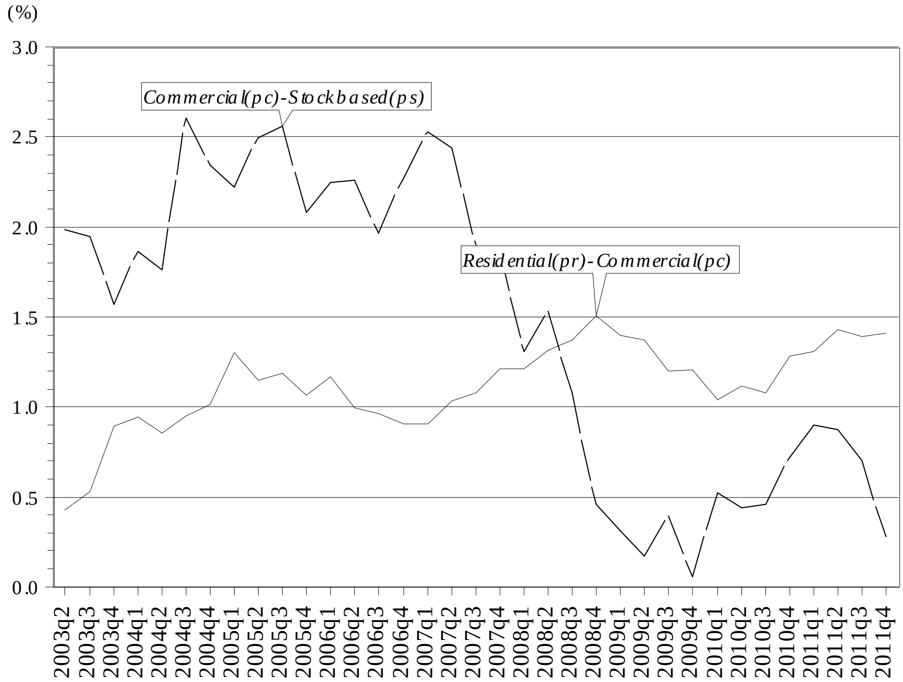

Fig. 4 Divergence Between Risk Premiums

Looking at the difference between residential property risk premiums (ρ^r) and commercial property risk premiums (ρ^c), one can see that it progressed at approximately 1.0 but increased to around 1.5 immediately before the Lehman Brothers collapse. This means that when the market was heating up, the commercial property risk premium (ρ^c) became relatively higher in comparison to housing. In other words, this suggests that the commercial property market is more liable to respond sensitively compared to the residential property market.

Looking at the difference between commercial property premiums (ρ^c) and risk premiums calculated from capital market-based discount rates (ρ^s), a divergence of 2.0 or more existed from the third quarter of 2004 until the second quarter of 2007 while the market was heating up. Then, when the Lehman Brothers collapse occurred, they converged toward 0. One can see that asset markets and capital markets became disconnected, and markets were formed based on differing risk premiums. In terms of the asset market, if one considers the subsequent market convergence (the divergence between the two approaching 0), the REIT market could be said to have been in a bubble-type situation. On the other hand and in terms of capital markets, it could be said that distortion in price formation was caused on the market prior to the Lehman Brothers collapse due to the inefficiency of asset markets.

4 Conclusion: How Should Property Investment Returns Be Determined?

Property investment combines two purposes based on the characteristics of real estate: maximizing the capital gains in the same manner as stock investment, and maximizing the return on investment in the same manner as securities investment.

Through a series of analyses, this study has clarified a number of items.

The first finding involved clarifying the relationship between property characteristics and property investment returns.

First, property income and price change according to characteristics such as building size and age. A hedonic function was therefore estimated, and the results of the estimated effects showed that when building floor space (S) increased by one unit for commercial property, income rose by 0.021 and price rose by 0.066, which means that the discount rate was lowered to -0.045 $(0.021-0.066)$; for residential property as well, income rose by 0.001 and asset price rose by 0.004, which means the discount rate was lowered to -0.003.

With regard to this, when the effect of increasing floor space was compared for commercial and residential property, the results showed that commercial property had a stronger effect on asset price, income, and discount rate alike. In other words, they showed that compared to residential property, a greater investment return can be obtained on commercial property by investing in larger properties. This suggests, as indicated by the fact that a discount rate-lowering effect exists, that there is also a lower risk in investing in large-scale commercial property.

Particular emphasis was placed on building age (A), since the issue of earthquake-resistance also exists in Japan. Looking at the effects, the results showed that when building age (A) increased by one unit, for commercial property the income decreased by 0.096 and the asset price decreased by 0.161, as a result of which the discount rate increased by 0.065 $(-0.161-[-0.096])$ based on an increase of one year. For residential property, it was revealed that income decreased by 0.1103 and asset price decreased by 0.1098, but the discount rate remained more or less unchanged $(-0.0004=-0.1103-[-0.1098])$. This result is highly suggestive.

In property investment, for both commercial and residential property, the effect of increasing building age was to lower asset price and income, but the findings show that this effect was especially strong for residential property. For residential property, the fact that the effect on the discount rate was almost zero means that the income-lowering effect and asset price-lowering effect due to increasing building age were around the same level. In other words, the income-lowering effect due to increasing building age was relatively strong for residential property in comparison to commercial property. In terms of absolute values as well, for residential property both income and price decreased significantly due to increasing building age. Based on this, it can be understood that one must give extremely careful consideration to building age when investing in residential property.

The second finding clarified that in terms of the factors that cause dynamic changes in property investment returns, these changes occur based on changes in discount rate and especially risk premium more than changes in income determined based on supply and demand. This fact suggests that in property investment, one must focus on discount rates and risk premiums formed via capital markets rather than on changes in income. In general, when it comes to property investment risk management, it is easy to direct one's attention toward risk management of the structure that comprises the property. However, if one considers that changes in property investment returns brought about by changes in capital markets are several times greater in extent, there is a strong need for knowledge of capital markets.

The third finding clarified the distortion that exists in asset price information based on property appraisals, which is widely used in property investment markets, as well as discount rates formed based on this information. In the Japanese property investment market, there is a strong tendency to rely on property appraisal prices when determining investment amounts. However, it is known that property appraisal prices are unable to appropriately reflect actual market conditions – a phenomenon frequently dubbed "property appraisal risk."

Accordingly, this study, focusing on REIT investment unit prices (share prices) published on stock markets and the relevant investment corporation's Tobin's q, calculated the capital market-based discount rate (r^s) and, furthermore, extracted the risk premium alone from this discount rate to clarify the difference from the risk premium determined based on property appraisals.

The results showed that when the commercial (ρ^c) and residential property risk premium (ρ^r) determined by asset markets and the capital market-based discount rate (ρ^s) were compared, there was a significant divergence between them, with (ρ^s) being significantly lower from 2003 until 2008, when the Lehman Brothers collapse occurred. Focusing on changes over time, although the capital market risk premium (ρ^s) abruptly reversed direction and trended upward starting in 2007, when the Lehman Brothers collapse occurred, (ρ^c) and (ρ^r), which are determined on asset markets and reliant on property appraisals, increased only gradually. Looking at the form of these changes in more detail, asymmetry existed: both the commercial (ρ^c) and residential property risk premium (ρ^r) formed by asset markets decreased rapidly in periods when prices were rising, but they increased only gradually in periods when prices were dropping. However, the risk premium calculated from the capital market-based discount rate (ρ^s) had a reverse form of asymmetry: in periods of contraction when the market was starting to stagnate, it increased at a faster rate than the rate at which it decreased in periods when prices were rising.

Furthermore, looking at the difference between the residential property risk premium (ρ^r) and the commercial property risk premium (ρ^c), it progressed at a level of approximately 1.0 but increased to around 1.5 immediately before the Lehman Brothers collapse. In other words, one could say that in 2008, when the collapse occurred, the commercial property market was heating up under bubble-like conditions. Moreover, in the period when the market was heating up, the fact that the commercial property risk premium (ρ^c) increased relative to housing suggests that the commercial property market is more liable than the residential property market to respond sensitively to changes and that it has a comparatively higher level of inherent volatility and risk.

Moreover, looking at the difference between the commercial property risk premium (ρ^c) and risk premium calculated from the capital market-based discount rate (ρ^s), they diverged by over 2.0 in the period from the third quarter of 2004 to the second quarter of 2007, when the market was heating up, but converged toward 0 once the collapse occurred. If one looks at this in terms of asset markets, one would conclude that the REIT market experienced bubble-type conditions from 2004 to 2007; yet if one looks at in terms of capital markets, one would conclude that the asymmetry of asset markets lead to distortion in asset price formation. Just which of these situations was responsible for generating the divergence?

In terms of the answer to this question, given the extent of the difference, it is perhaps natural to think that both situations occurred. It is possible that the divergence was generated by two causes: the REIT market was experiencing bubble-type conditions, yet property appraisals were unable to sensitively respond to the market.

That being the case, one can understand that when it comes to property investment decisions, it is essential to make active use not just of property investment returns formed by asset markets but also information formed by capital markets.

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