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Minor revision, February 1993

* This research was conducted when the authors were visiting researchers at the Research Institute on Monetary and Economic Studies, Bank of Japan. The authors thank comments and encouragement from Mr. Kumiharu Shigehara, former Director of the Institute, Mr. Kuniho Sawamoto, Director of the Institute, Mr. Hiroo Taguchi, the Division chief; Dr. Kunio Okina, and other researchers at the Institute. Comments from Professors Takahiro Miyao, Tatsuo Hatta, Makoto Ohta, James Poterba, and Robert Shiller are gratefully acknowledged. The Japanese-language version of this paper will be published in Bank of Japan, Kin-yu Kenkyu, October 1992. This paper is written for the reader who is not familiar with Tokyo geography and the Japanese language. Hence, the presentation is different, with the same all econometric results.

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Abstract

Extremely high prices of housing in Tokyo are well known. However, a real puzzle of the Tokyo housing market is not the absolute level of housing purchase prices, which could be justified by its high productivity of residents and limited supply, but the high purchase prices relative to rents.

We take advantage of annual micro data sets which we have compiled from individual listings in the widely-circulated real estate advertisement magazine. A data set compiled from the "properties for investment" section lists both asking (purchase) prices and rents for the same property. With this data, the price-rent ratio is directly observable and expected capital gains before tax and commissions are found to be just less than 90 percent in ten years. The "repeatedly-listed properties for investment" data set, a subset of the first data set, contains only those units in the same buildings after a one-year interval. In this data set, price, rent, and ex post capital gains are all observable. They are used to show that ex post returns on housing investment in the last four years were actually rather modest. The data set for "housing for purchase" and the data set for "housing for rent" data sections were separately used for hedonic regressions, from which we constructed the hedonic price index and the hedonic rent index. Those regressions show the effects of various determinants for housing prices and rents. The time (year) dummy variables in the hedonic regressions give that estimate of increases in prices and rents in the last eleven years in Tokyo. According to these estimates, prices increased 85 to 90 percent over the 1981-92 period, while rents increased about 65 percent during the same period. The price-(annual) rent ratio rents appears to have fluctuated around a constant ratio between 17 and 32. Finally, the weak-form efficiency of excess returns on housing is rejected. However, the conclusion is tentative considering the small sample of our data.

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1. Introduction

Extremely high prices of housing in Tokyo are well known. It is a social problem in Japan that an average wage earner [salary-man] finds a typical housing for his family size to be about eight times his annual salary.[1] However, a real interesting phenomenon from the economics point of view is not the absolute level of housing price but the high price-rent ratio in Tokyo. The absolute level of the land price is determined by demand and supply of land, and high productivities with limited supply will explain high prices. That is why we observe high land prices in downtown Tokyo, midtown Manhattan, the City in London, the central part of Paris, and their first-tier suburbs. What seems peculiar to Tokyo is that housing rents (both on land and structures) are not as high as purchase prices compared to other cities.[2]

The price-annual rental ratio (a reciprocal of investment direct return) for typical housing is found to be about 25 in Tokyo which means the return on housing investment is about 4% in a year, much lower than the long-term government bond coupon rates. The high price-rent ratio must imply high expected capital gains.[3] In other words, too high a housing price, or, to be precise, a high price-rent ratio, poses an apparent inefficiency of the market, if high capital gains are not realized. In this context, it is important to gather and analyze data on rents and (ex post and expected) capital gains, in addition to prices of housing.

A micro data set, which contains individual listings or transactions, is preferred for the analysis of the efficiency in the land and housing markets. Several papers have been written using such micro data sets in the United States. The present paper, to our best knowledge, is the first of such an analysis for the Japanese housing data.

The purpose of this paper is three-fold. First, individual listings data will be compiled from the widely-circulated (200,000 copies every week in 1992) housing advertisement magazine, Shukan Jutaku Joho [Housing Information Weekly]. The Weekly contains sections of housing for rent, housing for purchase, and housing for investment. The rental and purchase housing listings will be analyzed by hedonic regressions to estimate changes in rents and purchase prices from 1981 to 1992. The investment property section lists both the price (that the current owner is asking for a prospective investor to pay) and rent (that the investor can collect from the current or expected tenant) for the same property, making it possible to observe the price-rent ratio directly. Second, returns on housing investment will be calculated using the compiled data sets, with different assumptions regarding transactions costs, taxes, and holding periods. Third, the efficiency of the housing market will be tested using excess returns from housing investment.

To anticipate, conclusions are summarized as follows. Expected capital gains, before taxes and commissions for commercial investors, revealed from market prices and rents are about 90% in a decade, which is more or less consistent with a historical trend. The data set for "housing for purchase" and the data set for "housing for rent" data sections were separately used for hedonic regressions. Those regressions show the effects of various determinants for housing prices and rents. The time distance for commute and floor space of the housing unit are significant determinants for the price and rent. The time (year) dummy variables in the hedonic regressions reveal increases in prices and rents in the last eleven years in Tokyo. According to these estimates, prices increased 85 to 90 percent over the 1981-92 period, while rents increased about 65 percent during the same period. The price-(annual) rent ratio rents fluctuated between 17 and 32. Finally, the weak-form efficiency of excess returns on housing is tested, and rejected.

The rest of this paper is organized as follows. Section 2 is devoted to a survey of the literature. Details of our micro data sets are explained in Section 3. Returns on short-term and long-term holdings of housing are calculated in Section 4. Hedonic functions on housing for purchase and on housing for rent are, respectively, estimated in Sections 5 and 6. Section 7 gives a simulation of prices and rents in the last twelve years of the fictitious standardized housing. A formal test of efficient market hypothesis is conducted in Section 8. Section 9 concludes the paper.

2. Literature Survey

In this section, the relevant literature, both in the United States and in Japan, is surveyed, although it is not intended to be exhaustive or comprehensive. In the literature of tenure choice, (a optimizing question of choosing between owner-occupied housing and rental housing) tax treatment regarding owning a house, a down payment constraint, and inflation are major considerations in a model. The individual chooses the lifetime consumption pattern and optimal timings of switching between rental housing and owner-occupied housing. No taxation on the imputed rents and tax deductibility (or tax credit) of interest payments on mortgage makes owning a house a better choice in the United States (or Japan). A tradeoff is between benefits of tax saving and a sacrifice on consumption during the youth years to accumulate enough down payment. In the literature, returns for rental housing and owner-occupied housing are known, and perfect foresight for future prices and rents are assumed. See Slemrod (1982) and Hayashi, Slemrod and Ito (1988) for a general introduction to the tenure choice problem.

Hendershott and Hu (1981) attempted a decomposition of benefits for home-owners from

1956 to 1979 with fixed rate mortgages into unexpected general inflation, which reduced the real value of mortgage balances, and unexpected capital gains from a house. Case and Shiller (1989, 1990), who extended a method proposed by Bailey, Muth and Nourse (1963), tested the efficient market hypothesis for owner-occupied housing with repeated sales in individual transactions data. Their innovation was largely due to their access to an individual transaction data set of multiple listing services. Case and Shiller estimated the excess returns for repeated sales of single-family homes in Atlanta, Chicago, Dallas, and San Francisco from 1970 to 1986. They showed that the excess returns, that is, returns of owning housing instead of financial instruments, were predictable with past price increases and other economic variables. The persistence in price increases in the single-family housing market, found in quarterly data, was presented as evidence for the inefficiency of the market.

Linneman (1986) estimated hedonic functions of housing price, considering characteristics of individual housing units. His data set consists of a survey of self-assessment housing values of owners in Philadelphia in 1975 and 1978. The efficient market hypothesis was tested on the price index which was estimated in the hedonic functions. Although returns were found to be high, the efficient market hypothesis was not rejected considering high transactions costs.

Case (1991) examined housing prices in Boston from 1984 to 1990. Prices skyrocketed, from 1984 to 1987 and then plummeted from 1987 to 1990. He analyzed the connection between changes in housing prices and regional economic indicators. Case (1992) examined a long-term trend in real estate prices and real household income, by region in the United States. He showed that real household incomes went up in the 1950-60s, while housing prices were stable, and that housing price boomed in stagnant real household incomes in the 1970s. These general trends of income and housing prices agree with findings in Hendershott and Hu, and Case and Shiller, cited above. He also reported that timings of housing price increases are quite different in different regions. The asynchronous nature of price increases cast some doubt on the explanation of housing price increase by baby booms and other nationwide demographic changes presented by Mankiw and Weil (1989).

In sum, three aspects of findings on the U.S. housing markets by Hendershott and Hu, Case and Shiller, and Case, are relevant from our perspectives. First, in the 1970s and 1980s, housing prices increased sharply, especially in comparison with the trend from the 1950s and 1960s, and in comparison with underlying real income increases in many cities in the United States. Timings of price increases in different regions do not necessarily coincide each other. Second, excess returns on housing were significant. Third, when the housing prices increased, the increase persisted for some time, producing autocorrelations in time series. The autocorrelation implies predictable profit opportunities, so that the efficient market hypothesis in its pure form is rejected. On the other hand Linneman argued that the efficient market hypothesis is not necessarily rejected once the transactions costs are explicitly taken into account in the model.

For Japan, many studies on land prices were conducted in the wake of land price increases in the second half of the 1980s. Iwata (1977), preceding the episode of the 1980s, is now a classic for an microeconomic analysis of the land prices determination analyzing, among others, effects of real estate (property) tax, and land use regulations (zoning) in Japan. Toward the end of the 1980s, many studies were published in connection with the rapid land price increase at the time. Among others, Iwata (1988), Noguchi (1989, 1991a), and Miyao (1989) offer various policy recommendations in order to bring down land prices with good economics analyses and logic. For the particular aspects of the impediments against efficient usage of land, Noguchi (1991b) dealt with economic effects of overprotecting tenants in the Land Lease and House Lease Law; Barthold and Ito (1992) pointed out low assessments of real estates in the inheritance taxation; Homma and Atoda (1989) showed how low the effective tax rates on real estates are in most cities in Japan; Kanemoto, Hayashi, and Wago (1987) and Takagi (1989) analyzed lock-in effects of capital gains taxation on real estates. Nishimura (1990) and Ito (1993) examined the land price movements as a possible bubble process.

None of the above-mentioned studies in Japan has used micro data of individual listings or transactions of real estate prices. Land prices are taken from indices created by national surveys done by a private agency or the Land Agency, Government of Japan.[4] The data set compiled in this paper has an advantage over an land price index in the following aspects. First, for the housing market, it is important to find "housing" prices, as opposed to "land" prices, although most of housing equities are in fact in land rather than structures. When individual investors, or even smaller real estate companies, are maximizing their portfolios of housing assets, investments are made in housing units, rather than plots of land without structures. Land prices, measured by the private and official surveys, may be relevant to large real estate developers, but housing prices, rather than land prices, are more relevant to an economic analysis of the housing market. Second, land prices in the government survey are "fair assessment" values of the designated survey points. They are not necessarily market transactions prices. It is far more desirable to take listings or transactions values rather than assessment in surveys for the purpose of economic analysis, since "assessments" may be influenced by past transactions (stale quotes) if comparable transactions did not take place in the neighborhood in the survey period.

Hence, one of the strong points of this paper rests in its high quality data of housings, compiled from listings (sales advertisement) in the market. An approach taken in this paper, starting from compiling data from market prices and proceeding to test of the efficient market hypothesis, is directly comparable to a main-stream approach in the literature on the U.S. housing market, surveyed above. This paper is, to our best knowledge, the first of such an attempt in Japan.

3. Data

Data on housing prices and characteristics are collected from the Tokyo-metropolitan edition of the Jutaku Joho, a widely-circulated weekly magazine. Before an advent of an on-line multiple listings service, which became available only a few years ago, this magazine was a primary source for individual buyers, and even for real estate agents, in the market at large.[5] Even now, the weekly widely sells to the general public looking for housing. Copies of the weekly are available at any bookstore or kiosk at every railway station. Listings in the magazine are published upon request from sellers or real estate agents. Listings are first categorized into sections of detached houses for purchase, (highrise) condominiums for purchase, housings for rent, and housings for investment. Each section is then ordered by stations of commuter railway lines. Each listing includes information on asking price, commuting time (bus and/or walk) to a nearest station, floor space (in square meters) and a very simple floor plan description (e.g. "3DK" means "3 bedroom, dining and kitchen), availability of parking space, and other optional information, such as whether the unit faces south, whether the unit is a corner unit, whether zoning prohibits renovation of structures.[6] [7]

Before details of data sets are described, caveats in using the prices listed in the Jutaku Joho Weekly are in order. First, listings are asking prices, and not actual transaction prices. (Case and Shiller used the transactions price collected from real estate multiple listing services for their studies.) If the average difference between asking and transaction prices stays constant over time, this would not be a particular concern for us. However, a conventional wisdom is that in the soft market, discounts from asking prices are likely higher than in other normal time.[8] Second, not all units in the market are listed in the Weekly. Those units which are matched with buyers through real estate agents instantly will not be listed in the Weekly. When the seller's market, those listings in the Weekly may have a bias toward those units which have been in the market for a while for some reasons. Acknowledging these caveats, the Jutaku Joho Weekly is still a best source for housing prices among any publicly available, long-time-series data in Tokyo.

We have sampled and compiled the following four kinds of data sets from Jutaku Joho:

- Data Set No. 1, Housing (units in highrise condominiums) for purchase 1981-92;

  40 sampled units on the Yamate and Chuo lines in the first week of each of the 12 years.

- Data Set No. 2, Housing (units in highrise condominiums) for rent 1981-92;

  40 sampled units on the Yamate and Chuo lines in the first week of each of the 12 years.

- Data Set No. 3, Housing (units in highrise condominiums) for investment, 1987-1992;

  all 975 units all over Tokyo listed in the investment section in the first week of the year.

- Data Set No. 4, Repeatedly-listed housing for investment, 1987-1992,

  75 units, repeatedly-listed condominium building units as a subset of Data set No. 3.

Here, it is heuristic to preview our strategy of investigation depending on the data availability. First, recall the arbitrage equation for an asset:

$$r_t = \frac{(h_{t+1} - h_t) + (1 + r_t)\ d_t}{h_t} \tag{1}$$

where r_t is the rate of return from period t to period t+1, d_t is the cash flow income (rents) by holding this asset at period t, h_t is the price of asset (housing) at period t, h_{t+1} is the price of asset (housing) at period t+1. The first term of the numerator, h_{t+1} - h_t is capital gains and the second term is (front-load) rent revenue plus associated interest income.

We have direct observations on h_{t+1}, h_t, and d_t for each of individual listings in Data Set No. 4. Hence, the rate of returns on housing is easily calculated. This rate of return can be compared to the interest rate on a financial asset to discuss whether returns on housing command extra returns (presumably as risk premium). For each listing in Data Set No. 3, the combination of h_t and d_t is observed, but not h_{t+1}. However, for some "normal" level of return, r_t, the required level of capital gains can be calculated. Although these data sets are ideal from our purpose, they are not available before 1987. In order to measure long-term changes in housing prices, rents and returns, we use Data Sets No. 1 and No.2. Since housing for purchase (Data Set No. 1) have information on h_t, while housing for rent (Data Set no. 2) have information on d_t. A hedonic regression applied to Data Set No.1 will produce the relationship between traits of a house to the price, and the estimated price increase. Similarly, another hedonic regression applied to Data Set No. 2 will produce the relationship between characteristics of a house to the rent, and the estimated rent increases. Then one way to calculate the return on housing is to infer h_{t+1}, h_t and d_t by substituting some standardized housing asset by substituting arbitrarily fixed characteristics in both hedonic regressions. This can be easily done with Data set No.4. Another way is to substitute characteristics of rental housing listed in Data Set No. 2 into hedonic regressions estimated for housing prices (Data Set No. 1), so that prices that would have been required to purchase a particular housing for rent can be estimated. By aggregating these information for all rental housing samples, we have h_t and h_{t+1}, for rental housing listings which contain already information on d_t. These avenues will be pursued in the subsequent sections.

All housing samples are taken from highrise condominium units for residence (excluding corporate dormitories, corporate housing, offices, shops, and shop-cum-residence).[9] Reasons that we used only condominium units, and avoided detached houses, are as follows. First, a typical first-time buyer in Tokyo can only afford a highrise condominium unit. Without parent's help, an average wage earner of age 35 would not be able to purchase a detached house within a reasonable commuting distance. Thus, for condominium units, there is a thick, active secondary market. Second, in order to construct an index (or a proxy) for general housing prices, condominium prices are easier than detached houses to control for characteristics of housing units, because of lesser options for alternative use of space and rather homogeneous structures of buildings for condominium units.[10]

For the first and second data sets, we have limited ourselves to listings near 20 stations on the Yamate Loop Line (or inside that Loop) and the Chuo Line. (See Figure 1.) Let us explain the reasons for this sampling locations and our assumptions about commuting time.

*** Figure 1 about here ***

The 35-kilometer, closed-loop Yamate Line, defines the boundaries of primary commercial districts, and old core of Tokyo. Many subways lines connects various points inside the Loop. Although many major corporations have headquarters in Otemachi and Marunouchi area (near Tokyo Station on the Loop), large and small office buildings are scattered around various places inside the Yamate Loop Line. From the Loop, several suburban commuter railway lines extends like spokes. Major commuter terminals, such as Shinjuku, Shibuya, and Ikebukuro, are on the Yamate Loop and act as transfer points from suburban commuter lines to subways and the Yamate line. Suburban commuter lines often define the characteristics of neighborhood.[11]

The Chuo line is one of the oldest and established commuter line. The line extends due west from the Shinjuku station, plus a section from the Shinjuku station to the Tokyo station (see Figure 1). One-train service to both Shinjuku and Tokyo stations makes the Chuo line more attractive to a lot of suburban residents. Along the Chuo line in the past fifteen years, there has been little innovation on the rush-hour train schedules, little drastic demographic or social change among residents, or residential or commercial developments.[12] This allows us to attribute coefficients of the year dummy variables in the cross-section time-series pooled regressions to general price changes of housing in Tokyo.

All data sets are composed of samples as of the first week of the calendar year.[13] We chose January for sampling, because we will later compare changes in our housing prices to those in the official survey price of land measured on January 1. (Ideally, we feel that it would be desirable to construct and analyze quarterly data.) Housing units for our first and second data sets were sampled in the following manner. We have fixed 20 stations on the Yamate and Chuo Line (see notes to Figure 1) for our sampling. In order not to bias any station for particular price range of housing, we have rotated the price range (in decile ordering) of sampling for each station: denoting, the k-th decile-priced units around j-th station (where $j = 1, 2, 3, .., 20$) on the t-th year (where $t = 1,2,3,..., 12$), one unit from $k = j-t+1$, and one unit from $k = j-t+6$ for each j-th station and t-th year are sampled, where if $11 \leq k \leq 20$, then subtract 10 from k; if $-9 \leq k \leq 0$, then add 10 to k, and if $-19 \leq k \leq -10$, then add 20 to k.[14]

Data Set No. 3 lists units "for investment." These are housing units that owners (landlords) are asking to sell while tenants may be living in the units, or tenants can be easily expected.[15] We have taken all condominium units, regardless of location, listed in the investment section of the weekly of the first week of the year. The Weekly magazine lists both price for purchase and rents that can be collected each month. For a new owner (landlord), and also for econometricians like us, housing units listed as "for investment" provide good data for investment returns on housing. Many careful studies on housing prices, such as Case and Shiller, do not have matching data for rents, so that some kind of proxies have to be improvised. Hence, our data set of housing "for investment" is a uniquely excellent source for research. A shortcoming of this data set is its relatively short history.

Data set No. 4 is a repeatedly-listed housing units "for investment"; hence it is a subset of No. 3. For each year, we have listings of housing units for investment (Data Set No. 3). Among those units, pick up units in the same condominium building (not necessarily the exactly the same units) advertized in the adjacent years. Units in the same building share most of the characteristics which determine housing values. By correcting the price for the possible difference in floor space (square meters) proportionately, changes in prices between the two years can be regarded as capital gains, without running hedonic regressions. This data set closely resembles the repeated-sale data set compiled and used by Case and Shiller, who had implemented the idea of Bailey, Muth, and Nurse. For such repeatedly-listed units, we identified 15 units for the years of 1988 and 1989, 23 units for 1989 and 1990, 25 units for 1990 and 1991, and 12 units for 1991 and 1992.

4. Excess Returns on Housing

4.A Short-term excess returns

The central concept of analysis in the following is returns on housing investment, a standard concept in the literature (see for example Hendershott and Hu, and Case and Shiller). This can be considered as a portfolio investment in real estates in comparison with financial investment, or as a returns implicit in owning a owner-occupied housing. In the frictionless world, that is, without taxes and transactions costs, returns on investment and returns on owner-occupied housing should be equal, since imputed rents can be counted as revenue cash flows.

Returns on housing investment consist of cash flow yields (rents, and any interests on rents if front-load rents) and capital gains. By dividing returns by the initial capital, the rate of return is defined. Capital gains and rents may be subject to income taxation, while holding the housing assets may be subject to property tax. (Imputed rents are not subject to income taxation in Japan as in the United States.)

The one-year excess returns on housing investment, ER, with 100 % down payment, is defined as the difference between the returns on housing and returns on financial instruments:

$$ER_t = \frac{(h_{t+1} - h_t) + (1 + (1-\tau)\, r_t)\,(d_t + RE_t)}{h_t} - (1-\tau)\, r_t \qquad (2)$$

where h is prices of a housing unit, d is rents (in a year), RE is the non-refundable key money [rei-kin] which is usually two-month rents when rental is initiated or renewed, r is the interest rate, "tau" is the income tax on the rents and interests, where the tax on interest is ignored before 1988 due to the exemption known as the maru-yu.[16] [17] Note that the property tax is ignored, because of its extremely low effective rate in Tokyo.[18] Capital gains tax is excluded on the assumption that the owner does not realize gains (buy and sell the property in one year), and that we are interested in measuring returns including unrealized gains. Transactions costs are excluded on the same assumption.

In the case of less than 100 percent down payment, the equation has to be modified so that the denominator becomes housing equity, and the interest payment has to be deducted. The down payment ratio is relatively higher in Japan than in the United States (see Hayashi, Ito, and Slemrod). We take a case of 30% down payment as a typical case for first-time house buyers. The following equation is the one-year excess returns for housing investment with 30% down payment:

$$ER_t = \frac{h_{t+1} - h_t + (1 + (1-\tau_t) r_t)(d_t + RE_t)}{0.3 h_t} - \frac{0.7}{0.3} r_t^L - (1-\tau_t) r_t \qquad (3)$$

where r^L denotes the mortgage interest rate, and mortgage payments are assumed to be interests only (the principal stays the same) for simplicity. The leverage effect would make the excess returns more volatile, for the same degree of price fluctuations.

In order to define the excess returns, we should define a yield for an alternative (financial) asset. We have tried three alternative assets: the one year time deposit interest rate, the one-year discount bank debenture interest rate, and the certificate of deposit interest rate where 3 month rates are compounded to a year. The difference between returns on housing and returns on financial assets will possibly includes risk premium for housing investment.

4.B Excess Returns Measured in Repeatedly-listed Condominium units

Using the units in Data Set No. 4, we have direct observations on h_{t+1}, h_t, and d_t. Other variables r_t, and RE_t, and r^L are also observable from the financial markets. Recall that since we have observations on prices of units in the same condominium, the observed ex post capital gains are very precise, in the sense that hedonic regressions are not required. These units are for investments, so that rents are observed for the same housing units that capital gains are measured. Therefore, excess returns are precisely measured for individual observations.

For each pair of successive years from 1988 to 1992, the average excess returns is calculated from samples using equations (1) and (2). They are summarized in Table 1. The table tabulates excess returns for different financial assets to compare against, and also for the two different cases of down payment ratio.

*** Table 1 about here ***

The table shows that excess returns fluctuate widely one year to another. Even for the case of 100 % down payment, the least fluctuating case, it fluctuate from +15% in 1989-90, to -15 % in 1991-92. If down payment is only 30%, the upper and lower bounds are like +40% and -60%.

Three observations are in order. First, the level of excess returns are not impressive as financial assets considering how much risk is involved. If the transactions costs, such as real estate agent's commissions, registration taxes and fees, are considered, investment in housing for one year does not seem to be a sound choice. Second, this may be so because years that the data for repeatedly-listed housing investment are available are after a most dramatic increase in housing prices in Tokyo (as will be shown later). Third, excess returns may be different if we consider excess returns for long-term holdings. Since it covers only five years, any conclusions on the level of excess returns may not stand up to a statistical test for a long-term implication.

4.C. Capital Gains for Long-term Holdings

In this subsection, we estimate excess returns for long-term housing investment in more realistic situations. A purpose here is to calculate expected capital gains revealed in the market information, namely the current price and the current rent, by assuming a reasonable rate of rent increase and a reasonable required rate of returns as investment, taking into account of transactions costs. Namely, suppose that an investor buys a housing unit in a condominium, and holds onto it for ten years. Then we calculate capital gains and the discounted sum of rents in the future with some discount factor. For this purpose, we use Data Set No. 3, which contains information on the current price and current rent. We may assume the future path of rents, which is not too difficult because the Land Lease House Lease Law and court cases protect tenants from sharp increase in rents. In particular, we assume the average rate of increase for rents calculated from hedonic regression on rental housing that will be shown in Section 6.

In addition to rents, the landlord collect the key money worth two-month rents at the time of rental initiation and a renewal fee of one-month rent every two years. (This is a standard practice in the Tokyo rental housing market.) The rents revenues with a sliding increase schedule once every two years and key money every two years.

$$REV1 = 14d + \frac{12d}{(1+r)} + \frac{13d(1+k)}{(1+r)^2} + \frac{12d(1+k)}{(1+r)^3} + \frac{13d(1+k)^2}{(1+r)^4} +$$

$$+ \frac{12d(1+k)^2}{(1+r)^5} + \frac{13d(1+k)^3}{(1+r)^6} + \frac{12d(1+k)^3}{(1+r)^7} + \frac{13d(1+k)^4}{(1+r)^8} + \frac{12d(1+k)^4}{(1+r)^9}$$

where k is the rate of increase (in every two years) in rents, and 14, 13, and 12 reflects whether initial key money (2-month rent) and renewal fee (1-month) are added to regular 12-month rents for every other year. A security deposit, which is equivalent to two-month rents and collected at the time of rental initiation, is assumed to be returned in full to the lessee without accumulated interests. The interest on security deposit is counted toward revenue of the landlord. The present value of this interest free loan from a tenant to a landlord is,

$$REV2 = 2dr\left[\frac{1}{(1+r)} + \frac{1}{(1+r)^2} + \ldots + \frac{1}{(1+r)^{10}}\right]$$

The last component of revenue is the sales proceed after ten years, minus any capital gains tax. The capital gains from real estate is taxed separately from other income (such as wages and salaries) in Japan. For (residential) owner-occupied property, there has been 30 million yen basic deduction for capital gains. For most housing units in our data sets, this deduction is enough to make owner-occupied capital gains tax free. Hence, we calculate cases where capital gains are not taxed. For investment property, the tax rate up to 40 million yen capital gains is 26% (20% national tax, and 6% local tax). This is the bracket for most properties in our data set. Hence, the present value of after-tax proceed of sales after ten years is,

$$REV3 = \frac{P10 - t^c(P10-P)}{(1+r)^{10}}$$

where t^c is the capital gains tax rate, which is assumed to be 0 for owner-occupied housing and 0.26 for housing for investment.

The following items are counted on the expenditure side. First, the down payment and the principal repayment after 10 years, plus mortgage payments from the first to tenth year are counted as expenditure. These numbers depend on what kind of mortgage payments schedule is chosen. Here, we assume for the sake of simplicity that the principal is held constant for ten years and paid at the same nominal value after ten years. The fixed mortgage rate r^L is assumed, and that each year the interest payments of the mortgage is made without reducing the principal. The present value of expenditure related to the mortgage is,

$$mP + (1-m)P/(1+r)^{10} + (1-m)Pr^L\{1/(1+r) + 1/(1+r)^2 + \ldots + 1/(1+r)^{10}\},$$

where m is the down payment ratio. In the following, we assume down payment is 30 percent of the housing price, m=0.3.

There are taxes, fees, and commissions at the time of housing acquisition. We assume 6.822 percent of the housing value is paid for these kinds of transactions costs.[19] In addition, property [real estate] tax will be assessed every year. The assessment value of housing for housing is known to be lower than the market value. For the owner of real estates in Tokyo, two kinds of taxes are assessed on each of structures and land, the real estate tax and the city planning tax. The effective rate for the real estate tax is calculated as follows. First, the effective real estate tax rate on structures is calculated as the total tax revenues on such structures divided by the total market values of structures (an average of 1987-1990).[20]

Second, for the real estate tax on land, two cases are simulated, 50% and 25%.[21] We also assume that the effective city planning tax rate on structures and land is calculated as the total city planning taxes divided by the total values of land and structures (an average of 1987-90). A half of the condominium price is assumed to be assessed in structures and half in land. Hence, the expenditures are summarized as

$$EXP = P \times \left[m + \frac{(1-m)}{(1+r)^{10}} + (1-m)\, r^{L} \left[\frac{1}{(1+r)} + \frac{1}{(1+r)^{2}} + \ldots + \frac{1}{(1+r)^{10}} \right] \right] +$$

$$+ P \times \left[0.068222 + \left[0.00037 + \frac{0.00549}{2} + \frac{t^{L}}{2} \right] \times \right.$$

$$\left. \times \left[1 + \frac{1}{(1+r)} + \frac{1}{(1+r)^{2}} + \ldots + \frac{1}{(1+r)^{9}} \right] \right]$$

where the first and second terms in the first large bracket are the present value of the down payment and principal payment after ten years, the third is the stream of mortgage interest payments. The first term in the second large bracket is the one-time commissions and fees, while the second term reflect the present value of real estate and city planning taxes for this year and in the future.

The P10 which equates revenues (REV1+REV2+REV3) with expenditures (EXP) is the expected price in 10 years, revealed from the current price and the current rent of this particular property. Then, the capital gains over ten years, (P10-P)/P, can be tabulated easily for four different cases, depending on the effective capital gains tax rate and the effective real estate (land) tax rate, as Table 2.

*** Table 2 about here ***

Take, for example, a cell in Case 1 (land assessment is 50% of the market value and capital gains tax will be assessed at 26% when sold ten years later), column 0.05 (required rate of return), the row of 1991. The table shows that investors must have anticipated that the after-tax value of property (condominium unit) will increase by 78 % in ten years. The standard error of the cross-section data is 0.1227, so that we may safely conclude that the "revealed capital gains" range (with one standard deviation) from 66% to 90%. For a small investor whose alternative investment opportunity is financial instruments like CDs, the first column is appropriate. The expected before-tax capital gains range from 65% to 80%, for the year of 1988 to 1992.

If the required rate of return is higher, then the revealed capital gains has to be higher. Whether land is assessed at 50% or 25% of the market value (contrast of case 1 with case 2, or of case 3 with case 4) changes little for the expected capital gains, since the tax rate is low and the portion of land in condominium unit is small.

If capital gains tax is exempt (that is, they are within the 30 million yen basic deduction of owner-occupied housing), the expected capital gains can be much less, ranging from 40% to 50% (CD rate as the required rate of return) as shown in Cases 3 and 4. In other words, if a household expects that the condominium unit will appreciate in its value by more than 50% in ten years, it is financially better to purchase the unit and live there rather than renting it and investing money in financial instruments. If the unit is purchased by a landlord to have a tenant live there, the threshold is much higher, that is, 80% of price increase has to be expected in order to justify investment in such a unit.

Capital gains calculated above is the expected capital gains to justify the price and the rent observed in the market, and the required rate of return. Due to the short period of data, we cannot test whether capital gains were ex post realized as expected. This kind of capital gains expectation are at least consistent with the trend from the past, because the condominium price has increased more than 80% in the past ten years, as will be shown in later sections. Put differently, the current level of housing price is affected by the expected future housing price (or the difference, capital gains). If expectations are formed according to the so-called extrapolative manner (extending the past trend into the future), then prices of condominium units with associated rents are justified.

As emphasized in Introduction, the absolute level of housing may not be an interesting point, but the price-rent ratio is an important variable from the financial investment viewpoint. This section showed that even with an apparently high price-rent ratio, the ratio can be justified as reasonable by the high capital gains expectation consistent with the historical trend. If history shall repeat itself, or so investors expect, the current high level of housing prices should not be judged irrational or inflated by a bubble.

This conclusion has several caveats. First, the housing price does not rise gradually. As it is well known, and confirmed in later sections, housing prices suddenly increase for one or two years, while they are rather stable for several consecutive years. (This kind of movement is common to any asset prices, such as stock prices and foreign exchange rates.) Hence, the ten-year investment scheme described above will pay off, given that the ten-year holding period includes the spell of sudden increases. Historically, the sudden, sharp increase in land prices in Tokyo occurred in 1961-62, 1973-74, and 1986-87, about once in a decade.[22] Anyone who held the land through these periods were better off. In sum, the exercise here should be qualified for its ten-year holding period which includes a sharp increase in housing prices.

Second, although both the high price level and the high price-rent ratio seem to be justified by large expected capital gains, which are consistent with the historical trend, there is still a possibility that land prices in Japan is inflated by a bubble. Those who think that the fundamentals explain land prices would point out that changes in fundamentals (slower income growth and demographic changes) in the future will force down the land and housing price. It will occur sometime in the first half of the next century. (The population in Japan is expected to peak out around 2010.) However, it should also be noted that if the land supply is limited and the demand ever grows, by social inflows of households and corporations into Tokyo, it is consistent with the fundamentalist view to expect that the Tokyo land price may increase forever.[23]

5. Hedonic Regressions of Housing for Purchase

5.1 Housing Characteristics

Although repeatedly-listed housing units, analyzed above, are ideal in that they list both prices and rents for individual units, the data have been available only since 1987. Hence, the volatile price movement during the mid-1980s cannot be analyzed. In order to analyze the price and rent movements and to construct ex post returns through the 1980s, we will run hedonic regressions for housing for purchase and housing for rent. We will run time-series, cross-section pooled regressions with the calendar year dummy variables as well as various characteristics of housing units.[24]

Table 3 is the results of hedonic regressions for housing for purchase (Data Set no. 1), showing the coefficients of housing characteristics, but without reporting the coefficients of year dummy variables which will be analyzed later. The price on the left-hand-side of the regressions is in logarithms, while explanatory variables are not in logarithm. The total samples include housing units near stations on the Yamate Loop and Chuo lines from 1981 to 1992. All samples, and split samples were tried to see coefficient stability with respect to locations. Three different specifications are attempted in order to check robustness with respect to which characteristics are important.

*** Table 3 about here ***

The regressions are in general a success judging from high R squares and signs of coefficients in agreement with our theoretical prediction. The coefficient on the age of the building in the tables implies that the typical condominium unit in the Tokyo metropolitan area tend to depreciate in its value by 1.4% every year. However, the depreciation rate is lower for units on the Yamate Loop than units on the Chuo line. This may be the case because the proximity to business centers may override the economic depreciation of buildings.

On the condominium units along the Chuo Line, 10 more minutes on train for commuting to Shinjuku will depreciate the value by 16%.[25] For units from which a bus ride is required to a station on the Chuo Line, a 10 minute bus ride implies a 20% reduction in price. The amount of price reduction is larger for time on bus than for time on train, because taking bus involves the transfer at the train station (while transfer time is not included in commuting bus time) and the frequency of bus service is much less than train service in the late evenings. An increase in floor space by 10 squares meters raises the price by 22 percent. If the unit is on the first floor, the price is 11.6% less than other units on the second floor or up in the same building with same floor plan. These results are quite robust with respect to different specifications.

The housing units in the RC (reinforced concrete) is valued less than SRC (steel reinforced concrete), reflecting that fact that the former is a cheeper construction method.

For housing units on the Chuo Line, facing south or southeast is valued with a 10 percent premium. This effect is not detected for housing units on the Yamate Loop. Since it is more crowded along the Yamate Loop, there may be the case that facing south (or southeast) on the Yamate Loop does not guarantee sunshine for long hours due to adjacent high buildings.[26] Another possibility is that housing units on the Yamate Loop may be used as a combination of residence and business (home) office, or a second house while main residence is located far away from downtown Tokyo. In any case, it is interesting to find that characteristics valued on the Yamate Loop and the Chuo Line are slightly different. Other characteristics, such as a closet space, storage space availability, sunroom, roof balcony, a small garden, recent renovation, furnished (or not), facing east, were found insignificant in regressions.

5.2 Price Increases

The price increase (over the base year, 1981) in condominium units, after controlling for characteristics, along the Yamate and Chuo lines is estimated by the coefficient of calendar year dummy variables of the hedonic regression (all samples, specification (1), and Chuo Line). They are translated into year-to-year price increases, as shown in Table 4.

*** Table 4 about here ***

In addition to housing price increases estimated from our hedonic regressions, the land price increase of "official land price" [koji chika] surveyed by the Land Agency are shown for comparison. The land price increase in official land price by region and by commuter line is shown in Land Agency (1992).

One startling evidence in Table 4 is a gradual decline in housing prices from 1981 to 1984 and a sharp decline in 1991-92. The beginning of the 1980s, the official land prices tend to be increasing slightly. However, our housing price data shows the decline. For the 1991-92 period, both housing and land prices show a sharp decline. The discrepancy between the official land price and our housing price may be partly due to the difference between land and housing structures, and partly due to the method of pricing. The official land price for a particular point is assessed value from the general market movement in the neighborhood, but it is not necessarily the market asking or transaction prices, while our data are actual market asking price. It is likely that our data are more sensitive to the actual market movement.

The infamous sharp increase in land prices in 1986-88 indeed affected housing prices too. It is evident, both in land prices and housing prices, that the increase started inside the Yamate Loop and then spread to the suburbs like the Chuo Line. Our estimation show that housing prices, after controlling for characteristics, doubled in two years from 1986 to 1988.

It is now clear that the decline in housing price from 1991 to 1992 was as dramatic as the price increase in the mid-1980s. Housing prices on the Yamate Loop declined on average by 40% in a year, while housing prices along the Chuo line declined only about 14%. Even with these sharp price decline in 1991-92, the (nominal) housing prices increased about 90% in eleven years from 1981 to 1992. During the same eleven years, the wholesale price index declined by 10 percent, and the consumer price index increased by 20%.

6. Hedonic Regressions of Housing for Rent

In this section, hedonic regressions are used for housing units for rent (Data Set No. 2). Table 5 show results of such regressions, without reporting year dummy variables. Significant characteristics for determining rents are found to be commuting time, floor space and recent renovation, although some sings of renovation were wrong and insignificant.

*** Table 5 about here ***

On the Chuo line, an increase in commuting time by 10 minutes will decrease the rent by 16 percent, while rents will decrease only by 11 % for the housing units on the Yamate Loop. An increase in floor space by 10 square meters increase rents by 21 percent. These results are quite similar to those for housing for purchase. These results are also robust with respect to specification, namely whether another variable such as renovation or parking space is added. Recent renovation on the unit increase the rent by 13.3% and the availability of parking space will increase the price by 4.1%. Other characteristics, such as building age, on the first floor, with balcony, with a sunroom, piano allowed, kids allowed, corner unit, furnished, garden, women only, did not produce significant coefficients.

Increases in rents inferred from the coefficients of the year dummy variables are shown in Table 6. Rent increased gradually over the decade except for 1985-86 and 1988-89 when it declined. Changes in rents are much less volatile than changes in prices. It is also striking that for years 1981-82, 1983-84, 1991-92, when housing prices declined, rents were increasing. In particular, in 1991-92, when prices declined more than 20%, rents increased by more than 8 percent. The year 1987-88 was the only one that a large increase in prices coincided with a large increase in rents. Although it is difficult to make a general conclusion from 11 years of data, an increase in rents seem to have come after an increase in prices. Over the eleven years, rents increased about 65%.

*** Table 6 about here ***

7. Price and Rent of the Standardized Property

As we have estimated the hedonic functions for housing prices and rents, we can simulate any price and rent for the (fictitious) property with specific characteristics from 1981 to 1992. It is heuristic to calculate the absolute levels of prices and rents, rather than increases as done in preceding sections. Let us define the "standardized" housing as follows: a condominium unit 5 minute walk to the Mitaka station which is on the Chuo line (between Kichijoji and Musashisakai) and 18 minutes by train from Shinjuku station, with a floor space of 60 square meters, in the SRC building built in 1980, facing south on the second floor or up, without parking space. The time-series of price and rent levels are calculated from hedonic functions estimated above, and shown in Table 7.

*** Table 7 about here ***

The above-described property could be bought for 36.3 million yen in 1981, but the price went up to 69.5 million yen by 1991. A major increase in prices occurred in 1987 and 1988. Note that the price change here is slightly different from those in Table 4. In Table 4, the price increase was controlled for the age of the building, hence for the same age of the building every year, while, in Table 7, the age advances every year, as the standardized unit is fixed for the assumed building built in 1980.[27] The monthly rent was about 12,000 yen for the standardized unit and it became 15,000 yen in the mid-1980s and then 19,000 yen by 1992. It is notable that rents increased in 1984 and 1985 when prices were stable or slightly declined. These numbers, generated by our model, seem to be in a broad agreement with a casual observation of the local listings.

Rents are steadily increasing, while prices are volatile -- for example sharply increasing in one year and decreasing somewhat the year later. The relative movement of prices and rents is succinctly captured by the price-earning (rent) ratio, PER, defined by the price divided by twelve-month rents. The PER increased when prices went up, and then it declined as rents caught up with prices slowly. The average PER for the 12 years was 25, with the upper bound being at around 31 and the lower bound at around 17. The level of PER indicates that it was clearly high from 1988 to 1991. The correction came with both increasing rents and a sharp decline in price in 1992. At least judged from Table 7, the PER is almost back at the normal level, average of 12 years by 1992.

Rents are often fixed for two years, and the increase is often modest, as mentioned earlier. However, this institutional feature is not the reason that our data show only slow, but steady increase in rents. Our data (Data Set No. 2) are taken from new listings of vacant housing units for rent, thus free from "stickiness" caused by long-term contracts. Suppose, as a working hypothesis, that rents on new listings showed the rapid change in one year and zero change in other years, just like housing price movements. Even in that case, a survey on rents of existing renters would show the "stickiness" because some of the existing renters carry over old rents.[28] In sum, our findings suggest that rents of new listings are indeed slowly, steadily increasing, while prices jump in certain years, while rather stable in other years. The price-rent ratio (PER) fluctuates accordingly around the stable ratio.

8. Weak-form Efficiency of the Housing Market

In this section, we will test the weak-form efficiency, in the sense of Fama (1970), of the housing market. First, we will calculate the excess return from the housing and rental price time-series calculated by hedonic regression.[29] Second, we will formally test the efficient market hypothesis, that is, the excess returns are on average zero and unpredictable (hence no autocorrelation). It is more widely accepted that the financial market with small transactions costs, such as the foreign exchange market and the stock market, are efficient. The efficiency of the housing market is still controversial.

Recall that the returns on the one-year housing investment is defined as the sum of the rents plus capital gains to housing investment $\{(h_{t+1} - h_t) + (1+r_t)d_t\}$ divided by initial investment, h_t. Although hedonic regressions of housing for purchase and of housing for rent produce the price and rent index, they are not necessarily comparable for the same asset, so that h_t and d_t cannot be used for the calculation of returns. One possible solution would be to define the standardized housing as was done in the preceding section. Another way, which we think better, is to substitute characteristics of rental housing data into the hedonic regressions of housing for purchase, to derive the hypothetical sales prices, h_{t+1}, h_t for housings for rent. Since we are using rental housing data set, rent d_t is available. These numbers are available for each housing for rental.

The excess returns are defined as the difference between the returns and some financial asset. As a financial asset to be compared, we will take the interest rate of the time deposits, of discount bank debentures, or of certificate of deposits. Let us denote the excess returns to housing investment by ER_t, as defined by equation (2) for 100 % down payment, and by equation (3) for 30% down payment, which were derived in Section 4. Then the efficient market hypothesis can be tested as the ER_t to be uncorrelated with any public information available at time t, including the past excess returns, ER_{t-1}, j=1,2,...n . It is called the weak-form efficiency if the expected value of excess returns are zero (or a constant if certain risk premium should be allowed), and deviations from zero (or a constant risk premium) are not correlated from past returns.

The excess returns are calculated for each of rental housing, using the estimated hedonic price regressions, then averaged over the year. The excess returns, for a given financial asset for comparison, is reported in Table 8.

*** Table 8 about here ***

The excess returns shown in Table 8 can be compared to the excess returns in Table 1, which was calculated taking advantage of Data Set 3, without running the hedonic regressions at all. The patterns of increase and decrease in excess returns in the two tables, are the same, and levels are also similar, although Table 1 shows the higher values in 1990-91. This is encouraging since the two tables are calculated in totally different methods.

Excess returns were regressed on the constant and the one-period-lagged excess returns, in order to check for the first-order serial correlation.

$$ER_t = \alpha + \gamma ER_{t-1} + u_t$$

The null hypothesis of weak-form efficiency is a restriction of both coefficients be zero. Table 9 shows the results of estimation and test. In our data, the weak-form efficiency is not rejected in regular ordinary least squares. But, standard errors may not be correct in the presence of lagged endogenous variable. Hence, we should rather use a robust standard errors corrected for possible heteroskedasticity. When the robust standard errors are used, the null hypothesis is rejected, suggesting statistically significant autocorrelations in excess returns, or the predictability in the next period of excess returns. However, the result is qualified in that the sample is rather short (twelve annual data points) to make a conclusive statement using standard errors based on asymptotic theory.

*** Table 9 about here ***

Case and Shiller rejected the efficiency hypothesis by finding a significantly positive coefficient on the lagged dependent variable. One important difference is that they managed to use quarterly data, while our data is only annual data. Our efficiency test in this section does not take into account transactions costs, taxes, or fees. Hence, as the efficiency is found violated in our case, it does not necessarily mean that there was an unexploited short-term profit opportunity in the market. But, it does show that some potential owner-occupied household, a long-term investor, did not seize the timing of purchase optimally.

Our contribution is to show an analysis similar to Case and Shiller is possible in Japan, and excess returns are not necessarily persistently positive or on average large in magnitude, however contrary it is to the popular belief. Although the risk of fluctuation is large, the tendency of excess returns to be autocorrelated leads to a rejection of the weak-form efficient market hypothesis.

9. Concluding Remarks

This paper investigated the prices, rents, and excess returns in the Tokyo (high rise) condominium housing units along the Yamate Loop and Chuo lines. In eleven years from 1981 to 1992, the price went up about 90%, while the rent went up about 65%, controlling for the quality (characteristics) of housing. As a long-term investment asset, housing does not seem to provide enough cash flows (rents). Relatively low rents are compensated by the large expected capital gains, and large expected capital gains are not inconsistent with the historical trend. This is reflected in the pricing of housing. Excess returns calculated by two different methods show a significant fluctuations during the sample period. Although housing investment yields higher returns on average than investment in financial instruments (bank deposits and debentures), the unpredictability in the excess returns movement and high volatility one year to next makes the weak-form efficient market hypothesis not rejected.

This paper is the first attempt using individual listings data in Japan. There are several ways to extend methods developed in this paper. One obvious extension is to compile and analyze quarterly data. This will help both assessing the persistence and volatility of excess returns and produce a higher statistical power in the weak-form inefficiency. Another extension is to sample more locations along with different commuter lines. This would be desirable to see locational discrepancy in the valuation of different housing characteristics. There was some of this feature evident in comparing housings along the Yamate Loop and housings along the Chuo line. Discrepancy in timings of price increases, which might suggest a lack of geographical arbitrage (inefficiency), can be analyzed and tested if we had more locational points in quarterly data. These extensions, though important, are left for the future research.

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Notes:

1. The next national five-year economic plan has a stated objective to lower the housing price to "five times the salary."

2. Noguchi (1987) observed that downtown Tokyo's first-rate business properties are traded ten times the City's properties, while Tokyo rents are only twice the City's.

3. Another possibility is some tax wedge between rental and owner-occupied housing. See Hayashi, Ito, and Slemrod (1988) for comparative descriptions of tax related to owner-occupied housing in Japan and in the United States. See Barthold and Ito (1992) for comparative descriptions of inheritance (estate) taxes. The paper describes holding housing properties are lightly taxed for inheritance in Japan.

A tax break for owning rental properties as investment would make landlords willing to rent housing at a reasonable rents, and some tax factors for a special premium for owner-occupied housing (to accept low imputed rents).

4. For land price indices readily available in Japan, see Data Appendix to Chapter 14 of Ito (1992).

5. If a buyer is determined to find housing in a particular neighborhood, it is best to go real estate agents in that neighborhood. However, in order to decide which neighborhood to look for housing with some budget constraint, this magazine is perfect. Advertisers cater for those buyers and agents.

6. No one but a very few executives (with chauffeurs) commutes by car to downtown Tokyo. Commuter lines more than city boundaries often define characters of neighborhood. The availability of parking space is important for automobile owners, because one cannot even register a car without a certificate of off-street parking space. Facing south is usually preferred due to better access for sunshine. Sunshine is important because many residents do not have an access to a dryer, although almost every household has a washing machine.

7. For rental units in 1981-84, there are units that lack information on measured floor space. For those units, we have translated floor plan to floor space, using the formula we have estimated from other units which have both information.

8. Sellers in a soft market are known to ask too high a price and only reluctantly lower the price or accept a low-price offer after several months of no result. The February 12, 1992 issue of the Jutaku Joho has an article on changes in the difference between listing prices of Jutaku Joho and transactions prices (the last listing price before eliminated from computer listing) in 1991. The average difference in 1991 when the prices were on the sharp decline was 25% of listing prices. If such kinds of data are available every year, we may be able to correct listing prices into transactions prices.

9. Highrise condominiums in Japan are typically called "mansions." There are typically between five to ten stories high and with 15 to 60 housing units in the same building, but some of more recent ones have higher and larger structures.

10. The land portion in housing price is much less in a highrise condominium unit than in a detached house. A condominium price, unlike a detached house, would not reflect any option value of land, or a lack of it, for an alternative use, an extension possibility of floor space, improvement on interiors and so on. The height, the cubic maximum of a possibly renovated housing structure may be limited depending on the width of road facing the plot of land, and other zoning factors. Factors which determine detached houses are much more complicated than those mentioned in Jutaku Joho. It would need a more careful choice of variables for the analysis. The quality of structures are more or less homogeneous for highrise condominium units. The age of the building, as a proxy for depreciation of structures, would be an important variable. Hence, their prices reflect straightforwardly the locational premiums for commuting and for neighborhood characteristics.

11. It is widely known that housings on some commuter lines command higher values for the same commuting time to the Yamate Loop. They are regarded to be defined by which terminal of the Yamate Loop the commuting line is connected to, by various amenities along the commuting lines (frequency of trains, availability of express trains, whether there are suburban-type shopping malls near one of the stations), by school districts, and by income classes of residents.

12. One of the changes was the renovation of the Kokubunji station, and the newly-added tracks made it possible for the special rapid service to stop at the station during the daytime and evening hours. However, this did not affect train schedules of the morning rush hours.

13. The market information of the first week of the year is listed usually in the weekly published in the third week of January.

14. The order of stations is, Ochanomizu, Iidabashi, Yotsuya, Nakano, Ogikubo, Kichijoji, Musashisakai, Musashikoganei, Kunitachi, Tachikawa, Hachioji, Akihabara, Nishinippori, Sugamo, Mejiro, Shinjuku, Shibuya, Meguro, Shinagawa, and Shinbashi. The first year of sampling was 1981 and the last 1992.

15. The Land Lease and House Lease law and court precedents heavily protect tenants. By law and precedents, it is extremely difficult for a landlord to terminate house leases unless a lessee voluntarily terminates it. Even though a standard house lease is for two years, the lease is presumed to be automatically renewed at the end of the lease, so long as the tenant wishes to

stay. It is also extremely difficult for a landlord to raise the rent level (in order to price out tenants), because, if a tenant protests, the court would not allow rent hikes beyond cost increases or beyond an average of neighborhood rent increases. The latter aspect will be handy to guess the long-term stream of rents in the future.

16. There is also refundable security deposits when rental is initiated. Since it is refundable, it is not included in the excess return equation. However, interests from deposits could be included in the equation, since often security deposits are returned without interests (unlike the United States, where many states require landlord to pay interests on security deposits). On the other hand, security deposits are often not returned in full for normal depreciations on tatami mats in addition to obvious damage to the property. Hence, a question on interests is rather minor. There is no way to estimate how much of security deposits is returned, we ignore this portion, by assuming that a landlord does not make any excess returns on security deposits.

17. For institutional details of the maru-yu system, see Ito (1992; p. 272).

18. The statutory property tax rate is 1.4%. First, an assessment value may be lower than the market value. Second, a further reduction is available for small-scale, owner-occupied housing. The average effective rate is less than 0.5% for small-plot, owner-occupied housing.

19. The average price of housing units listed "for investment" was 36,743,134 yen. By assuming that the assessment value for acquisition tax and real estate tax is half of the market value, the tax and fees can be calculated as follows. The national stamp tax, for a receipt of transactions, is 20,000 yen; the registration fee for the real estate would be 5 % payable at the local government; and the acquisition tax on real estate is 3 percent of real estate assessment (half of market value) after 45 million yen deduction, $\{(36,743,134*0.5)-45,000,000\}*0.03 = 416,147$ yen. In addition, the commission for arranging a mortgage payable at the bank is 30,000 yen; the registration commission payable to an real estate assistant lawyer is 19,600 yen. The sum of tax, fees, and commissions above add up to 1,404,325 yen. Divide this by the house price 36,743,134 yen yields 3.822%. Lastly, the real estate agent's commission paid by the buyer is assumed to be 3 percent.

20. The source for tax revenues are from White Paper on Local Taxes, and the source for the total values of land and structures is Annual Report on National Accounts.

21. This corresponds to the following rule of sum. The official survey land price [koji chika] is about 70% of the market value, the real estate assessment value is about 70 % of the official survey land price. There is a further reduction on assessment value of small-plot, owner-occupied housing, about 50%.

22. See Ito (1992, chapter 14).

23. See Ito (1993) for such a model.

24. For applications of hedonic regressions, see, for example, Griliches (1961) for U.S. automobiles, Ohta (1978) for Japanese automobiles, and Berndt and Griliches (1990) for computers. Gillingham (1975) analyzed rents in 10 U.S. cities using hedonic regressions, and Linneman (1986) analyzed housing prices by a survey of self-assessment in Philadelphia. Census Bureau uses hedonic regressions for the "price index of new one-family houses sold" in National Income and Products Account.

25. Hatta and Ohkawara (1992) studied the land prices along the Chuo Line. They estimated the effect of commuting time distance on land prices in the non-linear form, so that the direct comparison with our result of housing prices in linear form is not appropriate. Hatta and Ohkawara estimated that at the point of 25 minutes from Shinjuku on Chuo line trains, an additional 10 minutes imply the reduction of 18 percent in price, and at the point of 45 minutes from Shinjuku, additional 10 minutes imply a 21 percent decline in land prices.

26. Sunshine is important to dry your laundry and to avoid excessive humidity and mold during the rainy season (June-July) every year.

27. Put differently, the price change in Table 4 does not include depreciation due to aging of the building, while the price change in Table 7 does include such depreciation.

28. Other data on rents, such as the Consumer Expenditure Surveys may suffer from the problem of stickiness. One caveat to our argument is that even in new listings, rents in one room may not be too different from rents in other units in the same building, if the building are solely for rental housing (like apartment housings). However, the listings (condominium units for rent) are mostly in the buildings where owner-occupants and renters are mixed. Hence this is not the issue.

29. Ideally, we would like to test the efficiency of the market from the Data Set No. 3 and No. 4, which list both prices and rents for each listings, so that hedonic regressions are not necessary. However, we have only five years of such data. Possibly, we may compile quarterly data and will also accumulate data for a few more years to have enough degrees of freedom.

Figure 1, Sample sites for housing prices

			Distance	Time
1.	Ochanomizu,	Inside the Yamate Loop,	n.a.	0
2.	Iidabashi,	Inside the Yamate Loop,	n.a.	0
3.	Yotsuya,	Inside the Yamate Loop,	n.a.	0
4.	Akihabara	On the Yamate Loop	n.a.	0
5.	Nishinippori	On the Yamate Loop	n.a.	0
6.	Sugamo	On the Yamate Loop	n.a.	0
7.	Mejiro	On the Yamate Loop	n.a.	0
8.	Shinjuku	On the Yamate Loop	n.a.	0
9.	Shibuya	On the Yamate Loop	n.a.	0
10.	Meguro	On the Yamate Loop	n.a.	0
11.	Shinagawa	On the Yamate Loop	n.a.	0
12.	Shinbashi	On the Yamate Loop	n.a.	0
13.	Nakano	On the Chuo Line	4.4km	5 min
14.	Ogikubo	On the Chuo Line	8.4km	10 min
15.	Kichijoji	On the Chuo Line	12.2km	14 min
16.	Musashisakai	On the Chuo Line	16.0km	20 min
17.	Musashikoganei	On the Chuo Line	18.3km	22 min
18.	Kunitachi	On the Chuo Line	23.7km	27 min
19.	Tachikawa	On the Chuo Line	27.2km	30 min
20.	Hachioji	On the Chuo Line	37.1km	40 min

Distance: Geographical distance of a Chuo line station to Shinjuku station, on which Chuo line reaches the Yamate Loop Line.

Time: Time required on a Chuo Line train from a Chuo Line station to Shinjuku station during the morning commuting hours.

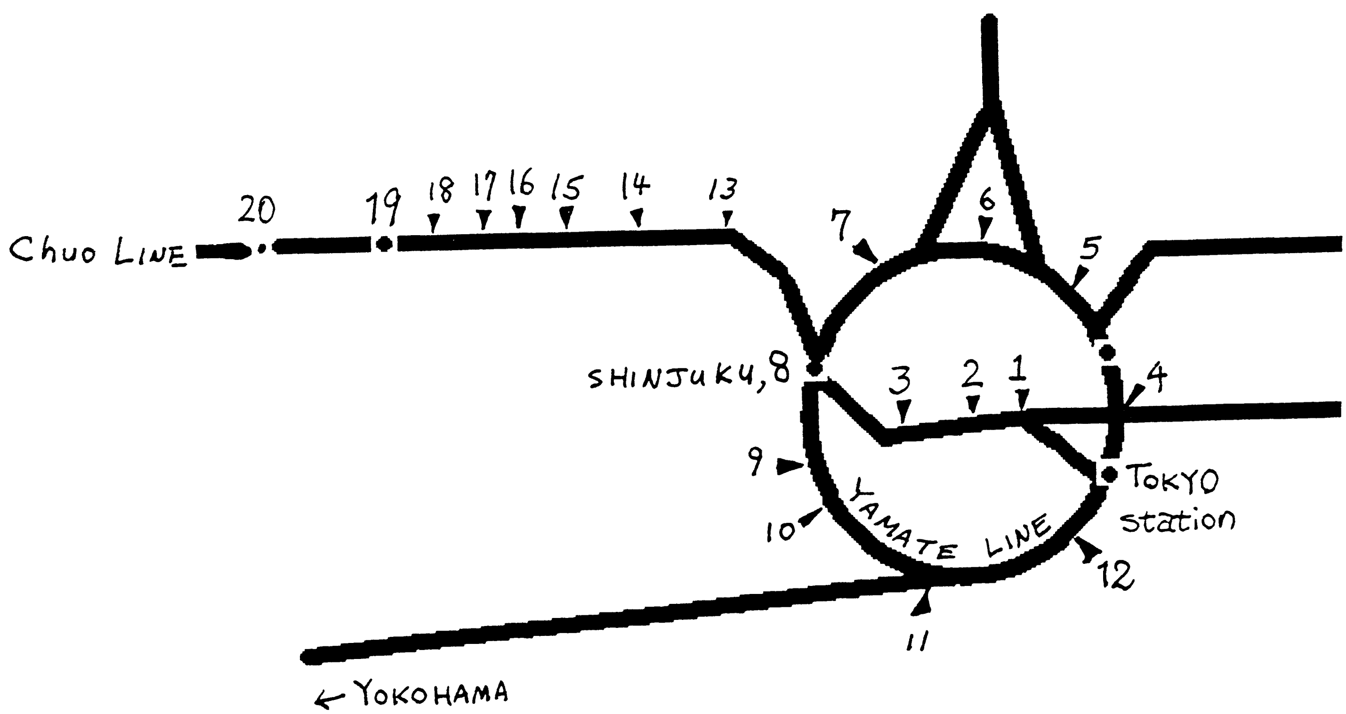

Table 1

Excess Returns from Repeatedly-listed, Investment properties

unit = %

		Paid in Full			Downpayment 30%		
year	N	Time Depeposit	Discount Bank Deb.	CD	TD	secur	CD
1988-89	15	1.00	0.74	-0.12	-4.14	-4.37	-5.16
1989-90	23	15.09	14.73	13.35	41.26	40.93	39.68
1990-91	25	10.07	9.76	7.26	25.13	24.84	22.54
1991-92	12	-14.97	-15.76	-16.36	-57.87	-58.60	-59.15
weighted average	75	5.79	5.40	3.87	10.94	10.58	10.04

Notes: Excess returns, paid in full, are defined as

$$ER_t = \frac{(h_{t+1} - h_t) + (1 + (1-\tau) r_t)(d_t + RE_t)}{h_t} - (1-\tau) r_t$$

Excess returns, with 30% downpayment, are defind as

$$ER_t = \frac{h_{t+1} - h_t + (1 + (1-\tau_t) r_t)(d_t + RE_t)}{0.3 h_t} - \frac{0.7}{0.3} r_t^L - (1-\tau_t) r_t$$

where subscript t or t+1 refer to the year

ER = excess return
h = housing price
r = interest rate
r^L = housing loan rate
d = annual rents
RE = key money (additional one-time, 2 months-worth rents)
tau = tax rate on interest income
N = number of observations

Time deposit = interest rate on the one-year time deposits (regulated rate).
Discount Bank Debenture = interest rate on one-year discount debenture notes issued by city banks.
CD = interest rate on certificate of deposits (3 month rate assumed to be rolled over for a year).
The housing prices, h_t and h_{t+1} for the repeatedly-listed properties are defined as housing units in the same high-rise condomium (not necessarily the exactly same unit) after proportionately adjusting for the difference for floor spaces.

Table 2

Revealed Expected Capital Gains

Expected Capital Gains, calculated by (P10-P)/P

Assumptions:

	Land Property [Real Estate] Tax Assessment,	Capital Gains Tax on Real Estate
Case 1,	50% of Market	26%
Case 2,	25% of Market	26%
Case 3,	50% of Market	0%
Case 4,	25% of Market	0%

	Required rate of return							
Case 1	CD rate	0.02	0.03	0.04	0.05	0.06	0.07	0.08
1987	0.3604 (0.3104)	0.1818 (0.2613)	0.2318 (0.2755)	0.2866 (0.2906)	0.3463 (0.3067)	0.4115 (0.3237)	0.4825 (0.3418)	0.5598 (0.3611)
1988	0.6670 (0.1740)	0.4398 (0.1465)	0.5039 (0.1544)	0.5736 (0.1629)	0.6492 (0.1719)	0.7312 (0.1815)	0.8202 (0.1916)	0.9165 (0.2024)
1989	0.6378 (0.1423)	0.4152 (0.1198)	0.4780 (0.1263)	0.5462 (0.1332)	0.6203 (0.1406)	0.7008 (0.1484)	0.7880 (0.1567)	0.8825 (0.1655)
1990	0.7598 (0.5166)	0.5179 (0.4348)	0.5863 (0.4585)	0.6605 (0.4836)	0.7409 (0.5104)	0.8280 (0.5388)	0.9224 (0.5689)	1.0245 (0.6010)
1991	0.8009 (0.1242)	0.5525 (0.1046)	0.6228 (0.1103)	0.6989 (0.1163)	0.7815 (0.1227)	0.8709 (0.1296)	0.9676 (0.1368)	1.0722 (0.1445)
1992	0.6644 (0.1881)	0.4376 (0.1583)	0.5016 (0.1669)	0.5712 (0.1761)	0.6467 (0.1858)	0.7286 (0.1962)	0.8173 (0.2071)	0.9135 (0.2188)

Case 2	CD rate	0.02	0.03	0.04	0.05	0.06	0.07	0.08
1987	0.3422 (0.3104)	0.1684 (0.2613)	0.2171 (0.2755)	0.2704 (0.2906)	0.3285 (0.3067)	0.3919 (0.3237)	0.4610 (0.3418)	0.5362 (0.3611)
1988	0.6488 (0.1740)	0.4265 (0.1465)	0.4892 (0.1544)	0.5574 (0.1629)	0.6314 (0.1719)	0.7116 (0.1815)	0.7986 (0.1916)	0.8929 (0.2024)
1989	0.6196 (0.1423)	0.4019 (0.1198)	0.4633 (0.1263)	0.5300 (0.1332)	0.6025 (0.1406)	0.6812 (0.1484)	0.7664 (0.1567)	0.8589 (0.1655)
1990	0.7416 (0.5166)	0.5046 (0.4348)	0.5716 (0.4585)	0.6443 (0.4836)	0.7231 (0.5104)	0.8084 (0.5388)	0.9008 (0.5689)	1.0008 (0.6010)
1991	0.7827 (0.1242)	0.5392 (0.1046)	0.6080 (0.1103)	0.6827 (0.1163)	0.7636 (0.1227)	0.8513 (0.1296)	0.9461 (0.1368)	1.0846 (0.1445)
1992	0.6462 (0.1881)	0.4243 (0.1583)	0.4869 (0.1669)	0.5550 (0.1761)	0.6288 (0.1858)	0.7090 (0.1962)	0.7958 (0.2071)	0.8899 (0.2188)

Table 2, continued.

Case 3	CD rate	0.02	0.03	0.04	0.05	0.06	0.07	0.08
1987	0.1887 (0.2297)	0.0565 (0.1933)	0.0936 (0.2039)	0.1341 (0.2150)	0.1783 (0.2269)	0.2265 (0.2396)	0.2791 (0.2530)	0.3363 (0.2672)
1988	0.4156 (0.1288)	0.2475 (0.1084)	0.2949 (0.1143)	0.3465 (0.1206)	0.4024 (0.1272)	0.4631 (0.1343)	0.5289 (0.1418)	0.6002 (0.1498)
1989	0.3940 (0.1053)	0.2293 (0.0886)	0.2757 (0.0935)	0.3262 (0.0986)	0.3811 (0.1040)	0.4406 (0.1098)	0.5051 (0.1160)	0.5750 (0.1225)
1990	0.4843 (0.3823)	0.3053 (0.3218)	0.3559 (0.3393)	0.4108 (0.3579)	0.4703 (0.3777)	0.5347 (0.3987)	0.6046 (0.4210)	0.6801 (0.4447)
1991	0.5147 (0.0919)	0.3309 (0.0774)	0.3829 (0.0816)	0.4392 (0.0861)	0.5003 (0.0908)	0.5664 (0.0959)	0.6380 (0.1012)	0.7155 (0.1069)
1992	0.4137 (0.1392)	0.2459 (0.1171)	0.2932 (0.1235)	0.3447 (0.1303)	0.4005 (0.1375)	0.4611 (0.1452)	0.5268 (0.1533)	0.5980 (0.1619)

Case 4	CD rate	0.02	0.03	0.04	0.05	0.06	0.07	0.08
1987	0.1752 (0.2297)	0.0466 (0.1933)	0.0827 (0.2039)	0.1221 (0.2150)	0.1651 (0.2269)	0.2120 (0.2396)	0.2631 (0.2530)	0.3188 (0.2672)
1988	0.4021 (0.1288)	0.2376 (0.1084)	0.2840 (0.1143)	0.3345 (0.1206)	0.3892 (0.1272)	0.4486 (0.1343)	0.5130 (0.1418)	0.5827 (0.1498)
1989	0.3805 (0.1053)	0.2194 (0.0886)	0.2648 (0.0935)	0.3142 (0.0986)	0.3679 (0.1040)	0.4260 (0.1098)	0.4892 (0.1160)	0.5575 (0.1225)
1990	0.4708 (0.3823)	0.2954 (0.3218)	0.3450 (0.3393)	0.3988 (0.3579)	0.4571 (0.3777)	0.5202 (0.3987)	0.5886 (0.4210)	0.6626 (0.4447)
1991	0.5012 (0.0919)	0.3210 (0.0774)	0.3720 (0.0816)	0.4272 (0.0861)	0.4871 (0.0908)	0.5519 (0.0959)	0.6221 (0.1012)	0.6980 (0.1069)
1992	0.4002 (0.1392)	0.2360 (0.1171)	0.2823 (0.1235)	0.3327 (0.1303)	0.3873 (0.1375)	0.4466 (0.1452)	0.5109 (0.1533)	0.5805 (0.1619)

(standard errors) in brackets

Table 3: Hedonic Regressions of Owner-occupied Units

	All samples (Yamate and Chuo)			Yamate Line		
	Spec (1)	Spec (2)	Spec (3)	Spec (1)	Spec (2)	Spec (3)
Constant	7.048 (112.553)	7.053 (110.531)	7.056 (110.984)	6.824 (57.473)	6.882 (57.069)	6.884 (57.046)
Commute	-0.014 (-17.066)	-0.015 (-16.651)	-0.014 (-15.583)	-0.002 (-0.247)	-0.003 (-0.435)	-0.002 (-0.325)
floor space	0.022 (32.873)	0.022 (29.680)	0.022 (29.804)	0.022 (10.665)	0.023 (18.896)	0.023 (18.777)
bldg age	-0.014 (-5.178)	-0.014 (-5.236)	-0.015 (-5.432)	-0.004 (-0.712)	-0.003 (-0.613)	-0.004 (-0.702)
1st floor	-0.116 (-2.673)	-0.114 (-2.606)	-0.094 (-2.103)	-0.179 (-1.877)	-0.103 (-1.042)	-0.086 (-0.848)
pkg space	---	0.043 (0.605)	0.040 (0.565)	---	-0.028 (-0.243)	-0.032 (-0.271)
face S.E.	---	-0.046 (-1.018)	-0.048 (-1.061)	---	-0.220 (-2.574)	-0.069 (-1.077)
face S.	---	0.016 (0.497)	0.023 (0.701)	---	-0.072 (-1.132)	-0.069 (-1.077)
RC struc.	---	---	-0.066 (-2.101)	---	---	-0.054 (-0.905)
R sq. SEE	0.844 0.300	0.844 0.300	0.845 0.300	0.830 0.360	0.834 0.356	0.834 0.356

Table 3, continued

	Chuo Line			Chuo Line		
	Spec (1)	Spec (2)	Spec (3)	Spec (1')	Spec (2')	spec (3')
constant	7.221 (108.261)	7.192 (108.292)	7.195 (108.801)	7.205 (105.26)	7.171 (105.12)	7.175 (105.42)
commute ttl	-0.016 (-19.814)	-0.016 (-19.788)	-0.016 (-18.981)	---	---	---
com, train	---	---	---	-0.0162 (-16.66)	-0.0163 (-16.78)	-0.0161 (-16.39)
com, bus	---	---	---	-0.0215 (-3.34)	-0.0222 (-3.51)	-0.0205 (-3.20)
com, walk	---	---	---	-0.0131 (-3.44)	-0.0125 (-3.33)	-0.0123 (-3.27)
floor space	0.022 (27.632)	0.021 (25.324)	0.021 (25.465)	0.0221 (27.511)	0.0213 (25.27)	0.0214 (25.35)
bldg. age	-0.020 (-7.877)	-0.021 (-8.171)	-0.021 (-8.350)	-0.0192 (-7.22)	-0.0200 (-7.54)	-0.0206 (-7.71)
1st floor	-0.155 (-3.876)	-0.151 (-3.785)	-0.136 (-3.357)	-0.1483 (-3.65)	-0.1440 (-3.58)	-0.1324 (-3.24)
pkg. space	---	0.112 (1.401)	0.113 (1.413)	---	0.1044 (1.305)	0.1056 (1.32)
face SE	---	0.094 (2.125)	0.088 (1.979)	---	0.0974 (3.19)	0.0913 (3.34)
face S	---	0.096 (3.018)	0.102 (3.212)	---	0.1017 (3.19)	0.1066 (3.34)
struc RC	---	---	-0.055 (-1.799)	---	---	-0.0482 (-1.57)
R sq. SEE	0.884 0.222	0.888 0.218	0.889 0.217	0.884 0.222	0.889 0.218	0.889 0.217

NOTES
Commute: Minutes of commuting to any railway station on the Yamate Line by walk, bus and train (on Chuo line). Practically, for housing on the Yamate Line, "Commute" is equal to minutes by walk to the nearest railway station on the Yamate Line; and for housing on the Chuo Line, "Commute, total" is equal to the sum of minutes by train, bus, and walk, required to reach the Shinjuku station (the station on the intersection of the Chuo and Yamate Line), without counting for minutes for transfer and waiting for a bus or a train; "Commute, train," "Commute, bus" and "Commute, walk" are, respectively, minute by each transportation required to reach Shinjuku station.

Floor space: in square meters.
Bldg age: the age of the condominium building.
1st floor: a dummy variable, = 1 if the unit is on the first floor.
pkg space: a dummy variable, = 1 if there is parking space available.
face S.E.: a dummy variable, = 1 if the unit faces out southeast of the building.
face S. : a dummy variable, = 1 if the unit faces out south of the building.
RC struc.: a dummy variable, = 1 if structure is reinforced concrete.
other buildings are SRC (steel reinforced concrete).

(t-statistics) in brackets

Coefficients on time dummy (calendar year) not reported here, see next table.

Table 4: Year-to-year Housing Price Increase revealed from hedonic regressions

Data Source	Our data	Our data	Koji Chika	Our data	Koji Chika
Location	Chuo and Yamate	Chuo	Chuo and Ohme	Yamate	Yamate
Specif.	Spec (1)	Spec (1)	n.a.	Spec (1)	n.a.
1981-82	-5.01	-0.70	6.6	-12.60	7.1
1982-83	-8.41	-14.31	3.8	2.69	6.0
1983-84	-1.33	5.54	2.9	-12.80	6.8
1984-85	4.45	2.67	2.2	8.74	11.1
1985-86	10.32	5.08	4.4	16.17	21.4
1986-87	59.61	44.85	36.7	83.55	95.2
1987-88	31.24	47.04	71.4	4.35	15.0
1988-89	-2.18	-0.85	-6.1	-4.30	-4.5
1989-90	19.03	13.64	-0.7	30.85	-0.3
1990-91	6.78	6.79	-0.3	7.59	-1.0
1991-92	-25.82	-18.74	-7.1	-40.12	-15.5
1981-92	90.12	91.01	145.9	85.13	192.4

Price increases with our data are inferred from coefficients of time dummy vaiables.

Table 5: Hedonic Regressions of Rental Housing

	All samples (Yamate and Chuo)			Yamate Line		
	Spec (1)	Spec (2)	Spec (3)	Spec (1)	Spec (2)	Spec (3)
Constant	1.430 (30.073)	1.430 (30.165)	1.443 (29.602)	1.338 (16.915)	1.347 (17.173)	1.358 (16.916)
Commute	-0.014 (-19.170)	-0.014 (-18.984)	-0.014 (-19.213)	-0.011 (-2.601)	-0.012 (-2.235)	-0.011 (-2.078)
Floor space	0.021 (48.394)	0.021 (48.460)	0.021 (41.823)	0.022 (30.172)	0.022 (30.381)	0.021 (25.206)
Renovation	---	0.133 (1.802)	---	---	0.181 (1.991)	---
Pkg space	---	---	0.041 (1.152)	---	---	0.084 (1.357)
R sq. SEE	0.893 0.213	0.893 0.213	0.893 0.213	0.865 0.242	0.868 0.240	0.866 0.242

	Chuo Line			Chuo Line		
	Spec (1)	Spec (2)	Spec (3)	Spec (1')	Spec (2')	Spec (3')
Constant	1.573 (24.773)	1.573 (24.726)	1.587 (24.143)	1.592 (24.716)	1.592 (24.688)	1.613 (24.128)
Commute total	-0.016 (-19.718)	-0.016 (-19.695)	-0.016 (-19.678)	---	---	---
Commute train	---	---	---	-0.014 (-15.486)	-0.014 (-15.466)	-0.014 (-15.529)
Commute but	---	---	---	-0.027 (-6.025)	-0.027 (-6.036)	-0.028 (-6.123)
Commute walk	---	---	---	-0.020 (-6.409)	-0.020 (-6.433)	-0.020 (-6.509)
Floor Space	0.021 (38.638)	0.021 (38.567)	0.021 (33.757)	0.021 (38.992)	0.021 (38.937)	0.021 (34.015)
Renovation	---	-0.117 (-0.623)	---	---	-0.136 (-0.729)	---
Pkg space	---	---	0.036 (0.854)	---	---	0.048 (1.165)
R sq. SEE	0.915 0.184	0.915 0.184	0.915 0.184	0.918 0.181	0.917 0.181	0.918 0.181

Commute: Minutes of commuting to any railway station on the Yamate Line by walk, bus and train (on Chuo line). Practically, for housing on the Yamate Line, "Commute" is equal to minutes by walk to the nearest railway station on the Yamate Line; and for housing on the Chuo Line, "Commute, total" is equal to the sum of minutes by train, bus, and walk, required to reach the Shinjuku station (the station on the intersection of the Chuo and Yamate Line), without counting for minutes for transfer and waiting for a bus or a train; "Commute, train," "Commute, bus" and "Commute, walk" are, respectively, minute by each transportation required to reach Shinjuku station.

Table 6: Rent increased inferred from rental housing hedonic functions

	All samples	Yamate	Chuo
1981-82	13.71	17.81	6.64
1982-83	2.62	3,26	-0.53
1983-84	13.90	25.70	9.06
1984-85	2.34	-12.12	11.42
1985-86	-1.87	-0.05	-0.46
1986-87	3.36	-1.02	6.32
1987-88	15.52	19.61	10.77
1988-89	-1.96	3.07	-4.73
1989-90	5.04	-4.84	13.13
1990-91	3.98	4.43	2.98
1991-92	8.18	14.36	3.90
Ref 1981-92	64.81	69.76	58.52

Table 7: Simulated Price and Rent for a Standardized housing

Standardized housing: 5 minute walk to the Mitaka station, which is 18 minutes away from the Shinjuku station by a Chuo-line train; 60 square meters, 2nd floor or higher, facing south, without parking, and structure is SRC.

Price and Rent are "fitted value" in the hedonic equations for the Chuo Line.

PER is the (annual) price-earning ratio, that is, Price/(12xRents).

	Price	Rents	PER
1981	36,288,920	120,720	25.05
1982	35,320,358	113,369	25.96
1983	30,629,787	112,897	22.61
1984	31,676,500	137,967	19.13
1985	31,764,049	151,152	17.61
1986	32,109,279	150,932	17.61
1987	48,638,648	159,402	25.42
1988	64,874,224	172,059	31.42
1989	63,229,901	167,051	31.54
1990	67,125,248	184,248	30.36
1991	69,490,564	187,534	30.88
1992	61,014,997	190,452	26.70
average			25.36

Table 8 Excess Returns in one year

	100 % down payment			30 % down payment		
	time deposit	Discount bank debentures	CD	time deposit	Discount bank debentures	CD
1981-82	-8.56	-9.46	-9.41	-33.10	-33.62	-33.57
1982-83	-9.84	-10.43	-10.71	-37.67	-38.16	-38.40
1983-84	-1.92	-2.51	-2.96	-12.74	-13.22	-13.59
1984-85	6.51	5.92	5.50	15.63	15.16	14.82
1985-86	14.67	14.08	13.68	43.66	43.20	42.88
1986-87	60.60	60.36	60.65	196.90	196.71	196.95
1987-88	19.12	18.86	18.54	56.12	55.89	55.60
1988-89	-0.23	-0.48	-1.35	-8.24	-8.47	-9.24
1989-90	11.33	10.97	9.59	28.71	28.38	27.16
1990-91	4.05	3.74	1.28	5.05	4.77	2.57
1991-92	-13.41	-14.19	-14.78	-52.69	-53.38	-53.90
average	7.48	6.99	6.37	18.33	17.93	17.39