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EFFICIENCY OF THE TOKYO HOUSING MARKET

Takatoshi Ito

Keiko Nosse Hirono

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Cambridge, MA 02138
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ABSTRACT

In analyzing the dynamics of Tokyo housing price, we have compiled annual micro data sets from individual listings in a widely-circulated real estate advertising magazine. A data set compiled from "properties for investment" lists both asking (sales) prices and rents for the same properties. With such data, a price-rent ratio is directly observable and expected capital gains before tax and commissions found to be just less than 90% in ten years. The "repeatedly-listed properties for investment" data set, a subset of the first, 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 sets for "housing for sale" and "housing for rent" sections were separately used for hedonic regressions, from which we constructed hedonic price and rent indexes. These regressions show the effects of various determinants of housing prices and rents. The time (year) dummy variables in the hedonic regressions give estimates of price and rent increases in the last 11 years in Tokyo. According to these estimates, prices increased 85-90% over the 1981-92 period, while rents increased about 65%. The price-(annual) rent ratio rents appears to have fluctuated between 17 and 32. Finally, the weak-form efficiency of excess returns on housing is rejected. However, the conclusion is tentative considering the short sample.

Takatoshi Ito
National Bureau of Economic Research
1050 Massachusetts Avenue
Cambridge, MA 02138

Keiko Nosse Hirono
Hitotsubashi University
4-8-24, Kajigaya
Takatsu-ku, Kawasaki 213
JAPAN

1. Introduction

Tokyo's extremely high housing prices are well known. It is indeed a social problem that typical housing for the average wage earner [salaryman] and his family is about eight times his annual salary.[1] However, an interesting phenomenon from the economic point of view is not the absolute level of housing prices but the high price-rent ratio. The absolute level of land prices is determined by demand and supply, and high productivity and limited supply can explain high prices as in downtown Tokyo, midtown Manhattan, the City of London, central Paris, and their inner suburbs. What seems peculiar to Tokyo is that rents (both for land and premises) are not as high as purchase prices compared to other cities.[2]

The price-annual rental ratio (a reciprocal of direct return on investment) for typical housing is found to be about 25 in Tokyo which means a return of about 4% a year, much lower than long-term government bond coupon rates. The high price-rent ratio must imply high expected capital gains.[3] It is thus important to collect and analyze data regarding rents and (ex post and expected) capital gains, in addition to housing prices.

A micro data set, which contains individual listings or transactions, is preferred to analyze the efficiency of 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 such analysis using housing data for Japan. The purpose of this paper is threefold. First, individual listing data is compiled from the widely-circulated (200,000 copies weekly in 1992) housing advertising magazine, Shukan Jutaku Joho [Housing Information Weekly], which contains sections on housing for rent, sale, and investment. The rental and sale listings are analyzed by hedonic regressions to estimate changes from 1981 to 1992. The investment property section lists both the price (that the current owner is asking) and rent (that the investor can collect from the existing or future tenant) for the same property, making it possible to observe directly the price-rent ratio. Second, returns on housing investment are 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.

The conclusions can be summarized as follows. Expected capital gains, before taxes and commissions for commercial investors, revealed by market prices and rents, are about 90% a decade, which is more or less consistent with the historical trend. "Housing for sale" and "housing for rent" data were separately used for hedonic regressions which show the effects of various determinants of housing prices and rents. Commuting time/distance and floor space are significant determinants of price and rent. Time (year) dummy variables reveal price and rent increases in the last eleven years in Tokyo: prices increased 85-90% over the 1981-92 period, while rents increased about 65%. The price-(annual) rent ratio rents fluctuated between 17-32. 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 are calculated in Section 4. Hedonic functions of housing for sale and for rent are, respectively, estimated in Sections 5 and 6. Section 7 simulates prices and rents in the last 12 years of fictitious standardized housing. A formal test of the efficient market hypothesis is conducted in Section 8. Section 9 concludes the paper.

2. Literature Survey

In this section, 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 concerning tenure choice (an optimizing question of choosing between owner-occupied and rental housing), tax treatment regarding owning a house, downpayment constraint, and inflation are major considerations in a model. See Slemrod (1982) and Hayashi, Slemrod and Ito (1988) for a general introduction to tenure choice and its application to Japan.

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 transaction data. Their innovation was largely due to their access to individual transaction data (multiple listing services). Case and Shiller estimated excess returns for repeated sales of single-family homes in Atlanta, Chicago, Dallas, and San Francisco from 1970 to 1986. They showed that excess returns, i.e. returns from 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 of market inefficiency.

Linneman (1986) estimated hedonic functions of housing price, considering characteristics of individual housing units. His data set consisted of a survey of owner-assessed housing values in Philadelphia in 1975 and 1978. The efficient market hypothesis was tested on the price index estimated by the hedonic functions. Although returns were found to be high, the efficient market hypothesis was not rejected considering high transaction 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 1950s and 1960s while housing prices were stable, and that housing prices boomed when real household incomes were stagnant in the 1970s. These general income and housing price trends agree with findings in Hendershott and Hu, and Case and Shiller, cited above. He also reported that the timing of housing price increases was different from region to region. The asynchronous nature of price increases cast some doubt on housing price increases being caused by baby booms and other nationwide demographic changes as presented by Mankiw and Weil (1989).

In sum, three aspects of the findings regarding 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 compared with the 1950s and 1960s, and in comparison with underlying real income increases in many cities in the United States. The timing of price increases in different regions does not necessarily coincide. Second, excess returns on housing were significant. Third, when housing prices increased, the increase persisted for some time, producing autocorrelations in time series. Such 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 transaction costs are explicitly taken into account in the model.

Many studies on land prices in Japan 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 microeconomic analysis, analyzing, among other things, effects of real estate (property) tax and land use regulations (zoning). Toward the end of the 1980s, many studies were published about the rapid land price increase at the time. Among others, Iwata (1988), Noguchi (1989, 1991a), and Miyao (1989) offer various policy recommendations to bring down land prices based on good economic analyses and rationality. Regarding particular aspects of impediments to the efficient utilization of land, Noguchi (1991b) discussed the economic effects of overprotecting tenants in the Land Lease and House Lease Law; Barthold and Ito (1992) pointed out the low assessment of real estates for inheritance tax proposes, Homma and Atoda (1989) showed how low effective tax rates on real estate are in most cities in Japan; Kanemoto, Hayashi, and Wago (1987) and Takagi (1989) analyzed the lock-in effects of capital gains taxation on real estate. Nishimura (1990) and Ito (1993) examined land price movements as a possible bubble process.

None of the above-mentioned studies used micro data regarding individual listings or real estate transaction prices. Land prices are taken from indices compiled by national surveys carried out by a private agency or the government's Land Agency.[4] The data set compiled in this paper has an advantage over a land price index in the following aspects. First, for the housing market, it is important to determine "housing" prices, as opposed to "land" prices, although most equity is in fact in land rather than structures. When individual investors, or even smaller real estate companies, are maximizing portfolios of housing assets, investments are made in housing units, rather than plots of land without structures. Land prices, measured by 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 designated survey points; they are not necessarily market transaction prices. It is far more desirable to take listings or transaction values than survey assessments 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 is its high quality housing data compiled from market listings (sales advertisements). The approach taken, from compiling data from market prices and proceeding to test the efficient market hypothesis, is comparable to the mainstream approach adopted by literature on the U.S. housing market. This paper is, to our best knowledge, the first such attempt in Japan.

3. Data

Housing price data is from the Tokyo metropolitan edition of the Jutaku Joho, a widely-circulated weekly magazine. Before the advent of an on-line multiple listing service, which became available only a few years ago, this magazine was a principal source for individual buyers, and even for real estate agents.[5] Even now, it enjoys wide sales being available at any bookstore or railway station kiosk. Listings, published upon request from sellers or real estate agents, are categorized into detached houses for sale, (high rise) condominiums for sale, housing for rent, and housing for investment. Each section is then ordered by nearest railway station.

Each listing includes asking price, commuting time (bus and/or walk) to the nearest station, floor space (square meters), and simple floor plan description, availability of parking space, and other information, such as whether the unit faces south, whether a corner unit, whether zoning prohibits renovation, etc.[6] [7]

Before details of data sets are described, caveats in using the prices listed in the Jutaku Joho are in order. First, listings are asking prices, and not actual transaction prices. (Case and Shiller used the transaction prices 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, it is conventional wisdom that, in a soft market, discounts from asking prices are likely higher than in normal times.[8] Second, not all units on the market are listed--units instantly matched with buyers through real estate agents will not appear. When a seller's market, listings may have a bias toward units which have been on the market for a while. Acknowledging these caveats, the Jutaku Joho is still the best source for housing prices available.

We have compiled four data sets from Jutaku Joho:

- Data Set No. 1, Housing (units in high rise condominiums) for Sale, 1981-92;

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

- Data Set No. 2; Housing (units in high rise condominiums) for Rent, 1981-92;

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

- Data Set No. 3, Housing (units in high rise condominiums) for Investment, 1987-1992;

all 975 units in 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 units as a subset of Data Set No. 3.

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

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

where r_t is the rate of return from period t to period t+1, d_t is cash flow income (rents) by holding this asset at period t, h_t is the price of the asset (housing) at period t, and h_{t+1} is the price of the 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-loaded) rent income plus related interest income.

We have direct observations on h_{t+1}, h_t, and d_t for each individual listing in Data Set No. 4. Hence, the rate of return on housing is easily calculated, and which can be compared to the interest rate on a financial asset to determine whether it commands 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 for our purposes, they are not available before 1987.

In order to measure long-term changes in housing prices, rents and returns, we used Data Sets No. 1 and No. 2. Since housing for sale (Data Set No. 1) contains information on h_t, and housing for rent (Data Set No. 2) information on d_t, a hedonic regression applied to Data Set

No.1 produces a relationship between characteristics of a house to the price, and estimated price increase; similarly, another regression applied to Data Set No. 2 produces the relationship between characteristics of a house to the rent, and estimated rent increase. Then, one way to calculate return on housing is to infer h_{t+1}, h_t and d_t by substituting some arbitrarily fixed characteristics in both price and rent equations. Alternatively, we 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 particular rental housing can be estimated. By aggregating information for all rental housing samples, we have h_t and h_{t+1}, for rental housing listings which already contain information on d_t. These avenues will be pursued in subsequent sections.

All housing samples are taken from high rise condominium units for residence (excluding corporate dormitories, corporate housing, offices, shops, and shop-cum-residences).[9] Reasons for only using condominium units, and avoiding detached houses, are as follows. First, a typical first-time buyer in Tokyo can only afford a high rise condominium unit. Without parental help, an average wage earner aged 35 cannot afford 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 to handle than those of detached houses because of fewer options in terms of alternative usage and rather homogeneous structure.[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 (Figure 1).

*** Figure 1 about here ***

Within the 35-kilometer Yamate Loop are primary commercial districts, and old Tokyo as well as developed subway network. Although many major corporations have headquarters in Otemachi and Marunouchi (near Tokyo Station on the Loop), large and small office buildings are scattered all over. Several suburban commuter railway lines have their terminals on the Loop--Shinjuku, Shibuya, Ueno, and Ikebukuro, are major transfer stations from suburban commuter lines to subways or the Yamate Loop. Suburban commuter lines often define the characteristics of a neighborhood.[11]

The Chuo line is one of the oldest, extending west from Shinjuku Station and from there to Tokyo Station in the heart of the business district which makes it attractive to a lot of suburban residents (Figure 1). In the past 15 years, there has been little innovation with respect to rush hour schedules and few big changes in terms of demographics and residential and commercial developments,[12] which allows us to attribute coefficients of year dummy variables in 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 of land prices as of January 1. (Ideally, we feel 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 chosen 20 stations on the Yamate Loop and Chuo Lines (see notes to Figure 1) for our sampling. In order not to bias any station for a particular price range of housing, we rotated the price range (in decile ordering) of sampling for each station: for the k-th decile-priced unit around j-th station (where $j = 1, 2, 3,.., 20$) on the t-th year (where $t = 1, 2, 3,.., 12$), sample one unit from $k = j-t+1$, and one unit from $k = j-t+6$

for each j-th station and t-th year, 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 units that owners (landlords) want to sell while tenants may be living in them, 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 magazine lists both sales prices 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 research source, but a shortcoming is its relatively short history.

Data Set No. 4 comprises 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 these, we selected units in the same condominium building (not necessarily the same units) advertized in 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 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 1988 and 1989, 23 for 1989 and 1990, 25 for 1990 and 1991, and 12 for 1991 and 1992.

4. Excess Returns on Housing

4.1 Short-term Excess Returns

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

Return on housing investment consists of cash flow yields (rents, and any interest if frontloaded) and capital gains, divided by initial amount of capital. Capital gains and rents may be subject to income taxation, while housing assets held 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% downpayment, is defined as the difference between return on housing and return on financial instruments:

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

where h is the price of a housing unit, d is rent (per year), RE is the non-refundable key money [rei-kin] which is usually two-months rent when the lease is initiated or renewed, r is the interest rate, "Tau" is income tax on rent and interest, where tax on interest is ignored before 1988 due to exemption (maru-yu).[16] [17] Note that property tax is ignored because of an extremely low effective rate in Tokyo.[18] Capital gains tax is excluded on the assumption that the owner does not realize gains (buying and selling in one year), and that we are interested in measuring returns including unrealized gains. Transaction costs are excluded on the same assumption.

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

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

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

In order to define 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 CD interest rate is calculated from its 3-month rates compounded quarterly. The difference between return on housing and return on financial assets will possibly include risk premium for housing investment.

4.2 Excess Returns on Repeatedly-listed Condominium Units

Using the units in Data Set No. 4, we have direct observations for h_{t+1} as well as h_t, and d_t. Other variables (r_t, RE_t, and r^L) are also observable from financial markets. Since we have observations for prices of units in the same condominium, observed ex post capital gains are very precise in the sense that hedonic regressions are not required. These units are for investment, so rents are observed for the same housing units that capital gains are measured.

Therefore, excess returns are precisely measured for individual observations.

For all pairs of consecutive years from 1988 to 1992, average excess returns (on the basis of full payment and 30% downpayment) are calculated from samples using equations (1) and (2) and compared with different financial assets as in Table 1.

*** Table 1 about here ***

The table shows that excess returns fluctuate widely from one year to another. Even in the case of full payment there is fluctuation from +15% in 1989-90 to -15% in 1991-92. With only 30% downpayment, the upper and lower limits are more like +40% and -60%.

Three observations can be made. First, the level of excess returns is not impressive in terms of financial assets considering how much risk is involved. If transaction costs, such as real estate agent 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 because data for repeatedly-listed housing investment are available only after a most dramatic increase in housing prices in Tokyo (as will be shown later). Third, excess returns may be different if we consider returns for long-term holdings. Since only five years are covered, any conclusions on the level of excess returns may not stand up to a statistical test for a long-term implication.

4.3. Capital Gains on Long-term Holdings

In this subsection, we estimate excess returns for long-term housing investment in more realistic situations. The purpose is to calculate expected capital gains revealed from market information, namely current price and rent, by assuming a reasonable rent increase rate as well as rate of return on investment, taking into account transaction costs. Suppose an investor buys a condominium unit, and holds it for ten years, we calculate capital gains and the discounted sum of future rent utilizing some discount factor. For this we use Data Set No. 3, which contains current price and rent information. We can/know future rents with some certainty because the Land Lease House Lease Law and legal precedent protect tenants from sharp increases. We have assumed the average rate of rent increase as calculated from hedonic regression on rental housing (Section 6).

In addition to rent, landlords receive key money equivalent to two-month's rent upon the start of a lease and a renewal fee of one-month's rent every two years (standard practice in the Tokyo rental housing market). Rents and key money increase 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 (every two years) in rent, and 14, 13, and 12 reflect whether initial key money (two-month's rent) and renewal fee (one month) are added to the regular 12-month rent every other year. A security deposit, equivalent to two-month's rent and collected at lease inception, is assumed to be returned in full to the lessee without interest. The interest on this deposit is the 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 sales proceeds after ten years minus any capital gains tax.

Capital gains from real estate are taxed separately from other income (such as wages and salaries) in Japan. For (residential) owner-occupied property, there has been a ¥30 million basic deduction for capital gains. For most housing units in our data sets, this deduction is enough to make capital gains from owner-occupied units tax free. Hence, we calculate cases where capital gains are not taxed. For investment property, the tax rate up to ¥40 million capital gains is 26% (20% national tax, and 6% local tax) and is the bracket for most properties in our data set. Hence, the present value of after-tax sales proceeds 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 on the expenditure side: first, the downpayment and principal repayment after ten years, plus mortgage payments from the first to tenth year (these depend on what kind of schedule is chosen). For the sake of simplicity we assume that the principal is held constant for ten years and paid at the same nominal value after ten years. A fixed mortgage rate r^L is assumed and annual interest payments on the mortgage we made without reducing the principal. The present value of expenditure related to the mortgage is,

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

where m is the downpayment ratio. In the following, we assume downpayment is 30% of the housing price, m=0.3.

We assume transaction costs such as taxes, fees, and commissions at the time of acquisition to total 6.822% of the sales price.[19] In addition, property [real estate] tax will be assessed every year. Assessment values are lower than market values. In Tokyo, real estate tax and city planning tax are assessed on structures and land. The effective real estate tax rate is calculated as follows. First, the effective rate on structures is calculated by dividing total tax revenues from such structures by their total market value (an average for 1987-90).[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 total city planning taxes divided by their total value (an average of 1987-90), and that structures and land each account for half of the condominium priced. Hence, 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 downpayment and principal payment after ten years, and the third is the stream of mortgage interest payments. The first term in the second large bracket comprises one-time commissions and fees, while the second term reflects 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 ten years, revealed from the current price and the current rent of this particular property. Then, 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 in Table 2.

*** Table 2 about here ***

Take, for example, a cell in Case 1 (land assessment is 50% of 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 for 1991. The table shows that investors must have anticipated that the after-tax value of property (condominium unit) would increase 78% in ten years. The standard error of the cross-section data is 0.1227, so that we may safely conclude that "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 1988 to 1992.

If the net required rate of return is higher, then revealed capital gains have to be higher. Whether land is assessed at 50% or 25% of market value (contrast Case 1 and Case 2, or Case 3 and Case 4) has little effect on expected capital gains since the tax rate is low and the portion of land per condominium small.

If capital gains tax is exempt (that is, within the ¥30 million basic deduction for owner-occupied housing), expected capital gains would be much less, ranging from 40% to 50% (CD rate as the required rate of return) as shown in Cases 3 and 4, i.e. if a household expects a condominium to appreciate more than 50% in ten years, it is financially better to purchase it and live there rather than renting it and investing in financial instruments. If the unit is purchased for rental, the threshold is much higher, that is, an 80% price increase has to be expected to justify the investment.

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

As emphasized in the Introduction, the price-rent ratio, not the absolute level of housing, 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 because of the expectation of substantial capital gains consistent with the historical trend. If history repeats itself, as investors expect, the current high level of housing prices should not necessarily be judged irrational or as being inflated by a bubble.

Two caveats are in order. First, housing prices do not rise gradually. As it is well known, and confirmed in later sections, housing prices suddenly increase for one or two years, and then are rather stable for several years. (This kind of price movement is common to any asset, such as stocks and foreign exchanges.) Hence, the ten-year investment scheme described above will pay off, given that the ten-year holding period includes a period when prices suddenly sport. Sudden, sharp increase in land prices were seen in Tokyo in 1961-62, 1973-74, and 1986-87, about once every decade.[22] In sum, the results obtained from this should be qualified for the 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 a possibility that land prices in Japan are still inflated by the long sustained bubble. Those who believe that fundamentals explain land prices would point out that future changes in fundamentals (slower income growth and demographic change) will force down land and housing prices sometime in the first half of the next century. (Japan's population is expected to peak around 2010.) Then a population decline forces housing price to go down in a logic similar to Mankiw and Weil (1989). However, it should also be noted that if land supply is limited and demand continues to grow reflecting the inflow of households and corporations into Tokyo, then it is consistent with the fundamentalist view to expect that land prices in Tokyo will may increase forever.[23]

5. Hedonic Regressions of Housing for Sale

5.1 Housing Characteristics

Although repeatedly-listed housing units, analyzed above, are ideal in calculating returns, data has only been available since 1987. Hence, the volatile price movement during the mid-1980s cannot be analyzed. In order to analyze price and rent movements and to construct ex post returns through the 1980s we ran hedonic regressions, one for "for sale" and one for "for rent", which are time series cross-section pooled regressions with calendar year dummy variables as well as various characteristics of housing units.[24] The price on the left-hand-side of the regressions is in logarithms, while explanatory variables are not in logarithm.

Table 3 gives the results of hedonic regressions for housing for sale (Data Set No. 1), showing the coefficients of housing characteristics, where the coefficients of year dummy variables are not reported to save space. The total samples include housing units near stations on the Yamate Loop and Chuo Line from 1981 to 1992. All samples, and split samples, were tried to find coefficient stability with respect to locations. Three different specifications are attempted to check robustness with respect to which characteristics are important.

*** Table 3 about here ***

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

With respect to condominium units along the Chuo Line, every ten more minutes commuting time to Shinjuku depreciates the value by 16%.[25] For units requiring a bus ride to a Chuo Line station, every ten-minute ride implies a 20% lower price. The amount of price reduction is more for bus travel than train travel, because taking a bus involves transfer at a train station (transfer time is not included in commuting bus time) and the frequency of buses for less than trains service late at nights. An increase in floor space of 10 squares meters raises the price by 22%. 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 the same floor plan. These results are quite robust with respect to different specifications. RC (reinforced concrete) housing units are valued less than SRC (steel reinforced concrete) ones, reflecting the fact that the former is a cheaper construction method.

For housing units on the Chuo Line, facing south or southeast is valued with a 10% premium, something not detected with respect to units on the Yamate Loop. Since it is more crowded along the Yamate Loop, facing south (or southeast) does not guarantee sunshine due to high buildings.[26] Another possibility is that housing units there may be used as combination residences/business (home) offices, or even as a second house (the main residence being located distant from downtown Tokyo). In any case, it is interesting to see that the value of characteristics on the Yamate Loop and the Chuo Line are slightly different. Other characteristics, such as closet space, storage space availability, sunroom, roof balcony, 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) of condominiums, after controlling for characteristics, along the Yamate Loop and Chuo Line 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 increases in "official land price" [koji chika] surveyed by the Land Agency are shown for comparison. The increase in official land prices by region and commuter line is shown in Land Agency (1992).

One startling piece of evidence in Table 4 is the gradual <u>decline</u> in housing prices from

1981 to 1984 and sharp decline in 1991-92. At the beginning of the 1980s, official land prices tended to increase slightly, but our housing price data shows a 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, as well as pricing method. The official land price is assessed value obtained from general market movement in the neighborhood, and is not necessarily the market or transaction price, while our data is based on actual market prices. It is thus likely that our data is more sensitive to actual market movements.

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

It is now clear that the decline in housing prices from 1991 to 1992 was as dramatic as the price increase in the mid-1980s. Housing prices on the Yamate Loop declined an average 40% in a year, although housing prices along the Chuo Line declined only about 14%. Even with these sharp price declines in 1991-92, (nominal) housing prices increased about 90% in eleven years from 1981 to 1992. During the same eleven years, the wholesale price index declined 5%, and the consumer price index increased 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 signs of renovation were wrong and insignificant.

*** Table 5 about here ***

For the Chuo Line, every ten minutes increase in commuting time lowers rent 16%, and for the Yamate Loop, only 11%. An increase in floor space of 10 square meters increases rent 21%. These magnitudes are quite similar to housing for sale. These results are also robust with respect to specification, namely whether another variable such as renovation or parking space is added. Recent renovation increases rent 13.3% and the availability of parking space, 4.1%. Other characteristics, such as building age, on the first floor, with balcony, with a sunroom, piano allowed, children 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 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 more than 8%. The years 1987-88 were the only ones when a large increase in prices coincided with a large increase in rents. Although it is difficult to make a general conclusion from eleven years of data, a rent increase seems to have followed after an increase in prices. Over the eleven years, rents increased about 65%.

*** Table 6 about here ***

7. Price and Rent of a Standard Property

As we have estimated hedonic functions for housing prices and rents, we can simulate any price and rent for a (fictitious) property with specific characteristics from 1981 to 1992. It is heuristic to calculate absolute levels of prices and rents, rather than increases as in preceding sections. Our "standard" housing unit is: a condominium, five minutes walk to Mitaka Station on the Chuo Line 18 minutes from Shinjuku Station, floor space of 60 square meters, an SRC building built in 1980, facing south on the second floor or up, and with no 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 in 1981 and ¥30 million in 1983, it started to increase. The price reached ¥69.5 million in 1991, after sharp increases 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 building age, while in Table 7 the age advances every year, as the standard unit is fixed for the assumed building built in 1980.[27] The monthly rent was about ¥12,000, in ¥15,000 in the mid-1980s, and ¥19,000 in 1992. It is notable that rents increased in 1984 and 1985 when prices were stable or slightly declined. These figures, generated by our model, seem to be in broad agreement with a casual observation of local listings.

Rents are steadily increasing, while prices are volatile -- for example sharply increasing in one year and decreasing somewhat the next year. The relative movement of prices and rents is succinctly captured by the capitalization ratio, Θ, (or the price-earnings (rent) ratio) defined here as price divided by twelve-months' rent.[28]

The capitalization ratio increased when prices went up and then declined as rents slowly caught up with prices. The average Θ for the 12 years was 25, with an upper figure of around 31 and lower one of around 17. Θ was clearly high from 1988 to 1991; the correction came with increasing rents and a sharp decline in price in 1992. Judging from Table 7, capitalization ratio was almost back to normal levels (average of 12 years) in 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 shows only a slow, but steady, increase in rents. Our data (Data Set No. 2) is 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 for new listings showed rapid change in one year and zero change in other years, just like housing price movements. Even in this case, a survey of rents of existing tenants would show "stickiness" because some of the existing tenants carry over old rents.[29] In sum, our findings suggest that rents of new listings are indeed slowly, steadily increasing--while prices jump in certain years they are rather stable in other years. The capitalization ratio Θ fluctuates accordingly around a 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.[30] Second, we will formally test the efficient market hypothesis, i.e. that excess returns are, on average, zero and unpredictable (hence no autocorrelation). It is more widely accepted that financial markets with small transaction costs, such as the foreign exchange and stock markets, are efficient. The efficiency of the housing market is still controversial.

Recall that returns on the one-year housing investment are defined as the sum of rent 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 sale and 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 standard 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 sale, to derive the hypothetical sales prices, h_{t+1}, h_t for housing for rent. Since we are using a rental housing unit data set, rent d_t is available. These numbers are available for each housing unit for rental.

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

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

*** Table 8 about here ***

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

Excess returns were regressed on the constant and the one-period-lagged excess returns to check for 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 being zero. Table 9 shows the results of estimation and test. In our data, weak-form efficiency is not rejected in regular ordinary least squares. But, standard errors may not be correct in the presence of lagged endogenous variables. Hence, we should rather use robust standard errors corrected for possible heteroskedasticity. When robust standard errors are used, the null hypothesis is rejected, suggesting statistically significant autocorrelations in excess returns, or predictability in the next period of excess returns. However, the result is qualified in that the sample is rather short (12 annual data points) to make any 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. Our efficiency test in this section does not take into account transaction 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 to 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. Conclusion

This paper investigated the prices, rents, and excess returns stemming from Tokyo condominium (high rise) housing units along the Yamate Loop and Chuo Line. In eleven years from 1981 to 1992, prices went up about 90%, while rents 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 flow (rents). Relatively low rents are compensated for 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 significant fluctuation 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 movement of excess returns and volatility from one year to the next do not reject the weak-form efficient market hypothesis.

This paper is the first attempt using individual listing 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 would help in 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 different commuter lines. This would be desirable to see locational discrepancy in the valuation of different housing characteristics. This was partly evident in comparing housings along the Yamate Loop and Chuo Line. Discrepancy in the timing of price increase, which might suggest a lack of geographical arbitrage (inefficiency), could be analyzed and tested if we had more locations in quarterly data. These extensions, though important, are left for 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 salary."

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

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 is lightly taxed for inheritance purposes in Japan.

A tax break for owning rental properties as investment would make landlords willing to rent housing at a reasonable rent, 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 to real estate agents in that neighborhood. However, 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) commute by car to downtown Tokyo. Commuter lines more than city boundaries often define neighborhood characteristics. The availability of parking space is important for automobile owners, because one cannot even register a car without proof of off-street parking space. Facing south is usually preferred because of more sunshine, which is important because many do not have a dryer, although almost every household has a washing machine.

7. For rental units in 1981-84, there are some for which we do not have floor space. For such units, we have translated floor plan to floor space, using a formula estimated from other units for which we have both.

8. Sellers in a soft market are known to ask too high a price and only reluctantly lower or accept a lower offer after several months. The February 12, 1992 issue of Jutaku Joho has an article on changes in the difference listing prices in it and transaction prices (the last listed price before being taken off computer listing) in 1991. The average difference in 1991 when prices were on a sharp decline was 25% of listing prices. If such kind of data is available every year, we may be able to correct listing prices to transaction prices.

9. High rise condominiums in Japan are typically called "mansions." Buildings are typically between five to ten stories with 15 to 60 units, but some recent ones are higher and larger structures.

10. The land portion of the housing price is much less for a high rise condominium unit than a detached house. The condominium price, unlike a detached house, naturally does not attach any extra value to land for alternative use, possible extension of floor space, interior improvements and so on. Height, maximum cubic capacity of a 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. Thus, a more careful choice of variables for analysis is needed. The quality of structures are more or less homogeneous for high rise condominium units. The age of the building, as a proxy for depreciation, is an important variable. Hence, their prices directly reflect a location premium for commuting ease and neighborhood characteristics.

11. Housings on some commuter lines commands higher prices despite the same commuting time to the Yamate Loop. Important are which terminal of the Yamate Loop the commuting line is connected to, various amenities along the line (frequency of trains, availability of express trains, whether there are suburban-type shopping malls near one of the stations), school district, and income of the residents.

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

13. The market information of the first week of the year is usually listed 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 protect tenants to a considerable degree. By law and precedent, it is extremely difficult for a landlord to terminate a lease 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 as long as the tenant wishes to extend. 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 the average for the neighborhood. The latter is useful to guess the future long-term stream of rents.

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

17. For institutional details of the maru-yu system, see Ito (1992; p272).

18. The statutory property tax rate is 1.4%. First, an assessment 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. By assuming that assessment value for acquisition and real estate tax purposes is half market value, then tax and fees can be calculated as follows. National stamp tax, for receipt of transaction, of ¥20,000; 5% registration fee payable to the local government; and acquisition tax of 3% of real estate assessment (half market value) after ¥45 million deduction {(36,743,134*0.5)-45,000,000}*0.03 = ¥416,147. In addition, commission for arranging a mortgage payable to the bank is ¥30,000; registration commission payable to a real estate assistant lawyer, ¥19,600. The sum of tax, fees, and commissions above is ¥1,404,325. Dividing this by the purchase price ¥36,743,134 yields 3.822%. Lastly, the real estate agent's commission paid by the buyer is assumed to be 3%.

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

21. This corresponds to the following: the official land price survey [Koji Chika] is about 70% of market value, with real estate assessment about 70% of the official survey land price. There is a further reduction of assessment value for small plots, 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 ten U.S. cities using hedonic regressions, and Linneman (1986) analyzed housing prices by a self-assessment survey in Philadelphia. The Census Bureau uses hedonic regressions for its "price index of new one-family houses sold" in the National Income and Products Account.

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

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

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.

28. The capitalization rate here is analogous to the price-dividend ratio in the stock price literature.

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

30. Ideally, we would like to test the efficiency of the market from Data Sets No. 3 and No. 4, which list both price and rent for each listing, so that hedonic regressions are not necessary. However, we have only five years of such data. Possibly, we may compile quarterly data and also accumulate data for a few more years to have a sufficient degree 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.

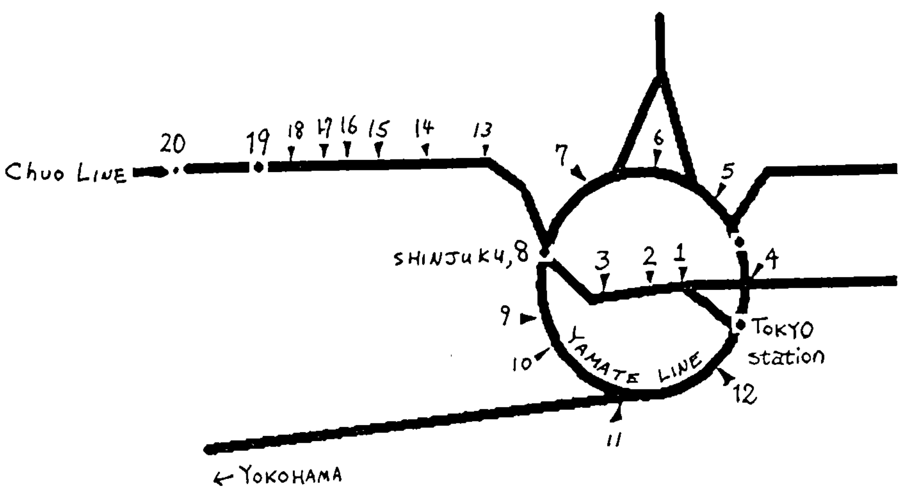

Table 1
Excess Returns from Repeatedly-listed Investment Properties

(%)

	N	Paid in full			Downpayment 30%		
		Time deposit	Discount bank deb.	CDs	Time deposit	Securities	CDs
1988-89	15	1.00	0.74	-0.12	-4.14	-4.37	-5.16
89-90	23	15.09	14.73	13.35	41.26	40.93	39.68
90-91	25	10.07	9.76	7.26	25.13	24.84	22.54
91-92	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, when unit paid for 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 rent
RE = key money (additional one-time, 2 months rent)
tau = tax rate on interest income
N = number of observations

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

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)
88	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)
89	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)
90	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)
91	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)
92	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)
88	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)
89	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)
90	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)
91	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)
92	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)
88	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)
89	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)
90	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)
91	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)
92	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)
88	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)
89	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)
90	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)
91	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)
92	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 parentheses)

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 SE	---	-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	---	---	-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, total	-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)
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 commuting time to any station on the Yamate Line on foot, by bus and train (Chuo Line). Practically, for housing on the Yamate Line, "Commute" is equal to minutes on foot to the nearest railway station; and for housing on the Chuo Line, "Commute, total" is equal to the sum of minutes by train, bus, and on foot, required to reach Shinjuku Station (the station at the intersection of the Chuo Line and Yamate Loop), without counting transfer and waiting time; "Commute, train," "Commute, bus" and "Commute, walk" are, respectively, minutes by each required to reach Shinjuku Station.

Floor space: in square meters.
Bldg age: age of the building.
1st floor: a dummy variable = 1 if unit is on first floor.
Pkg space: a dummy variable = 1 if parking space available.
Face SE : a dummy variable = 1 if unit faces southeast.
Face S : a dummy variable = 1 if unit faces south.
RC : a dummy variable = 1 if structure is reinforced concrete.
other buildings are SRC (steel reinforced concrete).

(t-statistic in parentheses)

Coefficients on time dummy (calendar year) not reported here, see Table 4.

Table 4 Housing Price Increase Revealed from Hedonic Regressions (y/y)

Data source	Our data	Our data	Koji Chika	Our data	Koji Chika
Location	Chuo and Yamate	Chuo	Chuo and Ohme	Yamate	Yamate
Spec	Spec (1)	Spec (1)	n.a.	Spec (1)	n.a.
1981-82	-5.01	-0.70	6.6	-12.60	7.1
82-83	-8.41	-14.31	3.8	2.69	6.0
83-84	-1.33	5.54	2.9	-12.80	6.8
84-85	4.45	2.67	2.2	8.74	11.1
85-86	10.32	5.08	4.4	16.17	21.4
86-87	59.61	44.85	36.7	83.55	95.2
87-88	31.24	47.04	71.4	4.35	15.0
88-89	-2.18	-0.85	-6.1	-4.30	-4.5
89-90	19.03	13.64	-0.7	30.85	-0.3
90-91	6.78	6.79	-0.3	7.59	-1.0
91-92	-25.82	-18.74	-7.1	-40.12	-15.5
81-92	90.12	91.01	145.9	85.13	192.4

Price increases for 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)
Commuting	-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 (bus)	---	---	---	-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 to any railway station on the Yamate Line on foot, by bus and train (Chuo Line). Practically, for housing on the Yamate Line, "Commute" is equal to minutes on foot to the nearest railway station on the Yamate Loop; and for housing on the Chuo Line, "Commute, total" is equal to the sum of minutes by train, bus, and on foot, required to reach Shinjuku Station (the station at the intersection of the Chuo Line and Yamate Loop), without counting transfer and waiting time; "Commute, train," "Commute, bus" and "Commute, walk" are, respectively, minutes by each required to reach Shinjuku Station.

Table 6 Rent Increased Inferre from Rental Housing Hedonic Functions

	All samples	Yamate Loop	Chuo Line
1981-82	13.71	17.81	6.64
82-83	2.62	3,26	-0.53
83-84	13.90	25.70	9.06
84-85	2.34	-12.12	11.42
85-86	-1.87	-0.05	-0.46
86-87	3.36	-1.02	6.32
87-88	15.52	19.61	10.77
88-89	-1.96	3.07	-4.73
89-90	5.04	-4.84	13.13
90-91	3.98	4.43	2.98
91-92	8.18	14.36	3.90
81-92	64.81	69.76	58.52

Table 7 Simulated Price and Rent for Standard Housing

Standard housing: five minutes walk to Mitaka Station (which is 18 minutes from Shinjuku Station by the Chuo Line); 60 square meters; 2nd floor or higher; facing south; no parking; and SRC structure.

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

Capitalization ratio, θ, is the (annual) price-earnings ratio, i.e. Price/(Rent x 12).

	Price	Rent	Capitalization ratio
1981	36,288,920	120,720	25.05
82	35,320,358	113,369	25.96
83	30,629,787	112,897	22.61
84	31,676,500	137,967	19.13
85	31,764,049	151,152	17.61
86	32,109,279	150,932	17.61
87	48,638,648	159,402	25.42
88	64,874,224	172,059	31.42
89	63,229,901	167,051	31.54
90	67,125,248	184,248	30.36
91	69,490,564	187,534	30.88
92	61,014,997	190,452	26.70
Average			25.36

Table 8 Excess Returns in One Year

	100% down payment			30% down payment		
	Time deposits	Discount bank debentures	CDs	Time deposits	Discount bank debentures	CDs
1981-82	-8.56	-9.46	-9.41	-33.10	-33.62	-33.57
82-83	-9.84	-10.43	-10.71	-37.67	-38.16	-38.40
83-84	-1.92	-2.51	-2.96	-12.74	-13.22	-13.59
84-85	6.51	5.92	5.50	15.63	15.16	14.82
85-86	14.67	14.08	13.68	43.66	43.20	42.88
86-87	60.60	60.36	60.65	196.90	196.71	196.95
87-88	19.12	18.86	18.54	56.12	55.89	55.60
88-89	-0.23	-0.48	-1.35	-8.24	-8.47	-9.24
89-90	11.33	10.97	9.59	28.71	28.38	27.16
90-91	4.05	3.74	1.28	5.05	4.77	2.57
91-92	-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

Table 9 Test of Weak-form Efficiency

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

Ordinary Least Square, with robust standard errors

	α alpha	γ gamma	R bar sq.	SEE	DW
100 % down					
time deposit	5.597 (0.768) [1.020]	0.365 (1.075) [2.402]	0.017	20.625	1.78
Discount bank debenture	5.301 (0.732) [0.957]	0.366 (1.080) [2.340]	0.018	20.728	1.79
CD	4.782 (0.662) [0.856]	0.373 (1.101) [2.327]	0.023	20.957	1.79
30 % down					
time deposit	14.172 (0.602) [0.770]	0.366 (1.073) [2.219]	0.016	69.214	1.78
Discount bank debenture	13.914 (0.591) [0.754]	0.366 (1.073) [2.227]	0.017	69.311	1.78
CD	13.459 (0.572) [0.727]	0.368 (1.080) [2.223]	0.018	69.504	1.78

t-statistics with regular standard errors in (brackets)
t-statistics with robust standard errors in [square brackets]