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Office Investment Market Becoming More Selective

－ Selection of the Winning Market in Tokyo's 23 Wards －

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Office Investment Market Becoming More Selective*

− Selection of the Winning Market in Tokyo's 23 Wards −

Chihiro Shimizu†

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Abstract

Following the collapse of the economic bubble in 1991, Japan's economic growth has slowed down. In particular, with respect to the office market, it has suffered high vacancy rates and there have been many cases where office buildings have had to be rebuilt. This trend is predicted to further increase in the midst of a precipitous decline in the size of the working-age population. When undertaking an office investment under such circumstances, it will be essential to select an investment property and the area (in which such property is located) carefully. The purposes of this paper were to extract the signals used to determine the market selection with respect to an office investment, and to make apparent areas that will, going forward, continue to maintain strong fundamentals (potential value) in the office investment market. In regards to area selection, this paper focused on the phenomenon where, following the collapse of the economic bubble, many office buildings had to be put to different uses out of necessity. This paper also focused on the changes in real estate investment returns and building use by area. Specifically, factors affecting changes in building use were extracted by applying a panel random probit model on the 3,134 areas surveyed under the national census from 1991, when the collapse of the real estate bubble began and onward. Further, based on the factors that were extracted per the above, areas that have strong survival rates as office markets were selected. As a result of estimating the panel random probit model, which focused on the changes in building use, it has been found that the conversion from office use to residential use has been largely brought about by the index which measures the extent of excess in rents when a building is converted to residential use as opposed to using it as an office building. This finding conformed to the result that was indicated in a series of analyses that began with Wheaton (1982) as follows: "return differentials effect land use conversions." Moreover, 303 areas predicted to have strong fundamentals for office investments have been extracted using the ratio of office rents to residential rents. These analyses have been conducted with respect to Tokyo, which is a region that has extremely weak land use regulations. As such, there are limitations to applying these analyses to cities that have stricter land use regulations that make it difficult to commence construction or rebuild in such cities. Nonetheless, as analyses of the Tokyo office market, where population decline and aging are progressing at the fastest rate, are being conducted ahead of other major developed countries, it is thought that such analyses will serve as an important guide for many cities, starting with European cities, that will be facing similar situations going forward.

Key Words :Hedonic Index; Market Selection; Census; GIS; Panel Random Probit Model

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1 Introduction: Is it Possible to Sell and Survive?

Among the major developed countries, Japan's society is aging at the fastest pace. The reason for this is a rapid decline in the birthrate and population decrease. One of the real estate markets that is most impacted in the midst of such progressive change in the population composition is the office market.

Sources of returns generated by office spaces would be rents distributed from business activities, and rents are determined by considering the inventory of office spaces versus demand.

The inventory of office spaces in Tokyo's 23 wards rapidly increased from the 1980s. Such inventory greatly increased from 1991, when the real estate bubble was at its peak, until 2001. Although such inventory decreased between 2001 and 2006, as of 2006, its scale had increased by 36% compared to that of 1991. In addition, in recent years, there has been an aggressive push for completion of large-scale office buildings in response to the expansion of the real estate securitization market.

On the other hand, the demand that has been supporting such inventory is predicted to rapidly decline going forward. Since peaking in 2004, Japan's population has started a downward trend.[1] In addition, as a result of aging at a pace that no major developed country has yet to experience, it is predicted that there will be a rapid decline in the working population.

It is easy to predict that there would be a surplus (redundancy) of office space inventory where the working population is declining rapidly in the midst of expanding such inventory. Where the arrival of such situation is expected, finding a method to eliminate such redundant inventory becomes an extremely important social-economic issue.[2]

This issue is particularly important for those involved in real estate investments. Redundancy of office space inventory does not refer to the total inventory having equally rising vacancy rates. Rather, it refers to having buildings that would produce no returns, of which there is a greater probability. Thus, even in a metropolis like Tokyo, it may become more likely that buildings will emerge that cannot attract any tenant, as seen in many of the suburban cities.

Based on this type of situation, questions such as, "Would it be possible to collect on the investment in the future (can (the asset) be sold)?" and "Who will take the loss?" are being

[1] placecountry-regionJapan's population peaked at 127,838,000 in December 2004. As the number of deaths exceeded the number of births by over 100,000 in 2010, placecountry-regionJapan is entering a phase of full-scale decline in population.

[2] When there are large quantities of inventory of unused office spaces in a city, there is a possibility that the entire area will turn into a slum, causing a negative externality. In such a case, not only would the real estate value in the said area decline, but the real estate value of the surrounding areas would also decline. As it would take an extremely long period to eliminate such a situation, efforts must be made in advance to reduce the scale of the issues that may arise. For this reason, the adoption of policies at an early stage to eliminate the above situation becomes extremely important.

frequently raised.

This issue is a typical phenomenon of liquidity risk, which is a representative of risks associated with a real estate investment. "Liquidity risk" refers to a risk stemming from a situation where owners of real estate cannot sell their property in the real estate market at the time they want to do so and must wait a certain period of time before such property is sold. Up to now, liquidity risk was based on the assumption that it would take some time before the property is sold, i.e., the property would be sold at some point. However, in the above-described case, it suggests that no buyer would be found no matter how much the price is lowered.

In general, "liquidity risk" tends to be measured by the time it takes to sell the property once the decision to sell the property is made (market stagnation period). If the market stagnation period is long, the price of the property may greatly fall (lose the sale timing) during such period, or opportunity costs may arise due to a delay in obtaining the cash (from the sale of the real estate). As such, the longer the market stagnation period, the greater such risk becomes. When thinking about liquidity risk in this way, not being able to make a sale means that the market stagnation period becomes "infinite." With the risk becoming infinite, the value (of the real estate) becomes zero.

Then, what factors affect the "market stagnation period"? The first factor is the sale asking price. The higher the initial asking price that is set by the seller in comparison to the market price, the lower the probability to sell becomes. Moreover, it is known that real estate owners take a while to change the initial asking price even if they have been unable to sell such real estate for a long time at such price (it takes (the owners) time to recognize that the property cannot be sold at the asking price) (Horowitz (1992), Stanley, et al. (2009)).[3]

Moreover, in the case of real estate for investment, most investments are being made through debt financing. Thus, the seller cannot change the selling price unilaterally. In addition, the selling price can greatly change depending on the particular seller's circumstances such as how much loan is remaining.[4] The selling price cannot be easily lowered when the loan to value ratio (LTV) is high.[5]

The second factor (which affects the market stagnation period) is the size of the real estate (i.e., the size of the investment value) and the locality.[6] Within this factor there is an issue

[3] In Knight (2002), it has been pointed out that as the market stagnation period lengthens, a stigma is created that the real estate is unsalable, causing a decrease in the final selling price.

[4] In Glower, Haurin and Hendershot (1998), the sellers' motivation to sell has been surveyed by telephone, and the relationship between the sale asking price and the market stagnation period has been examined. The results obtained indicate that when comparing those sellers who need to sell their real estate quickly due to, for example, a change in employment, versus sellers who do not, the asking price of the former is lowered by about 30%. This is innovative research in which "the differences (in selling price) based on the actual circumstances of the transactions," as would be referred to in an appraisal, are being surveyed empirically.

[5] This is also true in the residential market. It is known that households that have considerable amounts of home loans outstanding tend to set the seller's asking price high and take a while to bring such price down, which prolongs the market stagnation period (Genesove and Mayer (1997), (2001), Engelhardt (2003)). In a securitized real estate investment, if the real estate is to be sold at a price that is lower than the outstanding loan amount, the (selling) price cannot be lowered unilaterally as it would cause financial institutions to incur losses.

[6] It has been reported that even in the case of the residential market, the market stagnation period differs for standard real estate versus atypical real estate such as big-sized real estate, and that the more atypical the real estate, the longer the market stagnation period (HaurinÅ@(1988)).

that no matter how much the price is lowered, no buyers would appear.

Following the above understanding, it can be understood that factors that greatly affect the market stagnation period are the potential selling price and the individuality of the real estate. Let us first think about the selling price.

How is the selling price of office spaces (P_t), i.e., the investment value determined?

Let us think about this by using an example. We will assume there is an investor named "A" who was thinking of investing for a period of 10 years. The investment value of the office building chosen by A would be determined by the cash flow for the 10-year scheduled investment period and the expected selling price in 10 years' time (P_{t+10}). Let us call "B" the new buyer (investor) who will appear in 10 years' time, which is when A expects to sell the real estate. Let us say that B is also thinking of an investment period of 10 years. In such case, B's expected purchase price to be assumed in 10 years' time (counting from at the time of B's purchase) (P_{t+10}) would be determined by the cash flow for the next 10 years (i.e., year 11 to year 20) and the expected selling price in an additional 10 years' time (i.e., 20 years after A's purchase of the property) (P_{t+20}).

Thinking about it this way, the expected selling price that A must anticipate (P_{t+10}) would be determined by the cash flow for 10 years from the time when A expects to sell the property (i.e., year 11 to year 20) and the expected selling price in an additional 10 years' time (i.e., 20 years ahead from at the time of A's purchase of the property) (P_{t+20}).

Assuming the office building retains its use value in 10 years' time, if many investors predict that such building would not generate profits if used for offices in an additional 10 years' time (20 years later), the expected selling price in 10 years' time (P_{t+10}) would greatly decline.

The above is also true in the case where investments are being made repeatedly over time periods of three years. The expected selling price in three years' time (P_{t+3}) would be dependent on the expected selling price in an additional three years' time (P_{t+6}). (P_{t+n}) simply repeats itself.

As per the above, if the market could make absolute predictions about the future, and the price is determined based on such predictions, then it would be impossible for liquidity risk to rise from the extension of the market stagnation period due to the initial price being set too high. Neither would it be possible for the real estate to become valueless due to it being impossible to sell.

However, information about the future is not absolute. Particularly in regard to the office market, the longer the duration, the more difficult it becomes to make predictions, and variations widen. Under such circumstances, the possibility remains that an office building, in which an investment was made due by determining that it has current value, may become valueless (in the future). As such, it can be said that the possibility of someone getting the short end of the stick in the future is becoming high.

Based on this situation, when investing in an office building, a "survivable office investment market" that has fundamentally (potentially) high earning power must be selected by taking a long-term view (to avoid getting the short end of the stick).

The selection of a real estate investment (decision-making) is made based largely on sorting out the following: the property itself and the area. As to structures like buildings, they can be managed post-investment through maintenance, renovation or rebuilding. As to the area, however, it cannot be improved with the above-mentioned efforts alone. Particularly when taking a long-term view, it can be said that the selection of the area would be the most essential element of decision-making.

This paper will make clear how the return differentials between the office market and the residential market have brought about changes in the inventory of each by comparing the two markets within Tokyo's 23 wards, Japan's biggest real estate investment sector. Furthermore, using such results, this paper will attempt to extract areas that have strong fundamentals as office investment markets and will have a high probability of being the preferred (investment) areas going forward.

2 Changes in Real Estate Investment Markets in Tokyo's 23 Wards

2.1 Macroscopic Changes of Real Estate Investment Returns[7]

2.1.1 Estimation of Profit Rate Model

When making a real estate investment, the starting point is to prognosticate the future by referring to the track record of past real estate investment returns. Normally, an assumption is made that investment returns that were generated in the past will persist in the future. Then, investment returns within the investment period are to be predicted by taking into consideration the differences in the past, present and future. Accordingly, this section will analyze both macroscopic trends and chronological changes, in detailed area units, of all the office and residential markets in Tokyo's 23 wards for the past quarter century.

When observing the chronological changes of real estate investment returns, comparisons must be made after making quality adjustments (of real estate). This is because according to microscopic data concerning real estate returns, prices differ based on such things as the building's size and number of years elapsed since it was built (i.e., building age), the type of building structure (e.g., steel framed, steel-iron framed), distance to amenity facilities (e.g., convenient transportation facilities such as train stations) and distance to the central business district (CBD). As such, analysis of macroscopic changes has been conducted after adjusting the price differences based on the above attributes.

In making quality adjustments, a hedonic model was estimated as shown below.[8]

$$\mu_{it} = X_i\beta + \delta_t + \upsilon_i \tag{1}$$

[7] Data pertaining to office spaces were provided by major brokerage firms and by the members of Zentakuren. Data collected by Recruit Co., Ltd., one of placecountry-regionJapan's largest housing ad agencies, to advertise on listings magazines and on the Internet were used as residential rents and apartment prices.

[8] For details of the methods of quality adjustments, refer to Shimizu, Nishimura and Watanabe (2010).

Table 1: Estimated Results of Hedonic Function -Time Dummy Model

	Office Rents		Residential Rents		Housing Prices	
	[Coefficient]	[t-Value]	[Coefficient]	[t-Value]	[Coefficient]	[t-Value]
Constant	9.62	306.81	-0.51	-91.91	4.63	631.51
log *S* :Floor Space (㎡)	0.13	30.92	-0.15	-259.46	0.02	19.91
log*A* : Age of Building (Year)	-0.05	-12.52	-0.06	-134.31	-0.22	-381.38
log *TS* : Time to the Nearest Station (minutes)	-0.13	-16.88	-0.03	-50.51	-0.04	-65.09
log *TT* : Time to the Tokyo Station (minutes)	-0.12	-21.35	-0.06	-48.97	-0.10	-55.01
Structure(RC) Dummy	-0.02	-8.28	-0.07	-82.43	-0.01	-10.43
Area Dummy	Yes		Yes		Yes	
Time Dummy	Yes		Yes		Yes	
Adjusted R-square	0.698		0.6791		0	
Number of Obs.	16,887		333,845		282,289	

Here, μ_{it} stands for the real estate return of building i at certain time t, and X_i stands for the attributable vector of relating to such building's size and age. After controlling the price differences (of buildings) based on the buildings' attributes, changes in returns accompanied by the passing of time was calculated as δ_t. However, within the elements that make up the real estate returns, unobservable variables (υ_i) exist. Further, in regards to the estimation, real estate returns were estimated as price per unit area.

The estimation results are arranged in Table1.

The estimated results seem convincing, showing that both office rents and residential rents have degrees of freedom adjusted for an R-square of around 0.70. Extremely good results also were obtained in regards to the housing price at 0.80.

2.1.2 Macroscopic Changes in Real Estate Investment Returns in the Quarter Century

Figure 1 shows the changes in office rents, residential rents and housing prices from 1986 using the estimation results.

Considering 1986 to be the starting point for both office rents and housing prices, it can be understood that they more than doubled in 1990, when the economic bubble was at its peak, and in 1991. Thereafter, housing prices fell in 1997 to a level that was lower than that of 1986 and took until 2006 to recover. This becomes the period that would be called "the lost decade."

Office rents were on the recovering trend from the late 1990s to the early 2000s. However, a real recovery is seen from 2005 to 2007. This period has been called the "mini bubble." It was a period when Japan's real estate market was being revitalized through the effects of the European and U.S. investment banks' huge appetite for investment.

Meanwhile, residential rents were seen to rise by 25% during the bubble. Thereafter, they were gradually adjusted until 1995 and then leveled off. However, there are signs that the market is rapidly worsening given the worldwide recessionary state of affairs following the

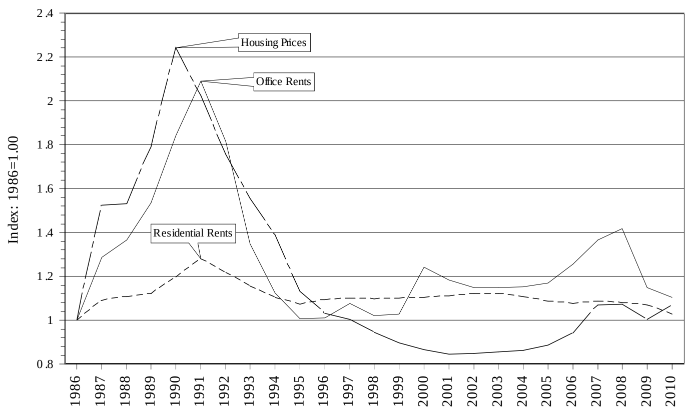

Figure 1: Dynamics of Real Estate Investment Returns

financial crisis that occurred after the collapse of Lehman Brothers in 2008. From 2005 onward, the period called the "mini bubble," it can be thought that rent adjustments in the market progressed due to the market being supplied with large numbers of rental homes for investment, which caused the vacancy rates to increase rapidly.

2.1.3 Area Distribution of Real Estate Investment Returns

The changes in investment returns within Tokyo's real estate market as shown above represent macroscopic trends of the 23 wards as a whole. However, where it is predicted that the market will shrink going forward, it is difficult to foresee the phenomenon in which the prices of all of the real estate in all of the areas will rise, then fall all at once, as had happened during the bubble period.

As such, we decided to observe changes in returns, in detailed area units, of the 3,134 areas that are surveyed under the national census for Tokyo's 23 wards[9] (for details of how we calculated profits in detailed area units, refer to the appendix).

Regarding real estate investment returns, total rate of returns were calculated taking into account the prices and rents. The overall rate of return for one year can be calculated as follows.

$$\phi_{jt} = \frac{R_t + (P_{jt+1} - P_{jt})}{P_{jt}} \tag{2}$$

It is calculated by adding together the income return, which is calculated using the rental income generated when operating for one year divided by the initial investment

[9]The focus was placed on the surveyed areas under the national census of 2005. In principle, the areas subject to surveys done for the national census correspond to each district in each town.

amount$(\rho_{jt} = R_{jt}/P_{jt})$ and the capital return, which would be considered the price volatility rate for such year $(\sigma_{jt} = (P_{jt+1} - P_{jt})/P_{jt})$.

In calculating the rate of return, two strong assumptions must be made.

The first assumption is that rents are theoretical, which means that they do not take into account the operating rates (vacancy rates). Normally, there exists a consistent relationship between rents and vacancy rates. Real estate that has high rents has relatively high vacancy rates. Thus, if the market is absolute, the contractual rents in the market would be adjusted to become proportionate to the operating rates.[10] However, in reality, the market does not work that way. There are often cases where, past a certain rent, the operating rate does not improve at all no matter how much the rent is lowered.

In addition, as terms like "rent free" and "rent holiday" are being bandied about, there is no guarantee that contractual rents are truly proportionate (to vacancy rates) in the market. As there are limitations to the (relevant) data, such issues must be ignored.

The second assumption is to do with the office price. What we have been able to observe are three changes in real estate investment returns as follows: office rents, residential prices and residential rents. Long-term price changes in office markets cannot be observed because the numbers of (office) real estate transactions are extremely low.

As such, prices in office markets were estimated in detailed area units, based on a fixed assumption. Income return(ρ_{jt}) can be calculated with respect to residential markets in concrete terms. Here, "income return" means a ratio that is being used to convert the rents that are being determined in the goods and services market to asset prices that are being determined in the asset market.

Here, we have assumed the income return spread between the residential market and the office market to be 1.1%,[11] and office prices for each area have been calculated accordingly.

There is no question that this is an extremely strong assumption. This is because there is a strong possibility that there is a locality within this assumption itself. However, in this research, the (above-mentioned) spread was applied uniformly while attaching weight to the possibility of making comparisons among the areas.

Total Rates of Returns Here, the focus is placed on the area distribution. Figure 2 shows the distribution of the average returns of the total rate of returns for office investments in each of the 3,134 areas. Areas in Tokyo where economic activities are advancing the most are Chiyoda Ward, with Marunouchi and Otemachi being the central areas; Minato Ward, in which Roppongi and Akasaka are situated; and Chuo Ward, home to Ginza. Within

[10] Being proportionate to the operating rates indicates that, if complete market adjustments (the vacancy rates arise when relatively high rents are determined and operating rates arise when relatively low rents are determined) are made, the rates of return per building (taking into account the operating rates) become the same for such buildings with higher rents and with lower rents.

[11] In Shimizu(2012), an estimated model for income returns was calculated for office markets and residential markets, for the period between 2002 and 2010, using the information disclosed in the Japan version of real estate investment trusts in Tokyo's 23 wards. From the above, it was calculated that the income return spread between the residential market and the office market was 1.1% (0.011). From there, each income return for the office market was calculated by subtracting 1.1% from each corresponding income return for the residential market that was calculated, in area units j, for the period from 1986 to 2010. Office prices were calculated using such income returns (for the office market), i.e., the discounted rate.

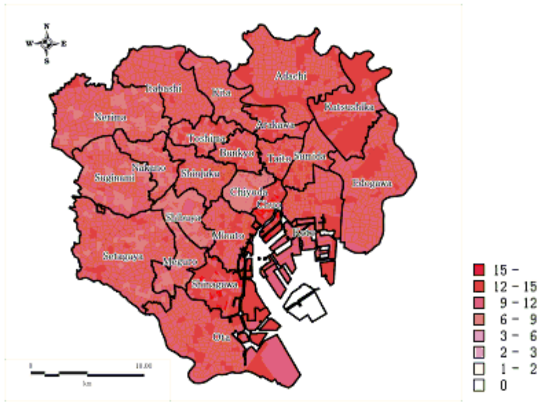

Figure 2: Office Investments - Average Overall Rates of Returns

these areas, (positive) income returns cannot be expected because the price levels are high. Moreover, when looking at the Total Rates of return (in these areas), the figure does not show very high rates of returns. This was due in part to the fact that there were large price fluctuations, which will be discussed later. If anything, the figure shows that rates of returns in the suburban areas were higher.

Next, let us look at the average returns of the total rate of returns for the residential markets (Figure 3. In regard to residential investments, following a continuous decline in residential prices from the 1990s, prices fell consecutively for about 15 years from 1991 to the mid-2000s. Because capital returns were negative, as compared to office investments, the average total rate of returns for all areas has become lower. The price decline was particularly large in areas where high-end residential districts are situated, including Chiyoda Ward, Minato Ward and Shibuya Ward. Due to this fact, investment rates of returns for residential investments in most of these areas have been negative. In contrast, rates of return have increased for those areas that were only slightly affected by the economic bubble and have relatively low price levels. However, in the central Tokyo area, there were positive returns in one part of Chuo Ward.

Volatility Next, let us look at the volatility of office investments (Figure 4). It shows that, within the central Tokyo area, the volatility of office investments was high in Chuo Ward. placeGinza, which has the highest accumulation of commercial establishments in Japan, is situated in this area. Since Chuo Ward is adjacent to Chiyoda Ward, which has an accumulation of financial institutions, Chuo Ward is able to charge high office rents. But it can also be thought that this is an area where its return is most easily affected by economic fluctuations. In a recessionary phase, before the areas that have the largest

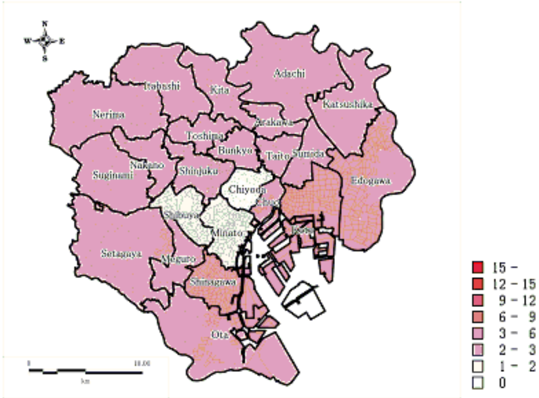

Figure 3: Residential Investments - Average Overall Rates of Returns

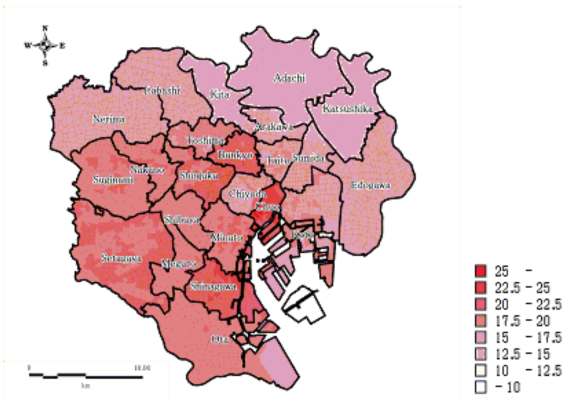

Figure 4: Office Investments – Volatility of Total Rates of Returns

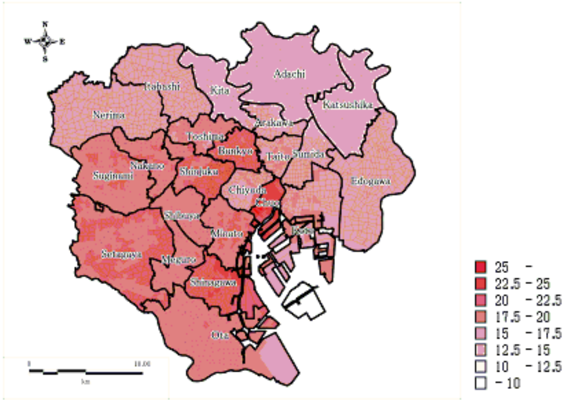

Figure 5: Residential Investments – Volatility of Total Rates of Returns

accumulation, such as the Marunouchi and Otemachi of Chiyoda Ward, began revising their rents, vacancies rose in the adjacent areas, and the phenomenon of declining rents was observed. It is thought that such movement (in the adjacent areas) is reflected in Chiyoda Ward. As for city sub-centers like Shinjuku Ward and Bunkyo Ward, which is adjacent to Chiyoda Ward, volatility is also becoming high.

Next, we looked at the volatility of residential investments (Figure 5). Similar to the cases of office investments, the areas with the highest volatility for residential investments were the representative areas of Ginza that have the highest accumulation of commercial establishments within Chuo Ward. These areas were the only ones within the central Tokyo area that had positive returns on residential investments. In these areas, commercial development progressed through the economic bubble period, which effectively caused the asset prices of residences to greatly rise. However, because the later price fluctuations were also large, it can be thought that the amount of risk also became relatively high.

Income Returns What about income returns? In regard to office investments (Figure 6), income returns were less than 4% in Chiyoda Ward, which has the highest office rents and prices. Income returns increase as people move towards the suburban areas. The levels (of income returns) are especially high in Adachi Ward Katsushika Ward. The asset prices themselves are low in these areas. This can be interpreted to mean that high income returns were attained not because there were high rental returns, but because the asset prices were low. As seen above, the overall rates of returns were high for these areas due to the fact that there were minimum fluctuations before and after the bubble (in these areas) and high income returns were attained on a continuous basis.

Likewise, income returns for residential investments were high in the suburbs and low in

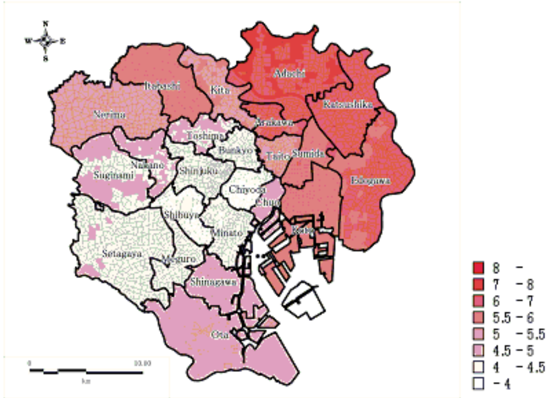

Figure 6: Office Investments – Income Return Average

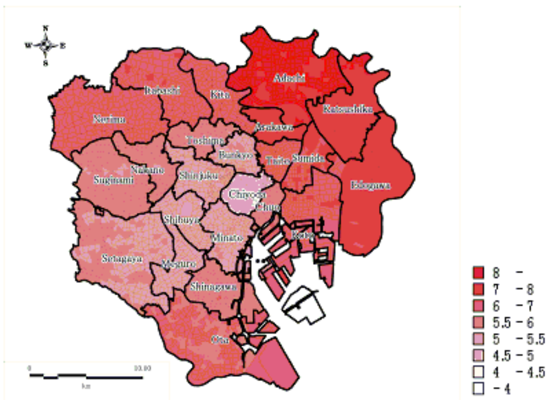

Figure 7: Residential Investments – Income Return Average

the central Tokyo area (Figure 7). Income returns for residential markets were more than 6% in the suburbs. As for areas in which urban accumulation has been progressing or high-end residential districts are situated, the levels of income returns were between 4.5% and 6%. The levels of overall rates of returns on office investments were relatively high compared to those on residential investments. With respect to income returns, however, they were higher for residential investments. Thus, the rates of returns on office investments rely on capital returns, while for residential investments, rates of returns are largely dependent on income returns.

Risk-adjusted Returns When making a decision on a real estate investment, determination must be made in regard to both the simple average return (ϕ_j) and the amount of risk (σ_j). As such, comparisons have been made on risk adjusted returns (ϕ_j/σ_j) by area (j) (Figures 8 and 9). Here, we are looking at the risk-adjusted returns for the past 25 years. First, when office markets are compared to residential markets, the profitability on office investments in all of Tokyo is about twice as high as that on residential investments, even though volatility in office markets were on average twice as high as that in residential markets (Figure 4).

The area distributions show that the levels of risk-adjusted returns are low in the central Tokyo area and the southwestern area, which includes Setagaya Ward, Meguro Ward and Shinagawa Ward, while they are high in the eastern areas. This trend is prominent in office investments.

Based on comparisons using this type of analysis, investments in the central Tokyo area, which has a large economic accumulation, in the past quarter century attained only low returns compared to the suburbs.

Based on the series of analyses above, we were able to see the changes of real estate investment returns for the past quarter century. Based on these analyses, let us predict the direction in which the selection of real estate markets may be heading, using detailed area units.

3 Selection of Real Estate Investment Markets

3.1 Importance of Area Selection

One of the most important elements that determine the rate of return for a real estate investment is the final selling price. It can be said that the biggest risk arises when faced with the issue that no buyer could be found at the sales stage. This is an issue to be most cautious about as the whole economy is in a shrinking trend and needs for real estate are stagnating.

In real estate investment, except in the case of securitization of real estate development, real estate is sold under the premise that its present use will remain the same, and a profit is determined (accordingly).

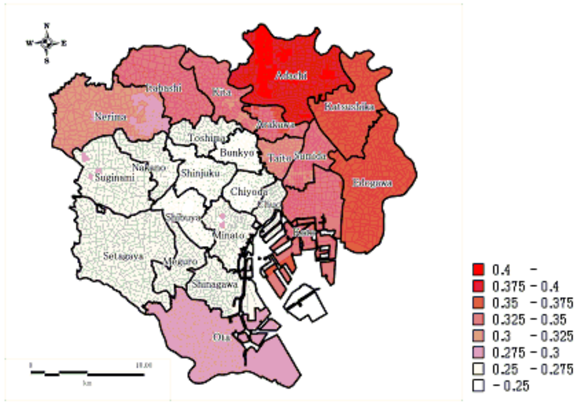

Figure 8: Risk-adjusted Returns - Offices

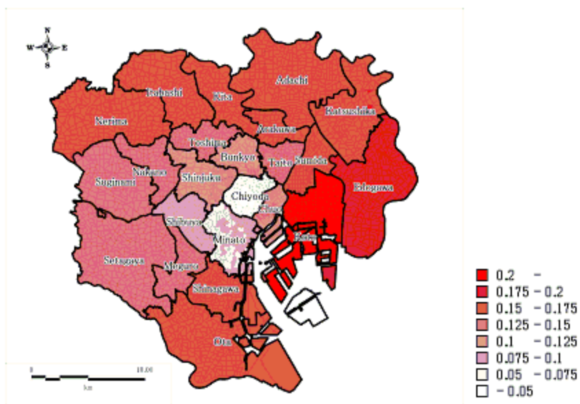

Figure 9: Risk-adjusted Returns - Residences

On the other hand, there can be a case where the future buyer demolishes the building and uses the new building for a new purpose. Such cases of converting to a new building, as a way to improve the returns through redevelopment, have occurred for some time. However, in such cases, it means that the present building value becomes zero. In other words, the value of the real estate at the sales stage would only include the land value. As a result, such real estate's price would largely decline, and the probability that there would be large losses on the investment return becomes high. In addition, if the redevelopment does not bring about any improvements on the returns, there is a possibility that no buyer would be found (i.e., the liquidity risk becomes infinite).
With respect to an office investment in Tokyo, this is an issue that requires the most care.

When looking at future real estate needs in Tokyo, it can be predicted that office building needs in particular will largely decline due to the effects of an aging society and accompanying rapid decline in the working age population. In such case, there will be redundancy in the inventory of office buildings. If there is redundancy of office buildings, it does not necessarily follow that vacancy rates in all areas or buildings will on average increase or that the rents will decrease. It would be more natural to assume a case where, in a specific area, the vacancy rates increase all at once, and in the end, it becomes difficult to find tenants no matter how much the rents are reduced. This is a phenomenon that has already been seen in many suburban cities.

As mentioned before, at the sales stage of a real estate investment, there will appear areas or buildings that will be asked to redevelop or whose liquidity risk becomes infinite.

In order to avoid such an issue, investments must be made by selecting areas where there is a high probability that the buildings in such areas will continue to be used in the future.

Now, from what viewpoint should (investment) areas be selected?

3.2 Changes to Building Use During a Declining Phase: Surviving Markets

In the appendix provided at the end of this paper, ("Analysis Regarding Relationship Between Building Use and Return Differentials"), a panel random probit model was used to make predictions regarding changes in building use.[12]Based on this model, it became clear that when the return differentials became large when comparing buildings with dissimilar uses, conversions of building use progressed. Among such differentials, it has been statistically shown that rent differentials ($Rent_{jt \cdot office}/Rent_{jt \cdot Condo}$) have significant effects. Specifically, even with respect to areas in which buildings were used as offices, such areas were converted from the office market to the residential market when returns from office use were found to be relatively lower compared to returns from other uses, such as residential

[12]Panel random probit model refers to a probit model that has implemented panel data. In this context, three points of chronological data — 1991-1996, 1996-2001 and 2001-2006 — were used as panel data, and this model has made estimations using cross-section data, in mesh units. Random probit model has investigated the effects of excess returns on real estate by applying one of the following variables: if increased, the variable would be "1"; and, if not, the variable would be "0."

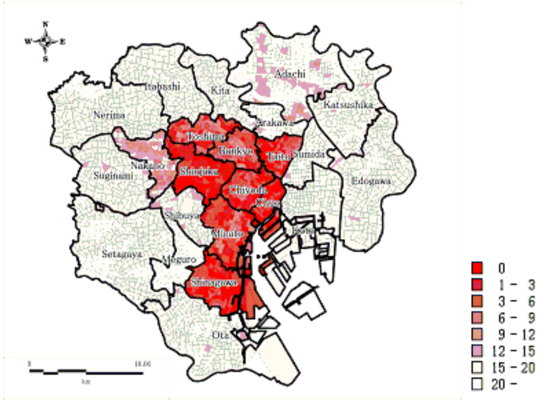

Figure 10: Spatial Distribution of Numbers of Years Where Excess Return were Negative

use. It has been predicted that areas that fell into such situations had no choice but to redevelop or had very high liquidity risk.

If return differentials are considered to be signals that prognosticate future changes in the market, it is possible to predict an eligible area for office investments based on the track record of past return differentials. Specifically, when analyzing the office market, we can verify at what scale the rents, when spaces were used as offices, exceeded (or fell below) the rents when spaces were used as residences.

Accordingly, we looked back at the past quarter century (i.e., 25 years) and compared the rents when spaces were used as offices versus the rents when spaces were used as residences. Then, within this fluctuating real estate market, we counted the number of years where the rents, when spaces were used as residences, exceeded the rents when spaces were used as offices. It can be interpreted that the lower the number of years, the stronger the earning power of office spaces were as compared to the earning power of residential spaces.

Figure 10 shows the spatial distribution of such numbers of years.

According to this distribution, there were only 303 areas out of 3,134 areas where return differentials were never positive. Such areas are limited to Chiyoda Ward, Chuo Ward, Minato Ward, Shinjuku Ward, Toshima Ward, Shinagawa Ward and Taito Ward. Even within Chiyoda Ward, which has the highest average office rents, its area is extremely limited.

This suggests that, going forward, in regard to office investments in Tokyo's 23 wards, investment decisions must be made within more limited area units.

Figure 11: Spatial Distribution of Arias Where Excess Return in Office Investment were Continuously Positive

4 Conclusion: Guide to Real Estate Investment During a Declining Phase

Japan's economy still holds the number three spot in the world on a GDP basis. Japan's political and economic function is concentrated in Tokyo's 23 wards. The social capital and infrastructure required to support the above function are also in place. Tokyo is one of the biggest cities in the world, with the daytime population being 11,284,699 (according to the 2005 national census) and the nighttime population being 8,949,863 (as of 2010). Further, Tokyo's economic scale (gross product within Tokyo) at around 85 trillion yen (2009) accounts for one-sixth that of Japan.[13] This means that the Tokyo real estate market, taking into account Tokyo's economic scale and quality of the inventory, would be considered one of the world's most attractive markets.

However, it cannot be denied that growth itself is declining. Compared to many of the Asian countries and developing cities that are showing notable growth, the residual growth power of Tokyo is inferior.

Provided that consideration must be paid to a few strong assumptions, the series of analyses in this paper suggest the following in regards to a real estate investment.
The first suggestion is the spatial distribution, in detailed area units, of the real estate investment returns for the past quarter century.

When observing the returns on real estate investment during the quarter century that includes Tokyo's economic bubble period, it was found that such returns were not necessarily

[13] Japan's nominal GDP in 2009 was 474,040.2 billion yen. The gross product within Tokyo in 2007 was 93 trillion yen, but following the economic crisis, it declined at once. It is thought that this is because the financial businesses that were affected the most from the economic crisis are accumulated in Tokyo.

high in areas that had strong growth power. With respect to areas that had strong growth power, their margin of decline became greater to the extent prices rose, and such areas ended up being exposed to high risks. In fact, profitability was higher in areas with higher income returns.
This suggests that, when looking at the real estate investment returns under a long-term perspective, although (good) capital returns could be expected when investing in areas with potential growth or have residual growth power, such investment also would be accompanied by greater risks.

Meanwhile, if investing in fully grown areas, fixed stable returns can be expected due to such areas being supported by high income returns. When thinking about it in this way, it can be predicted that, although large capital returns cannot be expected in Tokyo going forward, exposure to risks in connection with large-scale price fluctuations would also be small.

The second suggestion is made in regards to area selection when undertaking an office investment going forward.

When thinking about Tokyo's office investment market, the fact that there will be an overall decline in real estate needs cannot be avoided. In such a case, not being able to sell the real estate upon the expiration of the investment term is an issue that must be avoided at all costs. Thus, when doing an office investment, investing in an area or building that, at some point in the future, will end up with zero returns, and has no choice but to go through a use conversion, must be avoided.

In order to avoid this risk, there are increasing needs to rigorously select an area for office investment. Now, when supposing an office investment in Tokyo's 23 wards, how should the area be selected?

This paper estimated a prediction model of changes in building use based on the investment returns for office markets and residential markets in the past quarter century. Based on the results obtained, it has been found that return differentials of the two — particularly the rent differentials — brought about significant building use conversions or developments. In other words, for those areas in which returns were anticipated to be higher if the use was converted rather than maintaining the present use, there was no choice but to redevelop such areas.
Now, when we looked, from the perspective of making an office investment, for areas of which the office rents consecutively exceeded the residential rents for the past quarter century, an extremely limited number of areas — namely, 303 areas — were extracted.

When looking at these 303 areas that have been extracted, the following trends can be recognized.
Tokyo's city formation has been taking place over a long period of time. It began with the founding of the Edo government, and through the Meiji Restoration, the city function of Tokyo was crystallized as the capital of modern Japan. Then, the shape of the present city was formed as a result of restoration work, first following the Great Kanto Earthquake[14],

[14] Great Kanto Earthquake, occurred in 1923 with a magnitude of 7.9, centered in 80 kilometer north-

and then following the destruction from World War II. Under such premise, business areas and residential areas that were to serve as nucleuses were formed. And, in the midst of the rapid increase in population and economic growth post-war, Tokyo's city space had to be expanded.

In such, within Tokyo's city space, there exist areas that serve as nucleuses for businesses and areas that serve as nucleuses for residences. Among them are mixtures of areas that, on the one hand have not experienced any great changes for a long time, and on the other hand, that have experienced rapid changes to their land and building use. Areas that have the highest rents, such as Otemachi, Marunouchi and Nihonbashi, have been Tokyo's central business areas through the periods of placeEdo, Meiji, Taisho, Showa and Heisei. And in such areas, much social capital is accumulated. There is an overlap between many such areas and the 303 areas that were extracted.

Under such premise, it can be easily anticipated that for areas whose land use was converted from agricultural or residential use to office use following a temporary need to expand office spaces, they will, under the assumption that Tokyo will shrink, experience use conversions from offices back to residences. Even within the Tokyo area, there will appear areas that will likely be reconverted to agricultural land.

The analyses expressed in this paper are simply one type of measure. However, it should be apparent just from this paper's series of analyses that it is essential to have a clear policy of market selection when proceeding with an investment in Tokyo's real estate. In facing a real estate market that is about to encounter a declining phase, keen attention is paid to how the subject of real estate investment will establish its measurements regarding market selection.

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east offshore of the placePlaceNameSagami PlaceTypeBay, has been the most devastating earthquake in placecountry-regionJapan. In the course of restoration from the quake, placeCityTokyo built up its framework as a modern city by proactively developing infrastructure through street expansion programs, land readjustment programs and other measures.

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A Appendix. Analysis Regarding the Relationship Between Building Use and Return Differentials

A.1 Changes on Return Differentials and Building Use

Research on analyzing the relationship between returns on real estate investments and building use conversions has been reported extensively with U.S. precedents being at the center.

Wheaton (1982) was the person who first proposed an economic model of redevelopment by expanding on the traditional model of land use conversions that was started by Alonzo (1964), and explicitly incorporating the durability of buildings. Wheaton (1982) expressed in his dynamic model that, when comparing old building use with building use to be newly developed, if the return will be greater by converting the building use even when taking into consideration the demolishment fee and construction fee, then the building use would be converted.

Rosenthal and Helsley (1994) empirically proved such theories and conditions by applying the probit model to the residential market. Munneke (1996) analyzed the commercial real estate using the same framework as Rosenthal and Helsley (1994). Further,

McGrath (2000) expanded the above to an empirical model which incorporated costs to improve soil pollution.

However, the above analyses have the following limitations. First, in regards to the series of empirical research relating to return differentials and development incentive, they only clarified the relationship between return differentials and building use conversions of a particular point in time of economic conditions presented by Wheaton's (1982), as if taking a snapshot. Second, the analyses only addressed rebuilding, without altering the original use, within the office market or the residential market, rather than addressing the changes from residences to offices and vice versa. Third, the return differentials are compared only based either on the rent index or price index. Particularly when using the rent index, there is a strong assumption that certain rent differential at one point in time would persist in the future. In reality, however, the real estate market changes dynamically, thus, such assumption is too strong. The same is true when using the price index.

On the other hand, Shimizu, Karato and Asami (2010) analyzed building use conversions from offices to residences at numerous points in time by creating a dynamic model which uses panel data. As limitations one and two have been eliminated in such model, it can be considered a more generalized model. However, such model has only dealt with one-way conversions from offices to residences and has not considered the reverse. Also, such model still has an issue in that it has only looked at differentials between office rents and residential rents.

The purpose of this paper is to rectify such issues.

A.2 Theoretical Model

Let us assume that in each area j, there exists a representative real estate owner, and that in such area, all of the buildings are used either as offices or residences. Let us throw in the facts that there is asset k with land area $\overline{L}$, and that in such area, a building with floor area Q would be produced. Such production function is to be expressed as $(Q = F\left(K, \overline{L}\right)$. The discount rate is to be expressed as i, the floor area as Q, the rent when used as an office as R^O, and rent when used as an residence as R^R. Now, the formula which expresses the return (r^O) per unit lot area that has been maximized following a conversion from a residential building to an office building is shown below.

$$\max_K r^O = \frac{R^O F\left(K, \overline{L}\right) - iK}{\overline{L}} \tag{3}$$

$\overline{Q} = F\left(\overline{K}, \overline{L}\right)$ stands for the floor area of present area j. The amount of return prior to the conversion from a residential building to an office building is expressed as $r^R = R^R\left(\overline{Q}/\overline{L}\right)$ .Under such assumption, it can be thought that if the return (r^O) post-building use conversion turns out to be $r^O - r^R \geq 0$, then the building use would be converted. In contrast, if the present return happens to be $r^R - r^O \geq 0$, then actions may be taken to maintain or increase the current building use.

Based on the above, building use conversion would occur when the following condition is satisfied.

$$R^O F\left(\overline{K}, \overline{L}\right) - iK - R^R\overline{Q} \geq 0 \tag{4}$$

If the production function is specified as $F(K, L) = AK^{\alpha}\overline{L^{\beta}}$, the optimum condition for the three formulas would be $R^O\left(\partial F\left(K, \overline{L}\right)/\partial K\right) = i$, and the condition for a building use conversion would be as follows.

$$\Delta = (1 - \alpha) R^O Q - R^R\overline{Q} \geq 0 \tag{5}$$

This formula shows that such condition for building use conversion applies when return differential Δ derived from a particular building use is positive.

Based on such condition, empirical analysis is conducted through a binary choice model using panel data to determine whether the decision-making with respect to building use conversion can be explained by the rent differentials before and after such building use conversion. The estimated model can be written as follows.

$$\widetilde{\Psi} = \gamma\Delta_{jt} + \mu_{jt} \tag{6}$$

$$\mu_{it} = \sigma + \mu_j + \epsilon_{jt}$$

The following is to be established: $i = 1, 2, \cdots, n$ and $t = 1, 2, 3$. Here, focus will be given, using the surveyed areas under the national census as mentioned previously (j) as a unit, on the selections of building use made since the peak of the economic bubble in the 1990s.

μ_{it} stands for the error component, σ stands for the interception that is common to all samples, μ_{jt} stands for random effects of each group (area), ϵ_{jt} stands for a random variable that follows a standard normal distribution that assumes a dispersion of 1 and zero average. In accordance with the plus or minus coefficient of the return differential γ and the actual value of the return differential, if $\Psi > 0(\Psi = 1)$, then the building use would be altered, and if $\Psi \leq 0(\Psi = 0)$, then the present building use would be maintained. Thus, the probability of the building use being altered can be written as follows.

$$\begin{aligned}\Pr\left(\Psi_{jt} = 1\right) = \Pr\left(\widetilde{\Psi} > 0\right) &= \Pr\left(\varepsilon_{jt} > -\gamma\Delta_{jt} - \delta - \mu_j\right) \\ &= \Phi\left(\gamma\Delta_{jt} + \delta + \mu_j\right)\end{aligned} \tag{7}$$

If the building use conversion occurs when the return of the lot on which the building use has been converted is greater than the lot rent as is, it can be expected that γ would be greater than zero. Below, the unknown parameter and random effects will be estimated using a panel probit model (Baltagi 2008, pp. 237–244 was referenced in regards to the estimation method).

A.3 Empirical Model

There are limitations to the analyses in Shimizu, Karato and Asami (2010) because building use conversions are addressed at only two points in time, and they only involve situations where the buildings are converted from office use to residential use. Also, such analysis has the same issue as prior research in that the index used to explain converted use is limited to the rent differential.

As such, this analysis expanded the model used in Shimizu, Karato and Asami (2010) in the following way.

At the onset, in regards to data relating to building use, the data of inventory implemented to sort out the building use was expanded to four points in time — 1991, 1996, 2001 and 2006.[15] In other words, changes during the following points in time were analyzed: building use conversions from 1991 to 1996; building use conversions from 1996 to 2001; and, building use conversions from 2001 to 2006.

Moreover, in regards to building use conversions, as opposed to dealing with only one-way conversions from office buildings to residential buildings as was done in Shimizu, Karato and Asami (2010), the model was expanded to analyze building use conversions in both directions.

When focus is given to changes in the inventory, the inventory of office buildings increased from 1991 to 2001, but thereafter decreased until 2006. The inventory of residential build-

[15] Present land and building use survey that is being maintained by the Bureau of Urban Development Tokyo Metropolitan Government was used. In regards to the same data, surveys are being done on the coordinates, building shape, building structure, building area, type of building use and use restrictions under urban planning using the Geographic Information System.

ings increased every surveyed year and shot up between 2001 and 2006.[16] This was the period when both types of building uses were being upgraded through making the building structures taller.

Now, focus is given to the ratio of the total office area to the total condominium area [($office$)/($condo$)] within the surveyed areas under the national census for each survey year. If the finite difference of such ratio ($\log(S_{jt+1.office}/S_{jt+1.condo})$-$\log(S_{jt.office}/S_{jt.condo})$) turns out to be positive, the office area would increase faster than the residential area from period t to period $t+1$. In contrast, if such ratio turns out to be negative, then the increase in residential area would be greater. Thus, the way in which resources were distributed could be understood. By expanding the model in this way, effects of building use conversions from office buildings to residential buildings and vice versa can be seen.

A.4 Data

When attempting to observe the long-term trends of the real estate market, the first issue to be faced is the restrictions on obtaining data. Particularly in Japan, data relating to transaction prices and market rents are extremely difficult to obtain.

We began this paper by collecting as much microscopic information relating to market prices and market rents. As a result, we were able to collect microscopic data of office rents, residential rents and residential prices, all as shown below, for the quarter century from 1986 to 2010.[17] A summary of such statistics has been arranged as shown in Table 2.

Although concentrated in the central Tokyo area, 16,887 cases of office rent data were collected. In regards to residences, we were able to create a large-scale database at 333,845 cases for residential rents and 282,289 cases for residential prices. Based on the statistics for rents or prices: the average office rent per square meter per month is around 5,800 yen; the average residential rent per square meter per month is 3600 yen; and, the average residential price per square meter is 690,000 yen.

When looking at the contractual area, many of the office (lease) contracts are for small-scale office spaces at an average of 297m^2. In regard to residences, the average rental area is 37m^2 while the average area in the home buying and selling market is 56m^2. As such, the home buying and selling market involves bigger rooms. The reason being that many of the Tokyo rental units are studio-type units.

[16] The numbers of office buildings increased by the following numbers in the following years: 52,133 buildings (10.19km^2) in 1991; 61,302 buildings (12.74km^2) in 1996; 62,470 buildings (13.40km^2) in 2001; and, 61,711 (123.89km^2) in 2006. Meanwhile, with respect to the number of condominiums, they increased by the following numbers in the following years: 276,043 condominiums (33.68km^2) in 1991; 275,309 condominiums (34.73km^2) in 1996; 283,544 condominiums (43.38km^2) in 2001; and, 314,463 condominiums (48.37km^2) in 2006.

[17] Specifically in the central Tokyo area, data was limited to condominiums (apartments) since hardly any detached homes exist in such area.

Table 2: Summary Statistics of Main Variables

	Office Rents		Residential Rents		Housing Prices	
	[Average]	[St. Dev]	[Average]	[St. Dev]	[Average]	[St. Dev]
Unit Prices(JPY/㎡)	5,830.91	2,497.80	3,608.54	855.85	690,013.68	369,982.87
S: Floor Space (㎡)	297.26	533.80	37.55	20.39	56.33	18.22
A: Age of Building (Year)	15.97	11.32	8.89	6.60	14.90	9.20
TS: Time to the Nearest Station (minutes)*	3.65	2.25	6.97	3.79	7.37	4.28
TT: Time to the Tokyo Station (minutes)	6.33	3.95	24.99	8.13	25.72	8.55
Number of Obs.	16,887		333,845		282,289	

A.5 Dynamics of Real Estate Market by Region

A.5.1 Estimation of Rate of Return Model by Region

In calculating the rate of return by area, the following hedonic function, which incorporates structural forms of pricing in accordance with the changing of time, has been estimated.

$$\mu_{it} = X_{it}\beta_t + \upsilon_{it} \tag{8}$$

Here, μ_{it} equals the real estate return of building i at point in time t, and X_i is the attributable vector relating to such real estate's scale and building age. By controlling the price differences of such real estate attributes, the hedonic function was estimated at each period t. However, even within the elements that form the real estate return, there exists an unobservable variable (υ_i).

By using the hedonic function formula that has been estimated as such, estimation of returns on real estate, in area units, will be done in the following manner.

First, the midpoint of area j is supposed. It has been assumed that in such area's midpoint exists a building that has the following conditions: it is an office building where 10 years have elapsed since it was first built and the floor area per floor is 200 tsubo ($660m^2$); and, a (lease) contract for 100 tsubo ($330m^2$) is entered into every year. Normally, if one year passes, the age of the building becomes one year older. However, here it is assumed that there is no increase in building age that follows the passing of the years. As such, changes in office rents are being observed with the assumptions that each year, the building is 10 years old since it was built, the floor area per floor is 200 tsubo and 100 tsubo of such building enters into a new (lease) contract. By making such assumptions, the differences in the levels of rents among areas can be compared in a fundamental way.[18] In regards to a residential building, it has been assumed that the contractual area per room is 35m^2 and 5 years has passed since such building was built.

In regards to the distance to the nearest station, which has a huge effect on the determination of the real estate return, the nearest station was selected for each area j,[19] and the distance from the midpoint to such nearest station was calculated using the Geographic Information System.

In regard to the time it takes to reach the Tokyo station, the average transfer time that it takes from a nearest station to the Tokyo station during the daytime was used.[20]
Based on the above premise, real estate return (ρ_{jt}) for area j can be calculated as follows.

$$\widehat{\rho}_{jt} = X_j \widehat{\beta}_{jt} \tag{9}$$

Here, it is assumed that no change occurs with respect to the peculiarity of each area. However, it can be understood that since hedonic attributable prices β_{jt} change with time, changes in return per area are brought about by changes in average prices (changes in constant term) together with changes in the coefficient. The estimation results of the hedonic function per year are shown in Table 3.

Using this estimation results, real estate investment returns for the 3,134 areas designated as surveyed area units in the 2005 national census were estimated.[21]

A.6 Macroscopic Fluctuations of Rate of Return by Region

Using the prices and each of the predicted values of rents that have been figured out, the rate of return on investment was calculated.

$$\phi_{jt} = \frac{R_t + (P_{jt+1} - P_{jt})}{P_{jt}} \tag{10}$$

Per the above, the income return, which is calculated using the rental income generated when operating for one year divided by the initial investment amount ($\rho_{jt} = R_{jt}/P_{jt}$), and

[18]In reality, there are areas with special characteristics such as areas that have numerous new office buildings or areas that have accumulations of old buildings. Likewise, it is certain that there are areas that have accumulations of large-scale high-rise office buildings or accumulations of small office buildings. But as the purpose here is to seek the fundamentals of area units, comparisons are made with the assumption that all areas have the same buildings at all points in time.

[19]In selecting the nearest station for each area, the data that actually had appeared in advertisements for each area j was combined, and determination was made as to which station in said area in the past had the highest probability of being selected as the nearest station. Then, the station that had the highest probability of being selected as the nearest station became the nearest station for area j. In areas where such information was unavailable, using the Geographic Information System, the station which had the shortest straight-line distance (to the midpoint) was selected as the nearest station.

[20]The rail network data in respect of nearest stations to Tokyo Station was provided by Val Laboratory Corporation (Eki spaato). Such data have taken into consideration all effects including changes in the time table and developments of new lines.

[21]According to the 2005 national census, there were 8,949,863 people residing in 621.98 square kilometers within Tokyo's 23 wards. This survey is done by dividing the above into 3,134 surveyed areas. Generally, each area corresponds to per district per town (small areas).

Table 3: Estimation Results of Hedonic Equations: 1986-2010

	Office Rent					Residential Rent					Housing Prices				
Year	Constant	log *S*	log *A*	log *TS*	log *TT*	Constant	log *S*	log *A*	log *TS*	log *TT*	Constant	log *S*	log *A*	log *TS*	log *TT*
1986	9.48	0.08	0.00	-0.17	0.03	4.11	-0.03	-0.16	-0.02	-0.07	-0.33	-0.27	-0.06	-0.05	-0.09
1987	9.71	0.11	0.02	-0.10	-0.09	4.43	0.02	-0.15	0.01	-0.18	-0.30	-0.23	-0.05	-0.05	-0.13
1988	9.64	0.20	0.00	-0.14	-0.14	5.38	-0.09	-0.18	0.00	-0.25	-0.14	-0.27	-0.05	-0.04	-0.14
1989	10.09	0.11	0.02	-0.14	-0.16	5.92	-0.14	-0.18	0.00	-0.29	0.02	-0.28	-0.06	-0.04	-0.15
1990	9.29	0.22	0.00	0.01	0.02	6.45	-0.20	-0.15	0.01	-0.31	-0.18	-0.23	-0.08	-0.01	-0.15
1991	10.07	0.16	0.01	-0.11	-0.08	6.31	-0.17	-0.19	0.01	-0.31	0.02	-0.22	-0.07	-0.01	-0.18
1992	10.23	0.17	-0.04	-0.22	-0.15	6.14	-0.14	-0.20	0.01	-0.32	0.25	-0.28	-0.08	0.00	-0.18
1993	9.86	0.10	0.00	-0.10	-0.10	5.82	-0.07	-0.20	0.01	-0.32	0.27	-0.29	-0.09	0.00	-0.17
1994	9.81	0.09	0.02	-0.18	-0.12	5.51	-0.02	-0.22	0.01	-0.30	0.14	-0.25	-0.13	0.00	-0.16
1995	9.76	0.09	0.00	-0.16	-0.16	4.98	0.05	-0.25	0.00	-0.26	0.02	-0.25	-0.12	0.00	-0.14
1996	9.78	0.10	-0.01	-0.15	-0.19	4.72	0.09	-0.24	-0.01	-0.25	0.12	-0.27	-0.10	0.00	-0.15
1997	9.53	0.17	-0.06	-0.13	-0.11	4.70	0.09	-0.24	0.00	-0.25	0.07	-0.26	-0.09	0.00	-0.15
1998	9.72	0.15	-0.03	-0.17	-0.20	4.49	0.10	-0.23	0.00	-0.22	0.12	-0.28	-0.09	0.00	-0.15
1999	9.84	0.10	-0.05	-0.21	-0.10	4.38	0.11	-0.22	0.00	-0.21	0.16	-0.29	-0.08	0.00	-0.15
2000	9.72	0.13	-0.02	-0.09	-0.15	4.39	0.11	-0.22	-0.01	-0.22	0.27	-0.30	-0.09	0.00	-0.16
2001	9.61	0.15	-0.06	-0.06	-0.10	4.33	0.09	-0.22	-0.01	-0.19	0.30	-0.30	-0.10	0.00	-0.16
2002	10.23	0.07	-0.11	-0.16	-0.14	4.42	0.07	-0.20	-0.02	-0.20	0.40	-0.32	-0.10	0.00	-0.16
2003	10.01	0.08	-0.07	-0.12	-0.14	4.41	0.05	-0.21	-0.02	-0.18	0.27	-0.32	-0.10	-0.01	-0.13
2004	10.02	0.10	-0.09	-0.18	-0.11	4.44	0.04	-0.20	-0.03	-0.18	0.15	-0.30	-0.10	-0.02	-0.10
2005	9.92	0.09	-0.04	-0.11	-0.16	4.55	0.03	-0.21	-0.02	-0.18	0.08	-0.29	-0.11	0.00	-0.10
2006	9.99	0.14	-0.11	-0.11	-0.14	4.61	0.04	-0.21	-0.03	-0.18	-0.13	-0.25	-0.11	-0.02	-0.07
2007	10.10	0.15	-0.13	-0.10	-0.15	4.54	0.06	-0.21	-0.02	-0.18	-0.21	-0.26	-0.13	-0.01	-0.05
2008	10.00	0.15	-0.11	-0.13	-0.10	4.48	0.07	-0.21	-0.03	-0.17	-0.10	-0.27	-0.12	-0.01	-0.08
2009	9.95	0.10	-0.11	-0.08	-0.10	4.61	0.06	-0.22	-0.03	-0.19	0.22	-0.29	-0.14	-0.01	-0.14
2010	10.11	0.07	-0.11	-0.12	-0.12	4.91	0.02	-0.22	-0.02	-0.23	0.32	-0.31	-0.13	-0.01	-0.15

*Estimation Methd: Robust Regression

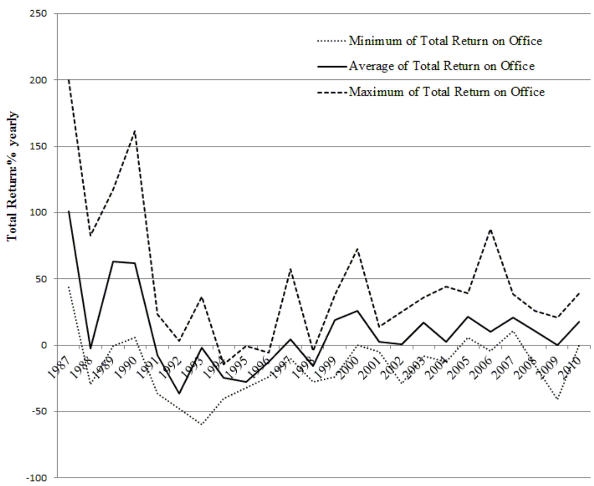

Figure 12: Total Rates of Returns on Office Investments

the capital return, which would be considered the price volatility rate were added together (to come up with the total rate of return on investment).[22]

Changes in the total rates of returns for office markets are shown in Figure 12, and those for residential markets are shown in Figure 13. Here, the average of the 3,134 areas and the highest and lowest rates were illustrated.

In regard to the office market, high rates of returns are shown from the late 1980s to the beginning of 1990s due to large price fluctuations ($\sigma_{jt} = (P_{jt+1} - P_{jt})/P_{jt}$) during the bubble period. In areas where the investment rates of returns (ϕ_{jt}) were high, there existed multiple years where the annual rates were more than 50%. However, as the collapse of the bubble in the 1990s continued its effect through the mid-1990s, it is not until the late 1990s when the average values of the rates of returns (ϕ_{jt}) become positive.

In regards to the residential market, due to the continued price decline for a long period, rates of returns were negative similar to office spaces that were affected by the price fluctuations ($\sigma_{jt} = (P_{jt+1} - P_{jt})/P_{jt}$). It is not until the early 2000s when the rates of returns (ϕ_{jt}) become positive for the first time.

Now, the following were arranged in Table 4[23] for the quarter century between 1986 and 2010 and for a period of 10 years from 2000: the average rates of returns and average

[22] We were unable to calculate the office prices due to restrictions in obtaining data. As such, the following method was used to calculate such prices. In regards to the residential market, income return (ρ_{jt}) can be calculated. This income return is also the ratio that is used to convert the rent to an asset price. Here, we have assumed a spread of 1.1% between the income return for a residential market and the income return for an office market. Then, using such spread, office prices per area were calculated. This 1.1% spread comes from the IPD data which analyzed Japan's REIT market.

[23] In regards to the calculations of the average returns and volatility, the total rates of returns for each of the 3,134 areas were calculated, followed by calculations of returns and volatility in 3,134 ways. The average values of the above were arranged in Table 4.

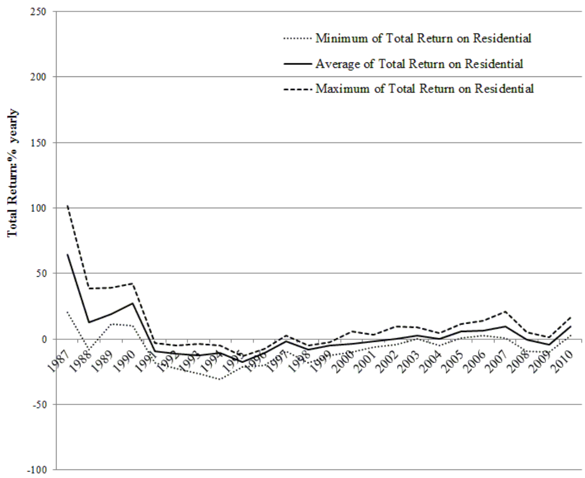

Figure 13: Total Rates of Returns for Residential Markets

volatility for the rates of returns (ϕ_{jt}) and income returns ($\rho_{jt} = R_{jt}/P_{jt}$) for each of the office markets and residential markets;[24] and, the risk-adjusted returns, which are considered to be ratios of the above.[25] Looking back at the past quarter century, the average rate of return on an office investment $\left(\overline{\phi}_{jt}\right)$ was 10.7%, and the average rate of return on a residential investment was 2.5%. Even if the time period is limited to the most recent past 11 years, which excludes the period in the 1980s when the economic bubble was being formed and the period in the 1990s when the bubble was collapsing, there has not been a huge change in the above numerical values.

With respect to volatility within the past 25 years, it was 36.5 for office investments and 17.6 for residential investments, which means that the risk amount for office investments were twice as high as that of residential investments. As the past 25 years includes the bubble period, which was a unique period, the values have been particularly high. If it is considered that the real estate bubble in Japan was the biggest bubble in the 20^{th} century, it can be thought that such values would be the upper limits of risks in real estate investments. If the period is limited to the most recent past 11 years, volatility for office investments and residential investments were 12.15 and 5.37 respectively. Based on the above, volatility has decreased to around half in office investments, and around one third for residential investments.

Income returns for office investments and residential investments were 5.173% and 6.273% respectively. The above was due to large increases in real estate prices as compared to rents during the bubble period. When focusing on the most recent past 10 years, there has been

[24] Volatility was calculated with a standard deviation of $\sigma_j = (\phi_{jt} - \mu_j)^2 / n - 1$.
[25] Risk-adjusted returns was calculated with ϕ_{jt}/σ_j.

Table 4: Summary statistics of Property Returns:1987-2010

	Office Market		Residential Market	
	[Average]	[St. Dev]	[Average]	[St. Dev]
1987-2010				
Average Total Return (φj)[a]	10.740	1.612	2.516	0.646
Volatility (σj)[b]	36.559	6.929	17.632	2.630
Income Return (ρj)[c]	5.173	0.932	6.273	0.932
φ_j /σ_j	0.300	0.050	0.145	0.039
2000年-2010				
Average Total Return (φj)[a]	11.536	1.508	2.691	0.649
Volatility (σj)[b]	12.156	3.813	5.379	1.042
Income Return (ρj)[c]	7.462	1.095	6.362	1.095
φ_j /σ_j	1.003	0.201	0.507	0.112

Number of Area: 3,134

a.Average Total Return is calculated by j area in t.

b.Volatility is calculated by j area in t.

c.Income Return is calculated by j area in t.

little change in income returns for residential investments at 6.262%. But there have been profits for office investments, with income returns at 7.462%. As such, although it may seem as though high risks are involved in real estate investments at first glance, if focus is given only to income returns, it can be said that stable returns (on real estate investments) have continued to occur.

A.6.1 Changes in Building Use and Returns

Changes in building use are observed using the ratio of the total office area to the total residential area [(office)/(condo)] per surveyed area for the surveyed areas (3,134 areas) under the national census.

First, the ratio ($\log(S_{jt.office}/S_{jt.condo})$) of office area to residential area [(office)/(condo)] was calculated for each area j at each of the four points in time ($t = 1991, 1996, 2001, 2006$). Then, we looked at the finite difference of such ratio ($\log(S_{jt+1.office}/S_{jt+1.condo})$-$\log(S_{jt.office}/S_{jt.condo})$). When such finite difference is positive, then the increase in the office area would be greater than that of the residential area for the period from t to $t+1$. In contrast, when such finite difference is negative, the increase in residential area would be greater. Thus, how the resource distributions of office buildings and residential buildings have changed within areas can be understood.

The average and the standard deviation for the same index (as above) that were calculated for the 23 wards, in national surveyed area units, were arranged in Table 5. It can be understood that in regards to changes in building use, increases in areas of buildings used as offices were greater than increases in areas of buildings used as residences within all of the 23 wards from 1991 to 1996. This was immediately following the collapse of the bubble period, however, adjustments to the inventory from such period had not been carried out in

Table 5: Chronological Changes of Building Use Conversions

Area		1991→1996 [Average]	1991→1996 [St. Dev]	1996→2001 [Average]	1996→2001 [St. Dev]	2001→2006 [Average]	2001→2006 [St. Dev]	Number of Local Area
Central	Chiyoda	0.206	0.831	-0.659	0.917	-0.100	0.550	51
	Chuo	0.479	0.938	-0.222	0.782	-0.836	0.902	71
	Minato	0.206	0.373	-0.087	0.314	-0.183	0.491	106
	Shinjuku	0.278	0.547	-0.088	0.443	-0.166	0.375	142
Subarban	Bunkyo	0.451	0.542	-0.145	0.278	-0.125	0.252	64
	Taito	0.222	0.710	-0.157	0.325	-0.302	0.374	104
	Sumita	0.191	0.473	-0.119	0.434	-0.185	0.295	101
	Koto	0.225	0.623	-0.154	0.388	-0.196	0.463	130
	Shinagawa	0.093	0.648	-0.004	0.461	-0.103	0.291	113
	Meguro	0.342	0.615	0.019	0.663	-0.069	0.406	83
	Oota	0.245	0.722	0.036	0.380	-0.072	0.390	178
	Setagaya	0.295	0.851	-0.051	0.562	-0.270	0.655	242
	Shibuya	0.456	0.582	0.122	0.399	0.028	0.333	76
	Nakano	0.002	0.470	-0.126	0.376	-0.014	0.306	80
	Suginami	0.309	0.681	-0.102	0.368	-0.281	0.712	130
	Toshima	0.083	0.728	-0.091	0.320	-0.164	0.602	83
	Kita	0.170	0.618	0.097	0.494	-0.098	0.460	100
	Arakawa	0.244	0.729	-0.115	0.441	-0.180	0.396	48
	Itabashi	0.349	0.579	-0.085	0.656	-0.063	0.338	121
	Nerima	0.224	0.860	0.027	0.571	-0.176	0.521	176
	Adachi	0.043	0.641	0.077	0.477	0.038	0.556	230
	Katsushika	0.491	0.791	-0.064	0.447	-0.132	0.262	135
	Edogawa	0.357	0.748	-0.273	0.514	-0.116	0.389	173
Sum		0.252	0.699	-0.071	0.505	-0.154	0.502	2737

Data Source: Tokyo Metropolitan Government

*Land Use Change is culculated by the deferences of log(Office area in *j* area / Residential area in *j* area)

the past 5 years.

However, the ratio of office use area to residential (use) area has decreased in 19 of the 23 wards from 1996 to 2001, and rate of such decrease was particularly large in Chiyoda Ward and Chuo Ward, which are situated in the central Tokyo area. From 2001 to 2006, such ratio decreased in 21 of the 23 wards, and within such 21 wards, rates of decreases were particularly large in Chuo Ward, Minato Ward and Shinjuku Ward.

It can be thought that such changes have been caused, from 1996 onwards, by the second generation baby boomers, who have acquired residences in masses, pushing up the needs for residences, while needs for offices were in large decline. It is surmised that such changes have also been caused by the rebuilding of those buildings that were quipped as "pencil buildings," due to the large decline in use rate following a flooding of such buildings during the bubble period.

Next, we looked at the chronological changes of the following three excess returns: price ratio ($Price_{jt\cdot office}/Price_{jt\cdot condo}$); rent ratio ($Rent_{jt\cdot office}/Rent_{jt\cdot Condo}$); and, the finite difference of risk-adjusted returns ($\phi_{jt.office}/\sigma_{jt.office} - \phi_{jt.condo}/\sigma_{jt.condo}$) (Figure 14).[26]

As of 1986, the price ratio ($Price_{jt\cdot office}/Price_{jt\cdot condo}$) was around 1.5, and the return

[26]Excess returns were calculated for each of the 3,134 areas. Here, we illustrated the average values for the 3,134 areas.

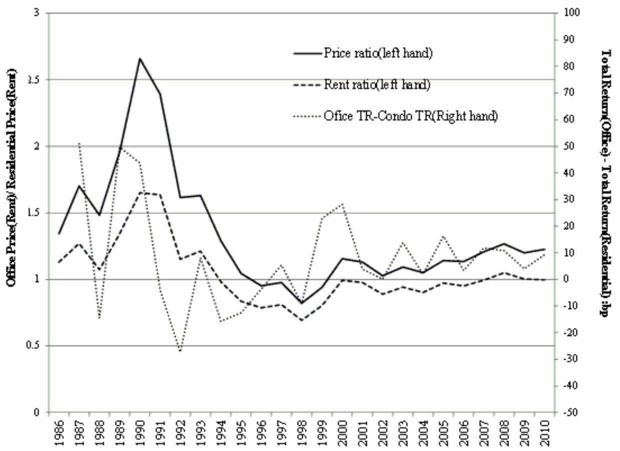

Figure 14: Chronological Changes of Excess Returns

rent ratio ($Rent_{jt \cdot office}/Rent_{jt \cdot Condo}$) was around 1.3. Although the return ratio remained at 1.65 times during the peak of the bubble, the price ratio rose as high as 2.65 times.

Thereafter, the return ratio fell below 1 from 1994 to 2007. The return ratio went slightly above 1 in 2008 and 2009. However, it fell below 1 again in 2010. Thus, reverse phenomenon was occurring in that residential rents became higher than office rents in all areas. In regards to the price ratio, the prices (of residences) also became higher than that of offices for the four years between 1996 and 1999, and even after such period, the gap has remained at around 20%.

As for risk-adjusted returns ($\phi_{jt.office}/\sigma_{jt.office} - \phi_{jt.condo}/\sigma_{jt.condo}$), they were negative immediately following the collapse of the bubble in 1991 and 1992, as well as from 1994 to 1998 (excluding 1997). However, for the other time periods, it can be understood that excess returns existed for office investments as against residential investments.

A.7 Estimation Results of Random Probit Model

Based on numerical 7, estimation of a random probit model was conducted by using the changes in building use calculated in the previous section, as well as the three excess returns. As for estimation of the probit model, binary variables were established as follows: in regard to ratio of office area to condo area ($\log(S_{jt.office}/S_{jt.condo})$) for each area j at points in time $t = 1991, 1996, 2001, 2006$, the variable would be "1" if such finite difference ($\log(S_{jt+1.office}/S_{jt+1.condo}) - \log(S_{jt.office}/S_{jt.condo})$) has increased (> 0); and, the variable would be "0" for all other cases. By doing so, events relating to building use changes in the three periods - t_1 =1991-1996, t_2 =1996-2001,and t_3 =2001-2006 – as seen

Table 6: Estimation Results of Random Probit Model

	Coefficient	S. E	z-score
Price.*office*/ Price.*condo*	0.211	0.057	3.690
Rent.*office* /Rent.*condo*	0.826	0.160	5.160
(φ.*office*/σ.*office*)$-$(φ.*condo*/σ.*condo*)	-0.033	0.019	-1.710
σ	0.001	0.005	0.000
r	0.000	0.000	0.000
Ward dummy		Yes	
Number of obs.	8,211		
Individual number of groups	2,737		
Wald (chi-squared)	775.85		
p-value	[.000]		

Likelihood-ratio test of rho=0: chi-square= 6.7e-04 Prob >= chi-square = 0.490

in Table 5 can be analyzed.

Based on the above, we looked at the relationship among the three excess returns that were calculated in the previous section.

Here, the three excess returns were calculated as shown below.

First, in regard to the price ratio ($Price_{jt \cdot office}/Price_{jt \cdot condo}$), such price ratio of area j at points in time t =1991, 1996, 2001 was used. In other words, the changes in building use from 1991 to 1996 (log $(S_{j1996.office}/S_{j1996.condo})-$log $(S_{j1991.office}/S_{j1991.condo})$) was to be determined by the price differential at the initial point in time $Price_{j1991.office}/Price_{j1991 \cdot condo}$.[27] In regards to the rent ratio ($Rent_{jt \cdot office}/Rent_{jt \cdot Condo}$), when thinking about the changes of building use from 1991 to 1996, the average rent ratio for the past five years $t = 1987, 1988, 1989, 1990, 1991$were used rather than using a ratio that was calculated at a single point in time, like a snapshot. With respect to the finite difference of risk-adjusted returns ($\phi_{jt.office}/\sigma_{jt.office} - \phi_{jt.condo}/\sigma_{jt.condo}$), it was calculated in the same manner as was done for the rent ratio, by using the average total rate of return (ϕ_{jt}) and volatility (σ_{jt}) for the past five years $t = 1987, 1988, 1989, 1990, 1991$.

The estimated results of the random probit model are presented in Table6.

Based on the estimation results, it was understood that building use conversions brought significant effects in terms of price ratio ($Price_{jt \cdot office}/Price_{jt \cdot condo}$) and rent ratio ($Rent_{jt \cdot office}/Rent_{jt \cdot Condo}$). No significant effects were detected with respect to the finite difference of risk-adjusted returns ($\phi_{jt.office}/\sigma_{jt.office} - \phi_{jt.condo}/\sigma_{jt.condo}$). In particular, out of the three excess returns, effects on building use conversions by the rent ratio ($Rent_{jt \cdot office}/Rent_{jt \cdot Condo}$) were of the strongest significance. This means that as the rent ratio ($Rent_{jt \cdot office}/Rent_{jt \cdot Condo}$) be-

[27] The asset price is determined by the future return and current discounted value. As such, when thinking about the fact that future information would be reflected at the present point in time, if the average value for the past several years is used, theoretical integrity is compromised due to future expectations being doubly reflected. It was assumed here that by establishing the price ratio at the point in time when changes in building use has begun, the future return, or prediction thereof, at such point in time would be reflected.

comes bigger, i.e., as the office rents become relatively higher as opposed to residential rents, the area of office buildings increases. In contract, as such ratio declines, the probability that the area of residential buildings becomes greater.

The above suggests the following. In regards to the rent ratio ($Rent_{jt \cdot office}/Rent_{jt \cdot Condo}$), as seen in Figure14, office rents have become higher than residential rents in many of the regions from 1994 onwards (the return ratio falls below 1). Moreover, the finite difference of the building use ratio was negative. In other words, in regard to the rent ratio ($Rent_{jt \cdot office}/Rent_{jt \cdot Condo}$), there was an increasing trend of areas where higher rents could be collected by converting the buildings to residential use rather than continuing their use as offices. In the midst of above, it can be thought that conversions from office use to residential use took place or new residential developments were being advanced.

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