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ABSTRACT

Japan has experienced turbulent behavior of land prices after World War II, especially after 1985. This paper first examines the explanatory power of a simple present-value model and shows its limitation. We then investigate two additional (not mutually exclusive) factors affecting the Japanese land price behavior: distortionary inheritance and capital-gains taxation, and excessive price sensitivity due to the non-Walrasian structure of the land market. Empirical results show that distortionary taxation is a major culprit of high residential land price, and that the non-Walrasian price behavior magnifies the effect of underlying change in the market fundamentals.

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1 Introduction

Japan has experienced turbulent behavior in land prices after the World War II as is depicted in Figures 1 (level) and 2 (rate of change) [1]. Between 1955 and 1990, the residential land price in the metropolitan area (six largest cities) soared by more than two hundred times, whereas the stock price rose by ninety times. Since the consumer price index was increased by eight times during the same period, the real value of land increased tremendously. This spectacular increase in the land price until 1990 was behind the so-called *Tochi Shinwa* (*the Myth of Land*) that land was an ultimate safe harbor always beating any other assets with ever-increasing prices. The myth was firmly entrenched in the post-war Japanese economic history.

There were three distinctive episodes for this phenomenon. The first one was from the end of the 1950s to the middle of the 1960s when Japan enjoyed high economic growth. The second was just before the first oil crisis in 1974, which was triggered by the national development planning proposed by the central government to alleviate the income differences between urban and non-urban areas. The third one was in the late 1980s, which was often attributed to the increased demand for office space in Tokyo under the expectation that Tokyo would become the center for international financial transactions. It is remarkable to note that except for one year (1975) the land price did not fall between 1955 and 1990.

In light of the tremendous increase in land prices until 1990, the magnitude and the duration of their downfall in the 1990s are also astonishing. The price was halved in five years from the peak of 1990, and it is still declining as of the end of 1997. It is now well-known that bad loan problems plagued in the Japanese banking system in this period stemmed from these "ever-declining" land prices. The sweet "Myth of Land" went sour: it turned into a "Nightmare of Land".

This turbulent behavior of land prices just described needs explanation, and the resulting turmoil in the Japanese economy needs prescription. Thus, land price behavior has been attracting much attention of economists as well as policy makers. In analyzing the land price behavior, most economists and policy makers have been using the present value (PV) model as a starting point. However, the PV model is based on the assumption of a well-organized asset market with no transaction cost. The Japanese land

[1] The land price is the Residential Land Price Index of Six Largest Cities, published by the Japan Real Estate Institute. (Japan Real Estate Institute, *Shigaichi Kakaku Shisuu [Urban Land Price Index]*, various issues). This price index is based on the assessment of licensed real estate appraisers. Since their standardized assessment procedure is based on actual transaction prices, the index reflects the movement of market prices. The stock price is the TOPIX of the Tokyo Stock Exchange, and the consumer price index is that of Tokyo's Twenty-Three Wards, both taken from the Nikkei Data Base.

market is full of various distortions and high transaction costs, so the PV model may not be valid in this market.

The purpose of this paper is to examine the applicability of the PV model and to show its limitation as a theory for the Japanese land market. We then investigate two additional (not mutually exclusive) factors affecting the Japanese land price behavior: the effect of distortion in the inheritance and capital gains tax systems, and excessive price sensitivity due to the non-Walrasian market structure of the Japanese land market.

The organization of this paper is as follows. In Section 2, we examine the PV model as a theory for the Japanese land market. We extend the PV framework to incorporate quasi-rent in the form of tax saving, stemming from distortionary inheritance and capital-gains taxation in which land is treated differently from financial assets with respect to the tax rate and the tax base. We test the validity of this augmented PV model as a long-run theory for Japanese land price behavior. We then turn to short run price behavior in Section 3. We develop a short-run model of land price behavior based on the non-Walrasian nature of the land market, and test its validity in both in commercial and residential properties. Section 4 concludes the paper with remarks of the limitations and possible extensions of this research.

2 Distortionary Taxation and Long-Run Land Price Behavior

2.1 Simple and Augmented Present Value Models

2.1.1 Frictionless Asset Market and a Simple PV Model

The present value (PV) model in its simplest form assumes that the land market can be approximated as a frictionless asset market with no distortionary taxation. Then, further assuming the risk neutrality of investors, we have the familiar no-arbitrage condition:

$$i_t - \pi_t^e = \frac{R_t + (P_{t+1}^e - P_t)}{P_t}$$

where P_t and R_t respectively denote the current (real) price of land and its (real) rent, P_{t+1}^e the expected land price, i_t the nominal rate of interest, and π_t^e the expected rate of inflation. Rearranging terms in the no-arbitrage condition, we have a current land price that is equal to the "fundamentals" that are the present value of current rent plus the expected future price as follows:

$$P_t = \frac{R_t + P^e_{t+1}}{1 + i_t - \pi^e_t}. \tag{2.1}$$

2.1.2 Special Treatment of Land in the Tax System and an Augmented PV Model

There are, however, two factors that make the Japanese land market deviate from the perfect asset market of the simple PV model. First, the land market is characterized by high transaction costs (*e.g.*, high brokerage fees, and high registration and acquisition taxes). It is not centralized and the buyer and the seller search out their counterparts. The land price is usually determined in the negotiation between the seller and the buyer who happen to meet. The seller has his reservation price: the minimum selling price under which the seller does not want to sell. Similarly, the buyer has his reservation price: the maximum purchasing price over which the buyer does not want to buy. If the buyer's maximum purchasing price is no less than the seller's minimum selling price, the trade takes place. The transaction price lies between the seller's minimum selling price and the buyer's maximum purchasing price. The determination of the actual transaction price depends on the structure of bargaining and the bargaining skills of the seller and the buyer. This market structure implies that the no-arbitrage relationship of the PV model may not hold in the short run, although it eventually prevails in the long run.

Secondly, there may be additional benefits other than land rent for investors to hold land in their portfolio. For individuals (especially farmers), it is widely pointed out that land has been a very good tax shelter (Ito 1994, Kanemoto 1997). This means the rent in (2.1) should include not only the land rent but the quasi-rent for tax saving purposes. Distortion in the inheritance and capital gains tax systems in Japan has often been suggested as a most probable culprit that makes the land price deviate from the simple PV model (Nishimura 1995). Land is undervalued in the inheritance tax base, and thus individuals can lessen their tax burden by holding their assets in the form of land.

The "tax-shelter service" of land is found only for individuals, not for corporations since there is no inheritance tax for the latter. However, Japanese corporations had in the past their own incentive to hold land in addition to earning the land rent. Land was considered as the most desirable collateral by banks. Thus, to own land made borrowing easy even in difficult periods for corporations (Nishimura 1996: p.154). This "collateral service" should also be included in the quasi-rent.

Therefore, in order to examine the PV model in the Japanese land market, we should consider an augmented PV model incorporating these quasi-rents, instead of the simple PV model (2.1), such that

$$P_t = \frac{R_t + P^e_{t+1}}{1 + i_t - \pi^e_t} + [PVQR]_t \,,$$

where $[PVQR]_t$ denotes the present value of future quasi-rents. Moreover, we should take the augmented PV model as a long-run relationship rather than a short-run relationship.

In this section, we calculate the present value of quasi-rent, and assess the explanatory power of the augmented PV model. As for individuals, we calculate the tax shelter value of land for individuals in Section 2.2, which is the discounted present value of tax saving from holding the land. We consider the tax shelter value both for farmers and non-farmers. Unfortunately however, it is difficult to calculate the present value of the collateral service of land for corporations, so we are obliged to omit it in the following investigation. Thus, the augmented PV model we consider is

$$P_t = \frac{R_t + P^e_{t+1}}{1 + i_t - \pi^e_t} + [TSV]_t \qquad (2.2)$$

where

$$[TSV]_t = TaxShelterValue.$$

It is worthwhile to show the practical importance of the tax shelter value of land for individuals in explaining land prices. If marginal sellers of land are corporations, then the tax shelter value of land for individuals does not have practical importance. However, Table 1 shows that most marginal land sellers have been individuals both nationwide and at the center of Tokyo. The corporate sector has been the net buyer except for 1978 and 1993-96 at the national level, and except for 1982 at the center of Tokyo. Thus, factors affecting individuals' decision to sell land, of which the tax shelter value is most important, are likely to influence land price behavior.

This is especially the case in farmland conversion to residential land. Farmland conversion has been a major supply source of residential land in the post-World War II urbanization. Under Japanese agricultural laws, no commercial corporation has been allowed to own farmland. Thus, the tax shelter value of land for farmers as individuals, is likely to influence residential land price. We will see its influence in the following two sections.

2.2 Calculation of the Tax Shelter Value of Land

In this section, we briefly summarize the characteristics of distortion in the Japanese tax system with respect to land, and then calculate the tax shelter value of the land due to this distortion, which will be used later in the empirical analysis.[2] A more detailed discussion can be found in Appendix A.

2.2.1 Distortion in the Japanese Tax System

Inheritance Tax Three distinctive characteristics should be pointed out concerning the Japanese inheritance tax system. First, there is a substantially favorable treatment for land in the inheritance tax base. Although all bequeathed assets, securities, and real estate are valued at their fair market value in principle, land is assessed, in practice, substantially lower than their market value (Barthold and Ito 1992, pp. 250-251). Since the assessment is not open to the public and sometimes vary among locals, it is hard to obtain information about the magnitude of under-assessment. However, experts say it was around 60% of the market value before the 1990s.[3] There is no such special treatment for financial assets. Their value is assessed at the market value.

Secondly, there is an even more favorable treatment for farm property. After 1975, the value of farmland in the Tokyo metropolitan area has been, in fact, assessed based on agricultural income from the land if the farmer's heir pledges to continue farming,[4] even though his farmland is traded as residential land in the market place. For example, in 1995, the average agricultural income per square meter was about 173 yen,[5] and its capitalization value was 3,460 yen if we use a 5% interest rate. In contrast, the corresponding average land price was about 500,000 yen, implying that the assessed value of the farmland was 0.7% of the market value. Thus, by pledging to continue farming, the farmer's heir could virtually avoid paying the inheritance tax.

Finally, changes in the tax system have been not systematic but haphazard (see Table A.1 in Appendix A). There was some inflationary adjustment in basic exemption between 1958 and 1974, but this was not adequate in light of the considerable land price inflation depicted in Figures 1 and 2. Then, a sharp rise in land prices in 1973 brought an even heavier tax burden, triggering political pressure on the government to ease the burden. The government increased basic exemptions by more than three times. An even more haphazard movement is found in the tax schedule. The schedule was unchanged from 1958 to 1987, which was just incredible in a period of skyrocketing land price inflation. As political pressure mounted to change the schedule in the last half of the 1980s, the government finally changed the schedule

[2] Here we follow the lead of Kanemoto (1994). There are several differences between our approach and Kanemoto's. In particular, Kanemoto considers the tax distortion in only one point in time, while we consider the dynamic behavior of the tax distortion.

[3] See Hayashi et al (1990). Land is assessed at Rosen-Ka said to be around 70% of Koji-Chika, which in turn was around 80 % of the market price before the 1990s. Combining these figures, the assessment was around 60% of the market value.

[4] Formally, the difference between the market value of the land and its farming value based on its agricultural proceeds is exempt from the value of land, which implies the land is assessed at its farming value.

[5] See Ministry of Agriculture, Forestry and Fisheries, *Statistics for Agricultural Income 1995*.

in 1988. Since then, the schedule has changed twice in seven years (see Table A.1 in Appendix A for details).

Capital Gains Tax The capital gains tax is far more complicated and its changes have been even more haphazard than the inheritance tax changes[6] (see Table A.2 in Appendix A). We identify four distinctive features.

First, the capital gains tax on land holding is substantial. This is in sharp contrast with the financial assets, since there is virtually no capital gains tax on them. Moreover, long-term landholdings and short-run ones are taxed differently. In general, short-run landholdings are more heavily taxed than long-run holdings. Overall capital gains tax on short-term holding is in general almost twice as much as those on long term holdings.

Secondly, the capital gains tax system has been pendulating between progressive taxation and a flat rate. Before 1968, the capital gains tax was progressive. Between 1969 and 1975, it was a flat rate taxation. Between 1976 and 1988, it was a two-part taxation, in which a flat rate was applied to a certain amount and progressive taxation followed beyond that amount. Between 1988 and 1991, it was still a progressive system, but it had only two rates in which the degree of progressiveness was greatly reduced. Between 1992 and 1994, it returned to a flat rate. After 1995, it went back once more to a progressive system with two or three rates depending on particular years.

Thirdly, the definition of "long-term holding", special exemption, and the tax rates changed quite frequently. Until recently, the direction of the change was to increase tax burdens on land. For example, the required length to be eligible for long-term holdings increased from three years (1968) to ten years (1982). The tax rate was also increased from fourteen percent (1969) to thirty nine percent(1992). There was no economic rationale for this haphazard change.

Lastly, between 1973 and 1992 a special provision lowered tax rates on farmland in the Tokyo, Osaka, and Nagoya metropolitan areas. This provision was a result of heavy lobbying by urban farmers to lessen their tax burden.

[6]Ito (1994) provides us with a concise summary of taxes levied on land, including capital gains taxes.

2.2.2 Tax Shelter Values for Farmers and Non-Farmers

Let us now estimate the tax shelter value of land, due to distortion in the inheritance and capital gains tax systems described in the previous section. The tax savings from landholdings differ considerably among individuals depending on their income, the size and location of their land, and so on. Since we are concerned with land prices in metropolitan areas, especially the Tokyo area, we consider a model family with substantial landholdings in the Tokyo Metropolitan Area. Its tax shelter value will be used as a proxy of the tax shelter value in estimating the augmented PV model (2.2).

Since farmers and non-farmers are treated differently in the inheritance tax system, we consider two types of families: a farm family and a non-farm family.

(a) A farm family here is in fact a token farmer. The family's primary income source is outside farming, and it is in the essence a land speculator. To make this clear, we assume that the family leaves its lot virtually vacant (growing some token crops of negligible economic significance).

(b) A non-farm family here has a large premise, and most of its lots are vacant or used as a garden. Like the farm family, the non-farm family is also a *de facto* land speculator. The family keeps the lots vacant, since if it leases them to someone, it loses many rights on them under the current Tenancy Law (*Shakuchi-Shakka Ho*).[7]

The above description of a model family with large landholdings is somewhat exaggerated, but it reveals common characteristics of large landholdings in the Tokyo Metropolitan Area. Regardless of agricultural or residential landholdings, they are the means of intertemporal speculation.

In order to investigate the effect of tax distortion, we have to specify the family structure and its change in time because the tax exemption depends on the number of statutory heirs (see Appendix A). We assume that one generation of the family consists of the father, the mother, and two children (son and daughter). As to the change in the family structure, we assume the following scenario:[8]

(1) The father of each generational family is deceased twenty-five years after his succession to his own father, and then the father's assets are bequeathed to his widow and two children.[9]

[7] Most of all, the lessor can terminate the tenancy only under very restrictive conditions. In practice, it is virtually impossible for the lessor to terminate the tenancy once he leases his land to the lessee.

[8] We follow Kanemoto (1994) in assuming this scenario.

[9] Among all mothers who give birth to the first baby, mothers at the age 25-29 have occupied the largest share for 50 years, and 48.2% as of year 1996. Ministry of Health and Welfare, *Vital Statistics of Japan (Jinkou Doutai Chosa), 1998*.

(2) Within one year after her spouse's death, the widow is also deceased, and her assets are inherited by her two children.

(3) In (1) and (2) above, the daughter gives up her statutory share, and the entire assets of the father and the mother are actually inherited by the son, who becomes the head of the next generation.[10]

This is one of many possible scenarios, and admittedly a simple one. However, since qualitative results do not change even if we assume more complex and realistic cases, we use this rather simple one as an illustrative case.

Let us consider a model family just after the succession from the previous generation to the current generation. In this period, the family owns Xm^2 of vacant land but has no financial assets. The family considers its asset position fifty years from now, after two generations. The family will convert all landholdings into financial assets at that time. Taking this condition as given, the family is now considering whether to sell *marginal land* (for concreteness we assume that it is $100m^2$) in this period or not.

We define two portfolios:

No-Sell Portfolio W_1: The family does not sell the land in this period. Twenty-five years from now, succession from this generation to the next one occurs. The next generation finances the inheritance tax payment by selling land, which is at the same time subject to capital gains tax.[11] Then, another twenty-five years lapses, and another succession occurs. The new generation liquidates all land holdings, pays the inheritance tax, and holds their assets in only financial assets. The present value of this portfolio in this period is denoted by W_1.

Sell Portfolio W_2: In this case, the family sells the marginal land of $100m^2$, pays the capital gains tax, and holds the proceeds in financial assets yielding interests. When the succession occurs, the next generation first tries to pay the inheritance tax by selling financial assets. If

[10]This patrilineal assumption is justified for farm families since the eldest son of a farmer, who is a successor of the father's farming, usually inherits most of the family's farmland. This assumption is more problematic for non-farm families. However, it is still the case the eldest son of a family with substantial land holdings inherits the principal part of the holdings. Thus, the assumption can be considered as a first approximation even for non-farm families with large land holdings.

[11]It is possible to save the inheritance tax by borrowing from banks and at the same time to buy another land, since the full amount of loan balances are deducted from the inheritance tax base but that the assessed value of new land is substantially lower than the market value. See Barthold and Ito (1992) for details. However, we ignore this possibility in our calculation.

they are inadequate, it starts selling land. Otherwise, this portfolio is the same as the No-Sell Portfolio. The present value of this portfolio in this period is denoted by W_2.

In order to calculate W_1 and W_2, the family must have expectations about current and future land prices, interest rates, and the tax structure. To highlight the effect of tax distortion as clear as possible and to make analysis tractable, we make the following expectational assumptions.

(A.1) The model family assumes the current and future rate of nominal land price inflation will be constant in the future and equal to the average of the nominal interest rates in the last three years. That is, the family assumes the expected rate of return on its land (which is the expected capital gains under the Assumption (a) above) shall be the same as the financial assets.

(A.2) The model family assumes that the current inheritance and capital gains tax systems will be perfectly adjusted to land price inflation in the future. Moreover, the current assessment practice in the inheritance tax will continue in which the value of land is assessed at sixty percent of the market value, while that of financial assets is assessed at the market value.

The assumption (A.1) seems to be the most conservative assumption with respect to land price inflation in most of the post-World War II period which we consider, except for the 1990s. Actual land price inflation is much higher than the nominal interest rate as shown in Figure 2 until 1990. We make this assumption in order to highlight the magnitude of the tax distortion's effect on land prices. It will be shown that we end up with a large distortion, even though we make this very conservative assumption on the family's expected land price inflation. Thus, if the model family expects higher inflation, the distortion will be much larger.

Under (A.2), the family is assumed to expect that inheritance and capital gains taxes do not change in real terms for the next fifty years. Although actually there are a lot of changes as demonstrated in Appendix A, the change is rather *ad hoc* and sporadic. It is difficult for the family to predict the change in the tax system. Thus, we make this simple expectational assumption.

In addition to expectational assumptions (A.1) and (A.2), we ignore property taxes since their effective rate is very low, between 0.1% and 0.3% depending on a particular year (Iwata et al., 1993). We also assume that the family earns an average non-capital-gains non-agricultural income of the Tokyo metropolitan area.[12] Then, we can calculate the expected present value of the Sell-Portfolio W_1 and that of the No-sell Portfolio W_2.

Let us now calculate the tax shelter value of the land. We consider how much of the extra price Q should be added to the market price P to convince the model family to sell the marginal land in the current period. In other words, we examine the extra price needed to make the Sell Portfolio equivalent to the No-sell Portfolio. As W_1 is the expected present value of the No-sell Portfolio in the current period and W_2 is that of the Sell Portfolio, $W_1 - W_2$ is the difference of the expected present value between not selling and selling the marginal land in the current period. The extra revenue $100Q$ (recall that the marginal land is $100m^2$) is subject to the capital gains tax in the current period and the inheritance tax in 25 and 50 years from now. Note that under the assumption (A.1), the present value of the land in the future is the same as its current value. Then, the family is willing to sell the marginal land only if

$$W_2 + (1-t)(1-\tau_{25})(1-\tau_{50})(100Q) \geq W_1,$$

where t is the marginal rate of the capital gains tax in the current period, and τ_{25} (τ_{50}) is the marginal rate of the inheritance tax in 25 (50) years from now.

The minimum of such Q is the tax shelter value of the marginal land. Thus, the Tax Shelter Value TSV of land per square meter is

$$[TSV]_t = \frac{W_1 - W_2}{(1-t)(1-\tau_{25})(1-\tau_{50})\,100} \tag{2.3}$$

The tax shelter value TSV may be positive or negative depending on the sign of $W_1 - W_2$. It may be negative if the "dis-service" of land or tax penalty on land in capital gains taxation outweighs the "service" of land as a tax shelter in inheritance taxation. If there is no distortion in taxation, we have $TSV = 0$.

In the empirical analysis later in this section, we will use the tax shelter value calculated from W_1 and W_2 as an explanatory variable of the regression explaining the current price P_t. In order to avoid the simultaneity problem in estimation, we construct W_1 and W_2 based on the model family's expected current price P_t^e based on the previous-period price such that $P_t^e = P_{t-1}(1+r)$ (see Assumption (A.1) above), not on the current price P_t. This procedure is justified as the first approximation since the result

[12] This average income figure is found in the "Receipts and Disbursements of All Workers Households" section of: Statistics Bureau of Management and Coordination Agency, *Annual Report on Household (Kakei-Chosa Nenpo)*.

is almost the same as in cases where we use the actual current price in the calculation. In the actual calculation, P_t is the land price in Tokyo and r is the real interest rate. [13]

2.2.3 Tax Shelter Value for Farm Family TSV_F

Let us first consider the tax shelter value of the land for the model farm family TSV_F. We assume that the model family owns $5,000m^2$ of farmland, which can be converted to residential land with a negligible cost. We consider $5,000m^2$ since it is approximately the median farmland holding in the Tokyo metropolitan area.[14] We are concerned with the change in TSV_F of the typical farm family over the period of our study. Thus, we calculate TSV_F each year for a model family just after the succession to the previous generation.

Table 2 reports the tax shelter value for farmers as the percentage of the market price between 1958 and 1997. Its movement is astonishing: it started from a negative value of - 7.07% and peaked at 338.33% in 1991. Even in 1997, the tax shelter value is 128.18% of the market price.

Before 1969, the tax shelter value of the land for the model farm family was negative, implying that the family had an incentive to sell its marginal land immediately, even if the buyer's offer price was lower than the market price. In this period, farmland was valued as residential land in calculating the inheritance tax base, and thus the model farm family had to pay a heavy inheritance tax on its farmland. The family had to finance the inheritance tax by selling its farmland, but then it had to pay a heavy capital gains tax due to very progressive taxation on capital gains in this period. Moreover, since the tax schedule was fixed in nominal terms and the expected land price inflation was high, the more the model family waited to sell the marginal land, the heavier its tax burden was. Under the tax system of this period, it happened to be better for the model farm family to sell the marginal land immediately, to decrease land holding and thus to reduce the inheritance tax on land.

In 1969, the progressive taxation on capital gains was replaced by a flat-rate taxation, which considerably reduced the capital-gains tax burden of the model farm family. This reflects an increase in the

[13]The interest rate is the 3-period Moving Average of average contracted loan rate of all banks (Bank of Japan, *Economic Statistics Annual (Keizai toukei Nenpo)*). As to the land price we use the average land price in Tokyo. Since the average land price itself is not available, we compute it by dividing the total value of the land in Tokyo by its total area. Here the total land value is the total value of land and forests of Tokyo owned by private sector (Economic Planning Agency. *Kokumin Keizai Keisan Nenpo (Annual Report of the National Accounts)*), and the total area is that of the Urbanization Promotion Area (Ministry of Construction, *Toshi-keikaku Nenpo (Annual Report on Urban Planning)*). These data are available only from 1969 to 1993. We extrapolate this average land price backward to 1958 by using the change in the land price index published by the Japan Real Estate Research Institute, and forward to 1997 by using the change in the average Koji Chika price in Tokyo (Land Agency, *Chika Koji*).

[14]According to the Metropolitan Government of Tokyo, agricultural land holding between 2,000 and 10,000 square meters is 61.0% of the total in the Ward area of Tokyo. The Tokyo Metropolitan Government, *Tokyo no Tochi (Land of Tokyo)*, 1998, p. 198.

tax shelter value, from negative before 1969 to 12-18% of the market value between 1969 and 1974.

In 1974, a special provision for metropolitan farmers was introduced, in which metropolitan farmland was assessed by the present value of agricultural returns on the land, although the farmland was valued substantially higher in the market place as residential land. This implied that the model farm family no longer paid the inheritance tax on its farmland, which made farmland as an ideal tax shelter for metropolitan farmers. This provision had an immediate and dramatic impact on the tax shelter value: it jumped from 12.9% in 1974 to 112.97% of the market value in 1975.

Since farmers can save on inheritance taxes by holding their assets in the form of farmland, a higher land price makes the farmland more attractive as a tax shelter for farmers. The tax shelter value for farmers steadily increased after 1975 and reached its peak in 1991 as high as 338.33%. This implies that, in 1991, the model farm family was willing to sell the marginal land only if the buyer's offer price was almost *four and a half times* as high as the market price.

The tax shelter value started to decrease in 1992 reflecting a sharp decrease of land prices in the 1990s. However, the tax reform of 1993 temporarily halted this decline. The 1993 change allowed exemption of the inheritance tax payment from capital gains if the heirs sold the land in order to pay the inheritance tax. This change increased the tax shelter value to 257.1% in 1993, because the change exempted the model farm family from paying the capital gains tax on land sold to pay the inheritance tax.

One anecdote illustrates the tremendous effect of the distortion in human terms. In 1997, the former student of one of the authors, a graduate of the University of Tokyo and a career-track employee of one of the top insurance companies in Japan, quitted his job to become a farmer and the successor of his father. This means that the tax saving due to his decision to succeed his farmer father far exceeded his lifelong income as an employee of the well-paid insurance company.

It should be noted here that the tax shelter value differs among farmers, depending on their particular conditions. In particular, it depends on the size of the initial landholdings: the larger the holdings are, the higher the tax shelter value becomes. Moreover, urgency to sell, or in other words demand for liquidity, differs considerably among farmers.[15] However, the change in the tax system alters the tax shelter value for various farmers in the same way. Therefore, the model farm family's tax shelter value can be used as a representative one.

[15] A sudden, unexpected death of the head of a farmer family often means that the family must finance the inheritance tax by selling a part of its land immediately, even though the price is not favorable. This finance motive is often singled out to be the most important in inducing a farmer family to sell its land.

2.2.4 Tax Shelter Value for Non-Farm Family TSV_{NF}

Next, consider a non-farm family having $1,000m^2$ of residential land. Here we take $1000m^2$ since it is a typical large-scale residential land holding. According to the Metropolitan Government of Tokyo, the share of residential land holding between 500 and 2,000 square meters occupies 20.2% of total residential land in the Ward area of Tokyo (The Tokyo Metropolitan Government, *Tokyo no Tochi [Land in Tokyo]*, 1998, p. 184). Table 2 shows the tax shelter value TSV_{NF} for the non-farm family. Although we have the non-negligible effect of distortionary inheritance and capital gains taxation on residential landholdings, the magnitude of the effect is rather small compared with the effect on farmland holdings. There has been a sizable deviation from zero, and the tax shelter value reached the peak of 35.16% of the market price in 1993. Thus, we can conclude that the distortionary taxation has some effect on non-farm families but the effect is far outweighed by the effect on farm families.

2.3 Testing the Augmented Present Value Model

As is well-known, the simple present value (PV) model (2.1) fails to explain the short-run behavior of Japanese land prices. The model is based on the assumption that the land market is efficient, which is generally rejected in empirical studies on the Japanese land market. For example, Nakagami (1995) examines excess returns on residential land using the panel data in forty six Japanese prefectures and rejects the efficiency. Thus, the issue is not whether the simple PV model explains the Japanese land price behavior perfectly, but to what extent the augmented PV model (2.2) described in the previous section has an explanatory power.

For residential land, we investigate the augmented PV model such that

$$P_t = a_0 + b_1 [FV]_t + b_2 [TSV_F]_t + b_3 [TSV_{NF}]_t + u_t, \tag{2.4}$$

where P_t is the residential land price, $[FV]_t$ is the "fundamental value" of residential land in period t such that

$$[FV]_t = \frac{R_t + P^e_{t+1}}{1 + i_t - \pi^e_t}, \tag{2.5}$$

and $[TSV_F]_t$ and $[TSV_{NF}]_t$ represent the tax shelter value for farmers and non-farmers in period t, respectively. The inclusion of the tax shelter value for farmers reflects the fact that farmland is one of the most important sources of residential land.

In the case of commercial land, however, it is rather unusual that farmland is directly converted to commercial land. Thus an appropriate specification of the augmented PV model for the commercial land is

$$P_t' = a_0' + b_1' \left[FV'\right]_t + b_3' \left[TSV_{NF}\right]_t + u_t', \tag{2.6}$$

where P_t' is the commercial land price, and $[FV']_t$ is the fundamental value of commercial land defined accordingly. We scrutinize the augmented PV model from both long-run and short-run perspectives.

In order to investigate the augmented PV models (2.4) and (2.6) directly, we must have the data of land prices and land rents. However, land rent data have not been readily available, and this difficulty has plagued previous attempts to assess the PV model in the Japanese land market. One contribution of this paper is to estimate land rent using various data sources. The method is explained in Appendix B. Other variables in (2.4) and (2.6) are constructed in the following way. The nominal interest rate i is the average contracted loan rate of all banks[16]. The expected rate of inflation π_t^e is the three-period moving average of past inflation rates. The expected price P_{t+1}^e is the forecast based on the $AR(3)$ model of the land price. The tax shelter values TSV_F and TSV_{NF} are the ones calculated in the previous section. All variables are semi-annual.[17] The sample period is 1958-1997 for residential land and 1963-1997 for commercial land reflecting data availability.

2.3.1 Long-run Land Price Behavior

Let us first examine the order of integration of the key variables in the augmented PV model (2.2). Table 3 reports the result. In the entire sample period (1958-1997 for residential land and 1963-1997 for commercial land) , both of the commercial and residential land prices are integrated to order two, *i.e.*, $I(2)$. The fundamental value and the tax shelter value for farmers are also $I(2)$, while the tax shelter value for non-farmers is $I(1)$. Thus, the fundamental value and the tax shelter value for farmers are strong candidates to explain land price behavior.

As is pointed out by Ito and Iwaisako (1996), the level of land price is sensitive to changes in the interest rate as well as the expected growth rate of the land rent, so that it is often argued that these two variables may explain the turbulent land price behavior. To investigate this issue, we examined the order of integration of the real interest rate, and the three-period moving average of rent growth rates as a stand in for the expected rent growth, for both commercial land and residential land (though not shown here). All of them were found to be $I(1)$ in 1958-1997. Although the sample size is small (less than 100), this result suggests the real interest rate and the expected rent growth ($I(1)$-variables) are not

[16]This is taken from *Keizai Toukei Nenpo* [*Economic Statistics Annual*] (Bank of Japan, various issues).

[17]The tax shelter values are available only annually. We intrapolate semi-annual series from them.

likely to explain the rampant fluctuations in land prices adequately ($I(2)$-variables).

Table 3 also shows the variables' order of integration in the subsample period before the outbreak of the so-called "bubble economy" around 1985. The land prices and the fundamental values are $I(1)$ for 1958-1985 for residential land and for 1963-1985 for commercial land. Similarly, the tax shelter values for farmers and for non-farmers are $I(1)$ for 1958-1985. The difference between this subsample and the entire sample periods exemplifies extraordinary land price movement after 1985.

Let us now investigate cointegration relationship among the key variables in the Augmented PV model. We then examine the explanatory power of the PV model and the effect of distortionary taxation on land prices from the following viewpoints:

(a) In the augmented PV model, b_1 in (2.4) and b_1' in (2.6) must be unity. Otherwise, the no-arbitrage condition does not hold. Thus, in order to examine the validity of the PV model, we test whether b_1 and b_2 deviate significantly from unity.

(b) If distortionary taxation on land has significant impacts on land price behavior, b_2 and b_3 in the case of residential land and b_3' in the case of commercial land must be statistically significant and substantially large.

The equations (2.4) and (2.6) are estimated for the entire sample period and the pre-"bubble economy" period,[18] by the instrumental variables method using the lagged values of regressors in the past two periods with $A(1)$ error terms. The estimation results are shown in Table 4.

In the case of residential land price, the cointegration relationship expressed in the augmented PV model cannot be rejected at the 5 percent significance level in both 1958-1997 and 1958-1985. In 1958-1997, the coefficient on the fundamental value FV is 0.763 which is significantly lower than unity. The P value of F statistics reveals that the hypothesis $b_1 = 1$ is rejected at the 5 percent significance level. The tax shelter value for farmers TSV_F has the coefficient of 0.081 while that for non-farmers has 0.486. Both coefficients are statistically significant at the 5 percent level. Thus, the PV model is rejected in the entire sample, while the effect of distortionary taxation, especially the tax shelter value of farmers has a significant effect on the behavior of residential land price.

The result of the pre-"bubble economy" period of 1958-1985, however, shows a somewhat different picture. The coefficient of the fundamental value FV is close to unity, though the hypothesis $b_1 = 1$

[18]Although the Tax Shelter Value for non farmers TSV_{NF} is $I(1)$ while other variables in (2.4) and (2.6) are $I(2)$, we include TSV_{NF} in the estimation taking account of the fact that the sample period is rather short and that the power of Augmented Dicky-Fuller (ADF) test in Table 3 is not so strong for small samples.

is rejected at the 5 percent significance level. Neither of the tax shelter value for farmers nor that for non-farmers have significant coefficients.

This implies that actual land price behavior was close to the one that the simple PV model predicted before 1985 concerning residential land. However, the PV model clearly failed to hold if land price behavior after 1985 was taken into consideration, even if we augmented the PV model with the tax shelter values. The result also shows a large impact of the tax shelter values for both farmers and non-farmers on residential land price.

In Figure 3, we show the percentage of the actual residential price that is explained by the tax shelter values in the estimated equation for 1958-1997. The tax shelter values for farmers and non-farmers increased the residential land price since 1974, and about 15% of the residential land price was attributed to the tax shelter values in 1985. It then soared to about 35% in 1991 and 1993, and remained above 20% as of 1996. These results show that the residential land price is substantially affected by distortions in the tax system.

In the case of commercial land price, the cointegration relationship of the augmented PV model is rejected at the 5 percent significance level in both, the entire sample period (1963-1997) and the pre-"bubble economy" period (1963-1985), although the coefficient of the fundamental value FV is close to unity and the hypothesis of b_1' being unity cannot be rejected at the 5 percent significance level. This result suggests that the augmented PV model does not hold as a long-run relation concerning commercial land even before 1985.

However, the tax shelter value for non-farmers does not fare well, either. Although it has a significantly positive coefficient in the entire sample period, it has a significantly *negative* coefficient in the pre-"bubble economy" period, which contradicts the theory of tax shelter values. This result questions the model specification (2.6), suggesting the possibility of a missing variable: the "collateral-service" value discussed in Section 2.1. The estimation and incorporation of its effect on commercial land prices is an important and pressing research agenda.

2.3.2 Short-Run Land Price Behavior

We next examine the short-run price behavior of prices and the effect of the fundamental value and tax shelter values. In Table 4, the change in land prices is regressed on the change in the fundamental value and that in the tax shelter values:

$$\Delta P_t = a_0 + b_1 \Delta \left[FV\right]_t + b_2 \Delta \left[TSV_F\right]_t + b_3 \Delta \left[TSV_{NF}\right]_t + w_t,$$

for residential land prices. A similar equation is estimated for commercial land prices.

Both in 1963-1997 and 1963-1985 the coefficient on the fundamental value is significantly below unity, around 0.5, for the residential land price. The effect of the tax shelter value for farmers is still significant in the entire sample, but it becomes insignificant before the "bubble economy". Moreover, the adjusted R^2 is low both in the entire sample and the pre-"bubble economy" sample. Thus, the augmented PV model fails to explain short-run land price behavior. The tax shelter values have little effect on short-run land price behavior before 1985, although the tax shelter value for farmers seems to have a substantial impact on short-run land price behavior after 1985.

The fundamental value in the case of commercial land price has the coefficient of 0.587 before 1985, which rises to 0.949 when we include the data during and after the bubble economy. However, the adjusted R^2 is low, implying that the augmented PV model does not adequately explain the short-run commercial land price behavior. As is similar to the findings of land price levels, the tax shelter value for non-farmers affects commercial land price insignificantly before 1985, though it has a significantly positive coefficient in the entire sample.

The foregoing results can be summarized in the following way. The residential land price can be explained relatively well in the PV framework until 1985, the starting point of the "bubble economy." However, the PV model fails to explain price behavior of the entire sample period, whose time-series property is heavily influenced by the turbulent price behavior after 1985. This turbulent behavior is partly explained by the effect of distortionary inheritance and capital gains tax systems. They raised the land price by more than 20 percent since 1987. The price of commercial land, however, cannot be explained even by the augmented PV model incorporating the effect of tax distortions.

The findings obtained in this section for the long- and short-run behavior of residential land price are in line with the results seen in previous researches. Many empirical researches, using data between 1960 and 1985 (such as those in the various issues of the *White Paper* of the Economic Planning Agency in the late 1980s), obtained relatively good results in the simple PV framework. Boone and Sachs (1989) analyzed the long-run level of land price from the macroeconomic point of view, and showed that the land price in Japan was not extraordinary high around 1985. However, such attempts broke down as the price movement of the late 1980s was included in the data set.

An empirical study by Hutchison (1994) decomposed the variance of the land price change during the 1955-93 period into the variances of the real GDP change disturbance, the GDP deflator change disturbance, and the land price change disturbance by a structural VAR model. He found that only a small part of the land price variance could be attributed to these aggregate demand and supply factors, while a large part would be attributed to non-macroeconomic factors specific to the land market. Stone and Siemba (1993) also examined the explanatory power of the PV model. Their conclusion, however, was not clear-cut, exemplifying fundamental difficulties in using the entire sample period encompassing the 1960s and the 1980s as a whole to assess the PV model.

Similar results are obtained in variants of the PV model. For example, Sato (1995) examined whether the land price change (or more precisely, the change in a proxy of the price-to-rent ratio) could be explained well by the movement of the mortgage rate, the Marshall's k and the average value product of urban land. The pattern of residuals suggested that the model had difficulty in explaining the movement in 1985-88. In another attempt, using an aggregate Cobb-Douglas production function, Idee (1997) showed that in 1980-1982 the actual value of land was almost the same as the theoretical value. The actual value then increased sharply in the late 1980s to become 6.4 times higher than the theoretical value in the three main urban areas, Tokyo, Osaka and Nagoya, and 2.3 times higher in non-urban areas in 1992. Fujita and Kashiwadani (1989) paid attention to the differences in the land prices of farming and residential lots in the middle suburbs of Tokyo, and their simulation results showed that the actual land prices in 1980 and 1984 were considerably higher than those associated with the efficient urbanization process.

3 Excessive Price Sensitivity and Short-Run Land Price Behavior

3.1 Land Market as a Non-Walrasian Asset Market

In the previous section, we have shown that the short-run behavior of land prices is hard to explain in the framework of the simple as well as augmented PV models. In this section, we will develop a model of short-run price behavior based on the structure of land markets, and test its validity using residential and commercial property data.

We start from the fact that the land market is a far cry from the frictionless Walrasian asset market that the PV model presupposes. The land market is not centrally organized nor has market makers to mimic to a certain extent a Walrasian auctioneer. Transaction costs are high. Land is heterogeneous, and information and thus expectations are imperfect and heterogeneous among sellers and buyers. In many cases sellers post their asking prices in newspapers and trade networks, and buyers search for the best buy. If the seller and the buyer meet, sometimes intensive negotiation follows on exact terms of trade. In such a market, we argue that the price might be excessively sensitive to an unexpected change in factors affecting the intrinsic value of land.

Let us consider price determination in such a market. In the following we will explain a simple version of the model proposed in Nishimura (1999).[19] Consider an encounter of a seller and a buyer. To make the analysis simple, let us consider a situation where no negotiation is involved and assume that the seller offers the price, and the buyer determines whether to accept it or not. Both the buyer and the seller are assumed to be risk neutral. Finally, we assume that if the trade between them fails then there is no further trade on this land.

Let us consider the seller's pricing problem. Let x_i be the unexpected change in the intrinsic value of this land i, that is, the value of holding this land. We assume that only the seller knows x_i.

The buyer j has his own subjective expectations about x_i, denoted by $E^j(x_i)$. The seller does not know the expectations $E^j(x_i)$ of the particular buyer he encounters, but he is assumed to know the distribution of the expectations among buyers:

$$Pr\left(E^j(x_i) < y\right) = F(y) \tag{3.1}$$

(For example, an investor survey may be conducted and the result may be made public). The seller determines his price change p_i corresponding to x_i based on this information.

Since the buyer j is risk neutral, he buys the land if the price change p_i is no more than his expected intrinsic-value change x_i, or equivalently, $p_i \leq E^j(x_i)$. Thus, the probability of successful sale, $\phi(p_i)$ is a function of p_i such that

$$\phi(p_i) = 1 - F(p_i). \tag{3.2}$$

Taking this in mind, the risk neutral seller determines p_i to maximize his expected profit:

[19] Nishimura (1999) specifies the structure of the non-Walrasian asset market and distribution of investors' expectations in detail, and derives rational expectations (Bayesian Nash) equilibrium. Since it is rather complicated, we adopt a simpler approach here.

$$Max_{p_i} \quad Expected\ Profit_i = \phi(p_i)(p_i) + (1 - \phi(p_i))(x_i) \tag{3.3}$$

It is evident that the optimal price change (3.3) satisfies the following equation.

$$p_i = \left(1 + \frac{\phi(p_i)}{\phi'(p_i)\, p_i}\right)^{-1} x_i = \frac{1}{1 - (1/\eta_\phi)} x_i \tag{3.4}$$

where

$$\eta_\phi = -\frac{p_i}{\phi}\phi'(p_i)$$

is the price elasticity of the sale probability. If the trade is completed, p_i will be the market price change of the land.

Equation (3.4) shows that the price change p_i is a mark-up of the unexpected intrinsic-value change x_i. Moreover, the mark-up rate depends on the inverse of the price elasticity η_ϕ of the sale probability $\phi(p_i)$. The smaller is the elasticity, the more sensitive is the price. Moreover, so long as η_ϕ is positive and greater than unity, the coefficient of x_i in (3.4) is always greater than unity. Thus in this case, we have excess price sensitivity.

Equation (3.2) implies that the sale probability depends on F, the distribution of buyers' expectations. Thus, (3.4) shows that the price effect of the unexpected change in the intrinsic value crucially depends on the shape of the distribution of buyers' expectations.

To illustrate this point, let us note that the price elasticity of $\phi(p_i) = 1 - F(p_i)$ is small if the absolute value of $\phi'(p_i)$ is small , for given p_i $[> 0]$ and ϕ. Since $-\phi'(p_i) = F'(p_i) = f(p_i)$, where f is the density function, this means that a smaller value of $f(p_i)$, or in other words, the more dispersed expectations around the optimal price, implies a higher price sensitivity. Thus, the foregoing analysis suggests that in some cases an increase in the variance of expectations' distribution may induce excessive price response to unexpected change in the intrinsic value of land.

3.2 Econometric Methodology

The non-Walrasian asset model developed in the previous section predicts that the sensitivity of land prices to unexpected changes in their fundamental value depends on the heterogeneity of investors' expectations. Specifically, the more dispersed investors' expectations are, the more sensitive land prices are. In what follows, we examine whether it is true using the Japanese land market data.

Our analysis is based on the single factor model, in which the asset return R_t is determined by one factor F_t, *i.e.*

$$R_t = \alpha + \beta_t F_t + u_t, \tag{3.5}$$

where β_t is the factor loading which measures the sensitivity of the asset return to the factor. In the conventional factor model, β_t is assumed to be constant. However, our model (3.4) suggests that it varies over time depending on the heterogeneity of expectations among investors.

In what follows, we will work with the innovations (*i.e.* the unexpected parts) of the land return and of the factor. Assuming that α is constant over time[20] and that β_t is known in period $t-1$, we may rewrite equation (3.5) as:

$$r_t = \beta_t f_t + u_t, \tag{3.6}$$

where r_t is the innovation in the land return and f_t is the innovation of the factor, *i.e.* $r_t = R_t - E(R_t|\mathbf{I}_{t-1})$ and $f_t = F_t - E(F_t|\mathbf{I}_{t-1})$ where $\mathbf{I}_{t-1}$ is the information set available up to time $t-1$.

By definition, we have $E(f_t|\mathbf{I}_{t-1}) = 0$ and $E(u_t|\mathbf{I}_{t-1}) = 0$. For identification, we assume that $E(f_t^2|\mathbf{I}_{t-1}) = 1$. We further assume that the u_t is homoskedastic, *i.e.* $\sigma_u^2 \equiv E(u_t^2|\mathbf{I}_{t-1})$ does not depend on time t.[21]

We denote the heterogeneity of investors' expectations by σ_t in what follows. The data used for σ_t will be discussed in the next section. To examine whether β_t depends on σ_t, we must specify the functional form to represent the relation between β_t and σ_t. Assuming a Normal distribution of expectations among investors, Nishimura (1999) shows us that the sensitivity may be asymmetric: the price (and thus the return) is very sensitive to the factor innovation when investors are on the average optimistic, while it is not when investors are pessimistic. To incorporate this possibility, we consider the following specification.

$$\beta_t = g_0 + (g_1 + g_2 D_{t-1}^+)\sigma_t, \tag{3.7}$$

where D_{t-1}^+ is a dummy variable that takes one if $r_{t-1} > 0$ and zero otherwise. g_0, g_1, and g_2 are parameters to be estimated. Here we simply assume that investors are on the average optimistic when the previous period's return innovation is positive, while they become pessimistic when the previous

[20] The Arbitrage Pricing Theory (APT) predicts that α is a linear function of β_t. Hence, if β_t varies over time depending on the heterogeneity of expectations among investors, so does α. However, taking it into account will increase the number of parameters we must estimate. Since the number of observations we can use is limited, we neglect the dependence of α on β_t.

[21] Some of the recent empirical studies that apply factor analysis to asset pricing explicitly take into account the heteroskedasticity in both of the asset returns and factors. (See Engle, Ng, and Rothchild (1990), Ng, Engle, and Rothchild (1992), King, Sentana, and Wadwhani (1994), Aguliar and West (1998), and Shephard and Pitt (1998).) The methods employed in such studies are, however, computationally expensive. Here, we take a simplified approach.

period's return innovation is negative. If the null hypothesis of $g_1 = g_2 = 0$ is rejected, it provides evidence that β_t depends on σ_t. If g_2 is statistically significant, it provides evidence that the effect of σ_t on β_t differs depending on the sign of the innovation in the previous period's return.

One simple method to estimate these parameters is to select a variable that can be considered as a proxy for the underlying factor. If we can use the innovation in such a variable as f_t, the parameters in the model that consists of equations (3.6) and (3.7) can be estimated by using ordinary least squares (OLS). However, if the selected variable and the land return are jointly determined, the obtained result will suffer from the simultaneity bias. To avoid such a problem, we take a different approach, in which f_t is treated as an unobservable factor.

We first select variables that are highly correlated with the land return and hence can be expected to be determined by the same factor innovation f_t. Specifically, we choose two variables. Let us denote the innovations of the selected two variables by y_{1t} and y_{2t}. We assume that the sensitivities of y_{1t} and y_{2t} with respect to f_t are constant over time. Under this assumption, r_t, y_{1t} and y_{2t} may be represented by

$$\begin{bmatrix} r_t \\ y_{1t} \\ y_{2t} \end{bmatrix} = \begin{bmatrix} \beta_t \\ c_1 \\ c_2 \end{bmatrix} f_t + \boldsymbol{w}_t, \quad \beta_t = g_0 + (g_1 + g_2 D^+_{t-1})\sigma_t, \tag{3.8}$$

where c_1 and c_2 are the sensitivities of y_{1t} and y_{2t} with respect to f_t. $\boldsymbol{w}_t$ is a (3×1) vector of idiosyncratic error terms, whose first element is u_t in equation (3.6). f_t and $\boldsymbol{w}_t$ are assumed to be distributed as follows.

$$f_t \sim NID(0,1), \quad \boldsymbol{w}_t \sim NID\left(\begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}, \begin{bmatrix} \sigma_r^2 & 0 & 0 \\ 0 & \sigma_1^2 & 0 \\ 0 & 0 & \sigma_2^2 \end{bmatrix}\right). \tag{3.9}$$

We estimate the parameters in this model in the following way. We first extract the innovations in the selected economic variables and land return using the vector autoregressive (VAR) model. The VAR model is estimated by using OLS. Given the OLS estimates, we take the residual as innovations in economic variables and land return. Given the residuals obtained from the VAR, we estimate the parameters in the system that consists of equations (3.8) and (3.9) by the maximum likelihood method.

Let us define

$$\zeta_t \equiv [p_t, y_{1t}, y_{2t}]', \quad \boldsymbol{\Sigma} = \boldsymbol{B}_t \boldsymbol{B}_t' + \begin{bmatrix} \sigma_r^2 & 0 & 0 \\ 0 & \sigma_1^2 & 0 \\ 0 & 0 & \sigma_2^2 \end{bmatrix}. \tag{3.10}$$

Then, the log-likelihood may be written as

$$\ln L = -3T \ln(2\pi)/2 - (1/2)\sum_{t=1}^{T} \ln|\boldsymbol{\Sigma}| - (1/2)\sum_{t=1}^{T} \zeta_t' |\boldsymbol{\Sigma}|^{-1} \zeta_t. \tag{3.11}$$

We estimate all parameters in the model that consists of equations (3.8) and (3.9) by maximizing log-likelihood (3.11).

3.3 Data

3.3.1 Property Prices and Property Rents

Let us consider the return on "typical" commercial and residential properties in the metropolitan area (see Appendix B). The return is calculated from the price and rent data by using the procedure adopted in Nishimura and Sasaki (1995). The typical commercial property here is an eleven-story building located in a Ward of Tokyo that was the average of commercial office buildings owned by four major real estate companies (*Mitsui*, *Mitshubishi*, *Tokyo Tatemono*, and *Tokyu*) in 1975. The typical residential property is the average of two-story houses located in the six largest cities.

3.3.2 Economic Variables

We collected semi-annual data on several economic variables that may be expected to affect property returns in Japan. All of the collected variables are listed in Table 5, and source of these variables are found in Appendix B. All of these variables and the property returns are measured in real values,[22] and the sample period for these data is from 1970:1 to 1996:1. In the following analyses, we take a logarithm of all variables. The Augmented Dicky-Fuller (ADF) tests do not reject the null hypothesis of the presence of unit root in all variables except money supply, so that we take the first-order differences in all variables except money supply. As for money supply, we remove the time trend by regressing the log of money supply on a constant and on time $t = 1, 2, \ldots, T$.

Table 5 shows the correlation coefficients between the property return and each of these variables. We select two variables which are highly correlated with the property return. For the residential property, we select money supply and total bill-clearing volume and construct a VAR model of these variables together with the residential property return. For the commercial property, we select total bill-clearing volume and commercial office vacancy rates and construct again a VAR model of these variables together with the commercial property return. Both of the Akaike (1973) Information Criterion (AIC) and the Shwarz (1978) Information Criterion (SIC) suggest the lag length of two. We therefore set the lag length in the VAR models equal to two.

Table 6 presents the estimation results of the VAR models. LB(12) in the table represents the Ljung-Box (1978) statistic for up to twelfth order autocorrelation in the residuals. The asymptotic distribution of this statistic is χ^2 with six degrees of freedom. Ljung-Box test does not strongly reject the null hypothesis of no autocorrelation in the residuals of all variables. The null in the residuals of all variables

[22] The consumer price index in Japan was used as deflator.

except money supply is not rejected at 10% level, while the null in the residuals of money supply is not rejected at 1% level. R^2 in the table denotes the coefficient of determination. It is worth noting that the coefficients of determination for the property returns are large. They are 0.799 for the returns on the residential land and 0.463 for the returns on the commercial land, respectively. It means that 80% of the variation in the residential property return and 46% of the variation in the commercial property return can be expected, providing further evidence for the inefficiency of the land market in Japan.

3.3.3 The Heterogeneity of Investors' Expectations

To measure the heterogeneity of investors' expectations, we use the survey data collected by the Bank of Japan (BOJ). In March, June, September, and December, the BOJ has conducted a survey on whether the interest rate is expected to fall or rise. We apply the Carlson-Parkin (1975) method to this data to calculate the standard deviation of the forecasts of interest rate, which is used as σ_t (See Appendix C for the detail of our procedure). Similar survey data on the property price, if existed, would be more desirable, but unfortunately we do not have such data.

The BOJ's survey data is available in March, June, September, and December, and the data on the economic variables are semi-annual. Hence, our estimation is based on two different σ_t. One is σ_t calculated using the survey data in March and September, which we call the March/September case, and the other is σ_t calculated using the survey data in June and December, which we call the June/December case. Figure 4 plots these two different σ_t. The June/December case is always larger than the March/September case, but roughly speaking their movements resemble each other.

The ADF tests reject the null hypothesis of the presence of unit root and the deterministic time trend is not observed in these series. Thus, we use each series as it is for σ_t in equation (3.7).

3.4 Estimation Results

Based on the residuals from the VAR model together with σ_t calculated by applying the Carlson-Parkin (1975) method to the BOJ's survey data on the forecasts of interest rate, we estimate parameters in the model that consists of equations (3.8) and (3.9). Survey data on the forecasts of interest rate were available since 1974:2. The estimation is conducted using the sample period between 1974:2 and 1996:1, which is called the full sample. As extensively discussed in the previous sections, the Japanese asset markets experienced a bubble-like behavior and also its crash after 1985. Thus, there is a possibility that the full sample analysis may be biased by extraordinary behavior of this period. Hence, we also estimate the model using the sub-period between 1974:2 and 1984:2, which can be considered as the pre-bubble period.

Let us first summarize the results on the residential land, which is shown in Table 7, Panel A. The most important are parameters g_1 and g_2. In all cases, a likelihood ratio test rejects the null hypothesis of $g_1 = g_2 = 0$. This provides evidence that the expectation diversity σ_t significantly affects price sensitivity β_t, which is consistent with our model of non-Walrasian markets.

The table also presents the maximum value and minimum value for the estimates of β_t. One possible problem is that in the sub-sample, the maximum value is positive while the minimum value is negative. The sign reversal of β_t is problematic to our model because the model predicts that the sign of β_t does not depend on σ_t and the absolute value of β_t is increasing in σ_t. The sign reversal, however, is not observed in the full sample, where both of the minimum and maximum values are positive. This result in conjunction with positive estimates of g_1 and g_2 indicates that a rise in σ_t leads to an increase in the absolute value of β_t. In all cases except the March/September case in the sub-sample, g_2 is statistically significant, providing evidence that the effect of σ_t on β_t is larger when the innovation in the previous period's return is positive. In the June/December case in the full sample, g_1 is not significant, indicating that σ_t affects β_t only when the innovation in the previous period's return is positive.

Next, let us turn to the commercial land. Table 7, Panel B summarizes the estimation results for the commercial land. In all cases, a likelihood ratio test rejects the null hypothesis of $g_1 = g_2 = 0$. The sign reversal of β_t is not observed in any cases. Hence, the results on the commercial land strongly support the non-Walrasian model of asset markets.

In all cases, the estimates of g_2 are positive and statistically significant, and hence the effect of σ_t on β_t is larger when the innovation in the previous period's return is positive. Except for the March/September case in the full sample, g_1 is not significant, indicating that σ_t affects β_t only when the innovation in the previous period's return is positive.

4 Concluding Remarks

Japan remains exotic to the eye of western observers and her economy seems still mysterious to neo-classical economists. The behavior of Japanese land prices is placed atop of such mysteries. In this paper, however, we have shown that it is not a mystery but largely a result of the market structure and institutional distortions. The failure to recognize the deviation of the land market from the well-behaved

Walrasian financial market simply made the Japanese land price behavior hard to understand. This paper has shown the limitation of the PV model that assumes a Walrasian asset market, as a long-run theory of land price. In conjunction with this, we have illustrated the quantitative importance of distortionary inheritance and capital-gains taxes in understanding turbulent land price behavior in Japan. It has also been clarified that short-run price behavior is greatly influenced by the non-Walrasian structure of the Japanese land market and that land prices become sensitive to the heterogeneity of investor expectations.

Factors examined in this paper, however, do not exhaust the list of probable causes of turbulent land price behavior in Japan. For example, we were obliged to ignore the "collateral service" value of land for corporations since we were unable to get quantitative data about such a service. We also ignored the expectational "bubble" explanation in this paper, in order to concentrate "real factors" behind the land price behavior. However, as many economists argue, the bubble explanation may have some relevance in explaining the land price behavior. For example, Nishimura (1995) argued that a liberal enforcement of city planning[23] and failure to absorb private returns from public investment fostered unduly optimistic expectations of land prices, regardless of commercial and residential lands. This may trigger a substantial increase in land prices which is not explained by the movement of the market fundamental, as in the famous Peso problem in international finance. To assess quantitative importance of these alternative explanations is an important agenda for future research.

[23] See Takeuchi et al (1993) for details.

Appendix A: Transition of Inheritance and Capital Gains Taxes in Japan: 1958-1997

This appendix summarizes the relevant information about the transition of inheritance and capital gains taxes in Japan between 1958 and 1997, in calculating the time series of the tax shelter value of land reported in Table 3. General discussion is found in Barthold and Ito (1992) for the inheritance tax system and in Ito (1994) for the capital gains tax.

1. Inheritance Tax. After 1958, the inheritance tax in Japan depends now on (a) the number of statutory heirs, (b) tax exemption, (c) tax rate schedule, and (d) tax credit. The inheritance tax is calculated on the basis of the total property bequeathed and the number of statutory heirs (and not distribution among them or nonstatutory heirs). The spouse and surviving children in our model family are statutory heirs. Once the total property and the number of statutory shares are determined, the actual tax is calculated in the following seven steps. Relevant information about tax exemption, rate schedule and tax credit of each year from 1958 to 1997 is summarized in Table A.1.

Step 1: Calculate the inheritance tax base. The inheritance tax base is the total net value of inherited assets minus basic exemption (fixed and per-statutory-heir exemptions). As explained in the text, the land is assessed as 60% of its market value while the financial assets are assessed at the market value.

Step 2: Divide the tax base to each statutory heir according to statutory shares. The share is 50% for the spouse and 25% for each of the surviving two children if there is a surviving spouse. If not, the share is 50% for each of the surviving two children.

Step 3: Apply the tax rate schedule to each heir's share of the tax base to get heir-wise taxes.

Step 4: Sum all heir-wise taxes to get a total inheritance tax.

Step 5: Distribute the total tax to each heir proportional to actual division of inherited assets among heirs.

Step 6: Calculate tax credits based on actual division of inherited assets among heirs.

Step 7: Deduct tax credits from the distributed tax to get actual heir-wise taxes.

2. Capital Gains Tax. Capital gains tax is levied when property is sold. It is a part of the income tax system, and its tax base is the capital gains net of any expenses.

Capital gains tax is far more complicated than the inheritance tax system, with various provisions for specific individuals and corporations. Especially, there are many special provisions for small land owners to reduce their capital gains tax. However, since our objective is to calculate the tax shelter value of land for long-term large-scale land owners, we are concerned with the tax rate and special exemption for them selling "quality residential land". The transition of the tax rate and the special exemption are reported in Table A.2.

Appendix B: Rent and Price Data

Property price and rent data of Section 3 and land price and rent data of Section 2 are constructed by the procedure explained in Nishimura and Sasaki (1995). We briefly explain their procedure in this appendix. A detailed discussion of the procedure is found in Nishimura and Sasaki (1995), which also contains information about publicly available land price data in Japan.

We consider the price and rent of "typical" commercial and residential properties in the metropolitan area. The typical commercial property here is an eleven-story building located in a Ward of Tokyo that was the average of commercial office buildings owned by four major real estate companies (*Mitsui, Mitshubishi, Tokyo Tatemono,* and *Tokyu*) in 1975. The typical residential property is the average of two-story houses located in the six largest cities (Tokyo, Osaka, Nagoya, Kyoto, Kobe, and Yokohama).

As for the commercial property price and rent, we refine the method of Ueda (1992). First, we estimate every six months the average rent on the rental properties owned by the four major real estate companies, from their financial statements. Secondly, we estimate the average value of these rental properties in 1975, using information contained in *Keizoku Chinryo no Jittai Shirabe [Survey on Actual Rollover Rents]* (Tokyo: Nichizei Fudosan Kanteishi Kai, 1976). The same survey contains the breakdown of the overall property value into the building value and the land value. Using this information we estimate the average value of the buildings including the value of the land at that time. The land value in the other years is then calculated utilizing the data contained in *Shigaichi Kakaku Shisu [Urban Land Price Indices]* (Tokyo: Japan Real Estate Institute, various issues). The building value in the other years is calculated using information about building costs contained in *Kenchiku Tokei Nenpo [Annual Report on Construction]* (Ministry of Construction, various issues).

The residential property price and rent are estimated in an analogous way. First, there are rollover rent data in major cities in *Kouri Bukka Chosa [Survey on Retail Prices]* (Tokyo: General Administration Agency, various issues). We calculate the average rent per square meter in the six largest cities. Secondly, using information contained in *Keizoku Chinro no Jittai Shirabe* like commercial properties, we estimate the average value per square meter of the rental residential properties in 1975 and its breakdown into the building value and the land value. The land value in the other years is then calculated utilizing the data contained in *Shigaichi Kakaku Shisu.* The building value in the other years is calculated using information about building costs contained in *Zenkoku Mokuzo Kenchikuhi Sisuu [National Price Index for Wooden Buildings]* (Tokyo: Japan Real Estate Institute, various issues).

The above procedure generates the data of the property rent, the property price, and the latter's breakdown into the building price and the land price. Remaining is the land rent which is obtained by subtracting the user cost of the building from the property rent.

In Section 4, we consider various economic variables that may affect land markets. The variables and their sources are: (a) commercial building starts (floor space): *Monthly Construction Statistics* (Ministry of Construction); (b) commercial office rent:, *Survey on Actual Rollover Office Rents* (Tokyo Building Association), (c) money supply, total bill-clearing volume, Nikkei average, new loan to real estate industry, and market value of listed real estate companies in Tokyo Stock Exchange; all are taken from *Economic Statistics Annual* (Bank of Japan); (d) GDP and fixed capital formation are taken from *Annual Report of National Accounts* (Economic Planning Agency).

Appendix C: Carlson=Parkin (1975) method

Carlson and Parkin (1975) introduce a method of extracting quantitative information about the distribution of expected inflation among economic agents from a survey of their expected *direction* of price change.

Suppose that the proportion of responses in period t is computed for each of three categories: A_t for "go up"; B_t for "go down"; and C_t for "stay unchanged" ($A_t + B_t + C_t = 1$.) Carlson and Parkin assume that the individual answers as follows: (1) "up" if his or her expected inflation rate m_t exceeds a threshold number δ_t; (2) "down" if m_t is below $-\delta_t$; (3) "no change" if m_t lies between $-\delta_t$ and δ_t. Under this assumption, we have

$$A_t = Pr(m_t \geq \delta_t), \tag{C.1}$$

$$B_t = Pr(m_t \leq -\delta_t), \tag{C.2}$$

$$C_t = Pr(-\delta_t < m_t < \delta_t). \tag{C.3}$$

It is convenient to standardize m_t by the transformation $y_t = (m_t - E(\pi_t))/\sigma_t$, where $E(\pi_t)$ and σ_t are respectively the average and the standard deviation of expected inflation among the population. Then, we have

$$A_t = Pr(y_t \geq a_t), \tag{C.4}$$

$$B_t = Pr(y_t \leq b_t), \tag{C.5}$$

with a_t and b_t given by

$$a_t = (\delta_t - E(\pi_t))/\sigma_t, \tag{C.6}$$

and

$$b_t = (-\delta_t - E(\pi_t))/\sigma_t. \tag{C.7}$$

Equations (C.6) and (C.7) can be solved for $E(\pi_t)$ and σ_t to give

$$E(\pi_t) = -\delta_t(a_t + b_t)/(a_t - b_t), \tag{C.8}$$

$$\sigma_t = 2\delta_t/(a_t - b_t). \tag{C.9}$$

Suppose that y_t follows the standard normal distribution. We can then compute a_t and b_t from equations (C.4) and (C.5) given the A_t and B_t data. Suppose further that δ_t is constant over time. Then, the role of δ_t is simply to scale $E(\pi_t)$ (see equation (C.8)). This scaling can be achieved by making the average value of $E(\pi_t)$ over the sample equal to the actual rate of inflation over the sample period, *i.e.*

$$\hat{\delta} = \sum_{t=1}^{T} \pi_t / \sum_{t=1}^{T} \frac{a_t + b_t}{a_t - b_t}. \tag{C.10}$$

Substituting the obtained $\hat{\delta}$ into δ in equations (C.8) and (C.9) will yield $E(\pi_t)$ and σ_t.

In this paper, we apply the Carlson=Parkin method to the interest rate forecasts surveyed by the Bank of Japan, which are obtained from *"Nichigin Tankan"*. Every three months the Bank of Japan has asked the selected companies in Japan whether they think loan rates will go up, go down or stay the same over the next three months. Since we are concerned with the interest rate, we use the bank loan contract rate in stead of π_t in (C.10).

One problem arises in applying the Carlson=Parkin method to our data. Our data, though it is not so common, includes periods in which no one answers "go up" i.e., $A_t = 0$ or in which no one answers "go down" $B_t = 0$. In such periods, a_t or b_t cannot be obtained (see equations (C.4) and (C.5)). To avoid this problem, we use the following *ad hoc* adjustment. If $A_t = 0$ ($B_t = 0$), we set $A_t = 1\%$ ($B_t = 1\%$) and decrease C_t by 1%.

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Table 1. Net Land Acquisition by Sectors (All Types of Land)

Area	Nation (in billion yen)			Center of Tokyo (in m2)		
Sector	Household	Corporate	Public	Household	Corporate	Public
1970	-2,119	1,624	495	na	na	na
1971	-3,347	2,706	641	na	na	na
1972	-4,642	3,791	851	na	na	na
1973	-6,388	5,531	856	na	na	na
1974	-3,394	2,343	1,052	na	na	na
1975	-2,449	1,296	1,153	na	na	na
1976	-1,953	749	1,204	na	na	na
1977	-1,524	27	1,497	na	na	na
1978	-243	-1,593	1,836	na	na	na
1979	-2,382	327	2,055	na	na	na
1980	-3,808	1,242	2,566	na	na	na
1981	-4,175	1,484	2,691	-497	185	312
1982	-3,560	776	2,784	-618	-80	764
1983	-3,610	874	2,736	-702	625	78
1984	-3,178	465	2,713	-671	541	132
1985	-5,649	2,795	2,853	-1,291	1,180	110
1986	-5,899	2,961	2,938	-1,606	1,387	221
1987	-8,806	5,350	3,456	-1,362	1,309	51
1988	-12,489	8,437	4,053	-1,163	937	226
1989	-14,484	10,273	4,211	-1,167	885	255
1990	-17,710	12,985	4,725	-1,782	1,649	133
1991	-10,018	5,012	5,006	-1,411	1,072	338
1992	-8,366	2,456	5,910	na	na	na
1993	-4,766	-1,728	6,494	-258	245	45
1994	2,056	-7,939	5,883	-80	63	17
1995	-5,591	-478	6,069	-69	57	12
1996	-122	-5,394	5,516	-62	43	19
1997	na	na	na	-52	64	-11

Source: *Annual Report on National Accounts* 1998, Economic Planning Agency, *Tokyo no Tochi [Land in Tokyo] 1985-1997* Tokyo Metropolitan Government.

Note: "na" denotes "not available". The corporate sector includes financial and non-financial organizations, and the public sector includes nonprofit organizations. Entries at the center of Tokyo before 1989 are the sum of transactions in selected 4 wards and 4 cities, and the remainders are in 23 wards.

Table 2. Tax Shelter Value as Percentage of Market Price

Year	Farmer	Non-Farmer	Year	Farmer	Non-Farmer
1958	-7.07%	1.67%	1978	96.58%	5.28%
1959	-5.89%	5.20%	1979	98.84%	9.35%
1960	-6.30%	6.08%	1980	117.85%	10.47%
1961	-5.97%	11.29%	1981	137.84%	12.11%
1962	-7.79%	8.92%	1982	161.14%	14.64%
1963	-10.06%	7.06%	1983	172.75%	15.65%
1964	-8.83%	7.99%	1984	172.54%	15.84%
1965	-9.05%	11.36%	1985	129.11%	15.52%
1966	-8.38%	9.18%	1986	102.23%	9.18%
1967	-7.62%	16.89%	1987	184.40%	-2.84%
1968	-6.13%	10.16%	1988	258.36%	-3.28%
1969	15.65%	3.91%	1989	271.99%	6.39%
1970	14.64%	3.63%	1990	256.20%	5.81%
1971	17.91%	3.79%	1991	338.33%	18.60%
1972	11.56%	2.31%	1992	188.18%	19.00%
1973	13.21%	2.75%	1993	257.10%	35.16%
1974	12.90%	1.67%	1994	199.10%	27.31%
1975	112.97%	1.45%	1995	169.33%	23.65%
1976	99.12%	6.00%	1996	161.55%	23.10%
1977	82.43%	5.32%	1997	128.18%	19.65%

Source: Authors' calculation.

Table 3. Order of Integration of Key Variables

Period	1958-85	1958-97
Residential Land Price	1	2
Residential Land Rent	1	1
Residential *FV* (Fundamental Value)	1	2
TSV_F (Tax Shelter Value for Farmer)	1	2
TSV_{NF} (Tax Shelter Value for Non Farmer)	1	1

Period	1963-85	1963-97
Commercial Land Price	1	2
Commercial Land Rent	1	1
Commercial *FV* (Fundamental Value)	1	2

Note: The order of integration is obtained by the augmented Dicky-Fuller (ADF) test where the length of lags is determined by the AIC criteria.

Table 4. Estimation Results of Augmented PV models (Semi-annual data)

Land Use	Dependent Variable	Estimation Period	Independent Variable	Coefficient	*t-stat.*	*DW*	Adj.R^2	*Fstat(P)*	Cointegration
Residential	*P*	1958-1997	constant	355.639	0.367	1.709	0.976	0.000	**
			FV	0.763	5.288				
			TSV_A	0.081	2.118				
			TSV_H	0.486	2.194				
			rho	0.608	4.103				
		1958-1985	constant	-979.138	-1.302	1.966	0.925	0.025	**
			FV	1.056	9.218				
			TSV_A	0.022	0.284				
			TSV_H	0.020	0.023				
			rho	0.423	2.105				
	P-P(-1)	1958-1997	constant	79.396	0.381	1.608	0.625	0.000	**
			FV - *FV*(-1)	0.573	4.211				
			TSV_A-TSV_A(-1)	0.134	4.946				
			TSV_H-TSV_H(-1)	-0.244	-0.669				
			rho	0.463	1.455				
		1958-1985	constant	134.348	0.760	1.601	0.399	0.000	**
			FV - *FV*(-1)	0.414	2.116				
			TSV_A-TSV_A(-1)	0.007	0.069				
			TSV_H-TSV_H(-1)	1.154	1.171				
			rho	0.533	0.817				
Commercial	*P*	1963-1997	constant	-58342.081	-2.263	1.837	0.970	0.007	
			FV	1.083	10.969				
			TSV_H	26.289	2.998				
			rho	0.798	5.298				
		1963-1985	constant	8112.361	0.478	1.790	0.707	0.001	
			FV	0.887	7.456				
			TSV_H	-12.429	-2.133				
			rho	0.416	2.070				
	P-P(-1)	1963-1997	constant	-715.651	-0.130	1.623	0.621	0.042	**
			FV - *FV*(-1)	0.949	7.520				
			TSV_H-TSV_H(-1)	24.015	2.680				
			rho	0.376	1.960				
		1963-1985	constant	-234.038	-0.094	1.624	0.354	0.000	**
			FV - *FV*(-1)	0.587	3.727				
			TSV_H-TSV_H(-1)	10.340	0.557				
			rho	0.403	0.606				

Source: Authors' calculation.

Notes: (1) *DW* is the Darbin-Watson statistics. (2) *Fstat(P)* is the *P* value of *F* statistics for the constraint that the coefficient of the *FV* should be unity. (3) Rho is the lag coefficient of *AR*(1) errors. (4) Sign ** in the Cointegration column shows that the cointegration relationship among dependent and independent variables cannot be rejected at 5% significance level.

Table 5. Correlation coefficients between return and each variable

	variable	correlation coefficient
Residential land		
1	Money Supply	0.411
2	Total bill-clearing volume	0.401
3	Nikkei average	0.211
4	GDP	0.204
5	Fixed capital formation	0.189
6	New loan to real estate industry	0.177
7	Residential rent index	-0.111
8	Housing starts	-0.075
9	Market value of listed real estate companies (Tokyo Stock Exchange)	-0.048
10	Land transactions	0.006
Commercial land		
1	Total bill-clearing volume	0.402
2	Commercial office vacancy rate	-0.343
3	New loan to real estate industry	0.334
4	GDP	0.315
5	Money supply	0.297
6	Fixed capital formation	0.268
7	Commercial building starts (floor space)	0.164
8	Commercial office rent (new contracts)	0.132
9	Nikkei average	0.127
10	Market value of listed real estate companies (Tokyo Stock Exchange)	0.090
11	Land transactions	-0.055

Table 6. OLS Estimation of the VAR model.

Panel A. Residential Land

$R_t =$ return on the residential land
$Y_{1t} =$ detrended log money supply
$Y_{2t} =$ first-order difference in the log of total bill-clearing volume

	Dependent variable		
Independent variables	P_t	Y_{1t}	Y_{2t}
Constant	0.031***	0.002	-0.019
	(0.008)	(0.003)	(0.021)
R_{t-1}	0.501***	-0.153**	0.510
	(0.143)	(0.065)	(0.402)
R_{t-2}	-0.082	0.097*	-0.029
	(0.121)	(0.055)	(0.341)
$Y_{1,t-1}$	0.886***	1.761***	0.080
	(0.225)	(0.102)	(0.635)
$Y_{1,t-2}$	-0.935***	-0.893***	-0.348
	(0.214)	(0.097)	(0.604)
$Y_{2,t-1}$	0.161***	0.022	0.151
	(0.054)	(0.025)	(0.153)
$Y_{2,t-2}$	0.084	0.032	-0.072
	(0.058)	(0.026)	(0.164)
R^2	0.799	0.959	0.186
LB(12)	8.66	13.26**	7.16

* Figures in parentheses are standard errors. R^2 is the coefficient of determination. LB(12) is the Ljung=Box statistic for up to twelfth order autocorrelation in the residuals. The asymptotic distribution of LR(12) is χ^2 with six degrees of freedom. $\chi^2(6)$ critical values: 10.64 (10%), 12.59 (5%), 16.81 (1%). ***, **, and *denote statistical significance at 1%, 5%, and 10% respectively.

Panel B. Commercial Land

$R_t =$ return on the residential land
$Y_{1t} =$ first-order difference in the log of commercial office vacancy rate
$Y_{2t} =$ first-order difference in the log of total bill-clearing volume

	Dependent variable		
Independent variables	P_t	Y_{1t}	Y_{2t}
Constant	0.055***	0.080	-0.016
	(0.020)	(0.084)	(0.021)
R_{t-1}	-0.149	-0.143	0.146
	(0.145)	(0.615)	(0.154)
R_{t-2}	0.276**	-0.160	0.239
	(0.138)	(0.585)	(0.147)
$Y_{1,t-1}$	0.001	-0.104	-0.038
	(0.036)	(0.154)	(0.039)
$Y_{1,t-2}$	-0.058	0.231	-0.022
	(0.037)	(0.016)	(0.039)
$Y_{2,t-1}$	0.359**	-0.501	0.132
	(0.145)	(0.617)	(0.155)
$Y_{2,t-2}$	0.324**	-0.628	-0.116
	(0.155)	(0.659)	(0.165)
R^2	0.463	0.163	0.205
LB(12)	10.29	4.04	10.32

* Figures in parentheses are standard errors. R^2 is the coefficient of determination. LB(12) is the Ljung=Box statistic for up to twelfth order autocorrelation in the residuals. The asymptotic distribution of LR(12) is χ^2 with six degrees of freedom. $\chi^2(6)$ critical values: 10.64 (10%), 12.59 (5%), 16.81 (1%). ***, **, and *denote statistical significance at 1%, 5%, and 10% respectively.

Table 7. Maximum likelihood estimation of the model that consists of equations (3.8) and (3.9)

Panel A. Residential Land

$y_{1t} =$ innovation in the log of money supply
$y_{2t} =$ innovation in the log of total bill-clearing volume

Sample	Full sample (1974.2–1996.1)		Sub-sample (1974.2–1984.2)	
Number of observations	44		21	
Interest rate forecasts	March/September	June/December	March/September	June/December
g_0	-0.009	0.013	-0.056***	-0.033***
	(0.011)	(0.008)	(0.019)	(0.010)
g_1	0.105**	0.022	0.188*	0.060***
	(0.043)	(0.016)	(0.010)	(0.012)
g_2	0.029**	0.022**	0.012	0.030*
	(0.014)	(0.011)	(0.019)	(0.016)
c_1	0.003	0.003	-0.010***	-0.011***
	(0.002)	(0.002)	(0.002)	(0.001)
c_2	0.010	0.014	0.013	0.013
	(0.043)	(0.012)	(0.010)	(0.008)
σ_r	0.856×10^{-9}	0.892×10^{-7}	0.014***	0.015***
	(0.142×10^{-3})	(0.126×10^{-3})	(0.002)	(0.002)
σ_1	0.012***	0.012***	0.005***	0.210×10^{-8}
	(0.002)	(0.002)	(0.001)	(0.800×10^{-6})
σ_2	0.086***	0.085***	0.036***	0.036***
	(0.016)	(0.016)	(0.009)	(0.009)
Log-likelihood	271.3	269.7	154.7	156.5
LR for H_0 : $g_1 = g_2 = 0$	8.12**	5.02*	10.39***	13.81***
β_t				
Min	0.014	0.019	-0.017	-0.017
Max	0.069	0.044	0.059	0.029

* Figures in parentheses are standard errors. ***, **, and *denote statistical significance at 1%, 5%, and 10% respectively. LR is the likelihood ratio statistic to test the null hypothesis of $g_0 = g_1 = 0$. The asymptotic distribution of this statistic is χ^2 with two degrees of freedom. $\chi^2(2)$ critical values: 4.61 (10%), 5.99 (5%), 9.21 (1%). Min and Max are the minimum and maximum values of the estimates of β_t.

Panel B. Commercial Land

$y_{1t} =$ innovation in the log of commercial office vacancy rate
$y_{2t} =$ innovation in the log of total bill-clearing volume

Sample	Full sample (1974.2–1996.1)		Sub-sample (1974.2–1984.2)	
Number of observations	44		21	
Interest rate forecasts	March/September	June/December	March/September	June/December
g_0	0.146***	0.077	0.072**	0.032
	(0.023)	(0.073)	(0.034)	(0.053)
g_1	-0.320***	-0.055	-0.139	0.064
	(0.054)	(0.163)	(0.104)	(0.137)
g_2	0.194***	0.103***	0.310***	0.158***
	(0.036)	(0.033)	(0.079)	(0.046)
c_1	-0.053	-0.056	-0.085	-0.077
	(0.045)	(0.043)	(0.060)	(0.060)
c_2	0.025***	0.023***	0.034***	0.028***
	(0.009)	(0.007)	(0.010)	(0.007)
σ_r	0.118×10^{-7}	0.275×10^{-6}	0.045**	0.151×10^{-6}
	(0.835×10^{-5})	(0.133×10^{-2})	(0.020)	(0.825×10^{-3})
σ_1	0.307***	0.306***	0.268***	0.271***
	(0.023)	(0.040)	(0.045)	(0.044)
σ_2	0.082***	0.083***	0.036***	0.041***
	(0.013)	(0.013)	(0.006)	(0.009)
Log-likelihood	90.5	90.0	54.1	54.6
LR for H_0 :				
$g_1 = g_2 = 0$	10.23***	9.36***	6.60**	7.59**
β_t				
Min	0.007	0.029	0.017	0.052
Max	0.117	0.107	0.170	0.164

* Figures in parentheses are standard errors. ***, **, and *denote statistical significance at 1%, 5%, and 10% respectively. LR is the likelihood ratio statistic to test the null hypothesis of $g_0 = g_1 = 0$. The asymptotic distribution of this statistic is χ^2 with two degrees of freedom. $\chi^2(2)$ critical values: 4.61 (10%), 5.99 (5%), 9.21 (1%). Min and Max are the minimum and maximum values of the estimates of β_t.

Table A.1. Transition of Inheritance Taxation: 1958-1997

Unit = Million yen

Year	1958-1961	1962-1963	1964-1965	1966-1970	1971-1972	1973-1974	1975- 1987	1988-1991	1992-1993	1994-present
Basic Exemption										
Fixed	1.5	2	2.5	4		6	20	40	48	50
Per Statutory Heir	0.3	0.5		0.8		1.2	4	8	9.5	10
Marginal Tax Rate	**Corresponding Tax Bracket**									
10%	0-2							0-4	0-7	0-8
15%	2-5							4-8	7-14	8-16
20%	5-9							8-14	14-25	16-30
25%	9-15							14-23	25-40	30-50
30%	15-23							23-35	40-65	50-100
35%	23-33							35-50	65-100	
40%	33-48							50-70	100-150	100-200
45%	48-70							70-100	150-200	
50%	70-100							100-150	200-270	200-400
55%	100-140							150-200	270-350	
60%	140-180							200-250	350-450	400-2000
65%	180-250							250-500	450-1000	
70%	250-500							500-	1000	2000-
75%	500-									
Special Exemption and Tax Credit for Surviving Spouse										
Exemption	no special provision			2	4	6	no special provision			
Tax Credit	no special provision						Max [40 million yen, 1/2 of spouse's actually inherited asset value]	amount of inheritance tax on Min [X, spouse's actually inherited asset value]; X = Max [Y million yen, value of spouse's statutory share]; Y = 80		Y = 160
Special Exemption for Farmer's Heirs										
	No Special Provision						Difference between Market and Farming Values			

Source: Ministry of Finance, Tax Bureau, *An Outline of Japanese Taxes* (various issues).

Note: This table shows only the part of the inheritance tax system which is relevant to the model family described in the text.

Table A.2. Transition of Capital Gains Taxation on Long-Term Large-Scale Land Holding: 1958-1997

Unit = million yen

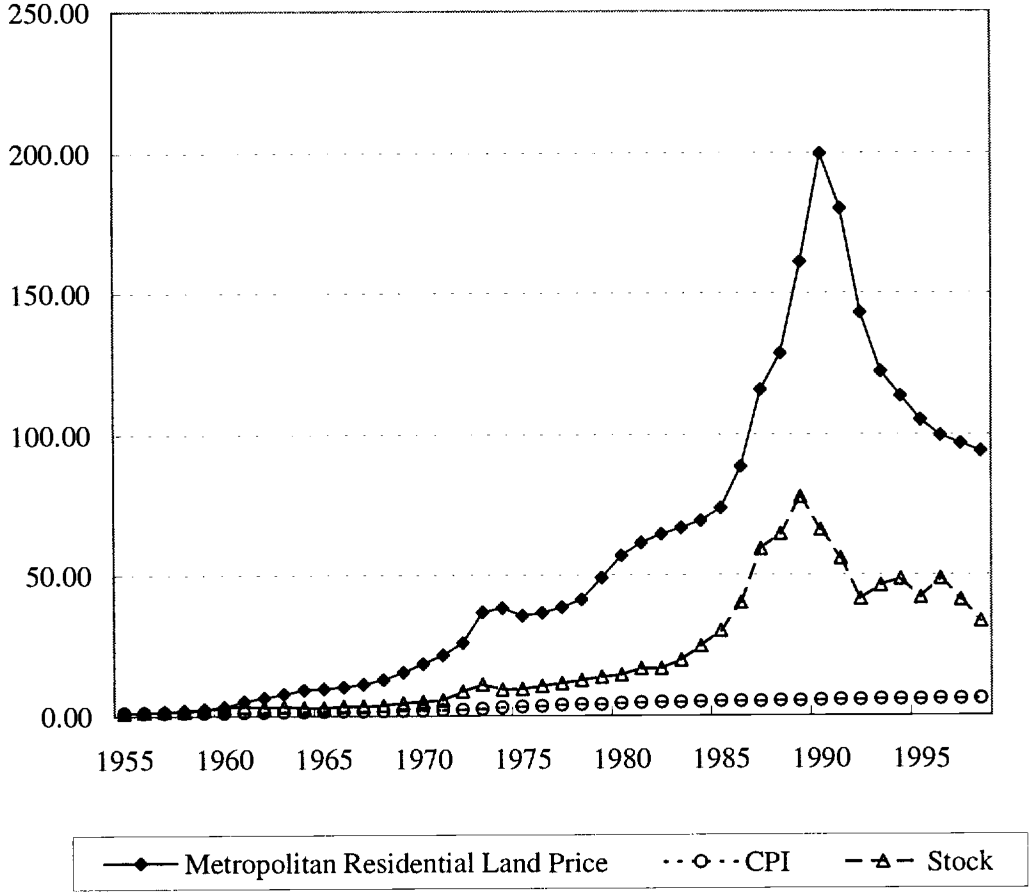
Year	~68	69	70	71	72	73	74	75	76	77	78	79	80	81
Eligibility of "long-term holding"	over 3 years	over 5 years												
Type of Taxation	comprehensive	separate (flat rate)							combination of separate and comprehensive					
Special Exemption														
Residential land	no special provision	10				17		30						
Farmland			1.5			2.5		5						
Marginal Tax Rate (%)														
Bracket														
0-20	progressive rate(*)	14			20		26		26			26		
20-40									progressive rate (**)					
40-60												progressive rate(***)		
60-80														
80-														
Marginal Tax Rate for Farmland in Metropolitan Area (%)														
Bracket														
0-20	No special provision					14	20		20			20		
20-40									26					
40-												26		

Year	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98
Eligibility of "long-term holding"	over 10 years						over 5 years										
Type of Taxation	separate (progressive)						separate (flat)									separate (progressive)	
Special Exemption(****)																	
Residential land	30																
Farmland	5							8									
Marginal Tax Rate (%)																	
Bracket																	
0-20	26						26			20						20	
20-40																	
40-60	32.5															26	
60-80																	
80-																	
Marginal Tax Rate for Farmland in Metropolitan Area (%)																	
Bracket																	
0-20	20			26				26			35.5	No special provision					
20-40																	
40-	26			32.5				29.5									

Source: Ministry of Finance, Tax Bureau, *An Outline of Japanese Taxes* (various issues). This table shows only a part of the capital gain system which is relevant to the model family described in the text.

Notes: (*) 1/2 of capital gain with an exemption of 0.3 million yen is added to usual income tax base, and is taxed as usual income; (**) 3/4 of this part is are added to usual income tax base, and is taxed as usual income. The resulting tax is added to the first 26% tax; (***) 1/2 of this part is added to usual income tax base, and is taxed as usual income. If capital gain exceeds 80 million yen, 3/4 of that part is added to usual income tax base. The resulting tax is added to the first 26% tax. (****) The tax reform of 1993 allowed exemption of the inheritance tax payment from capital gains if the heirs sell the land in order to pay the inheritance tax.

Figure 1 Nominal Residential Land Price, Stock Price and CPI
(1955.3=1)



Source: Land Price (Urban Land Price Index, Japan Real Estate Institute), Stock Price (TOPIX, Tokyo Stock Exchange),
CPI (Annual Report on the Consumer Price Index, Management and Coordination Agency)

Figure 2 Rate of Change of Nominal Land Price, Stock Price and CPI

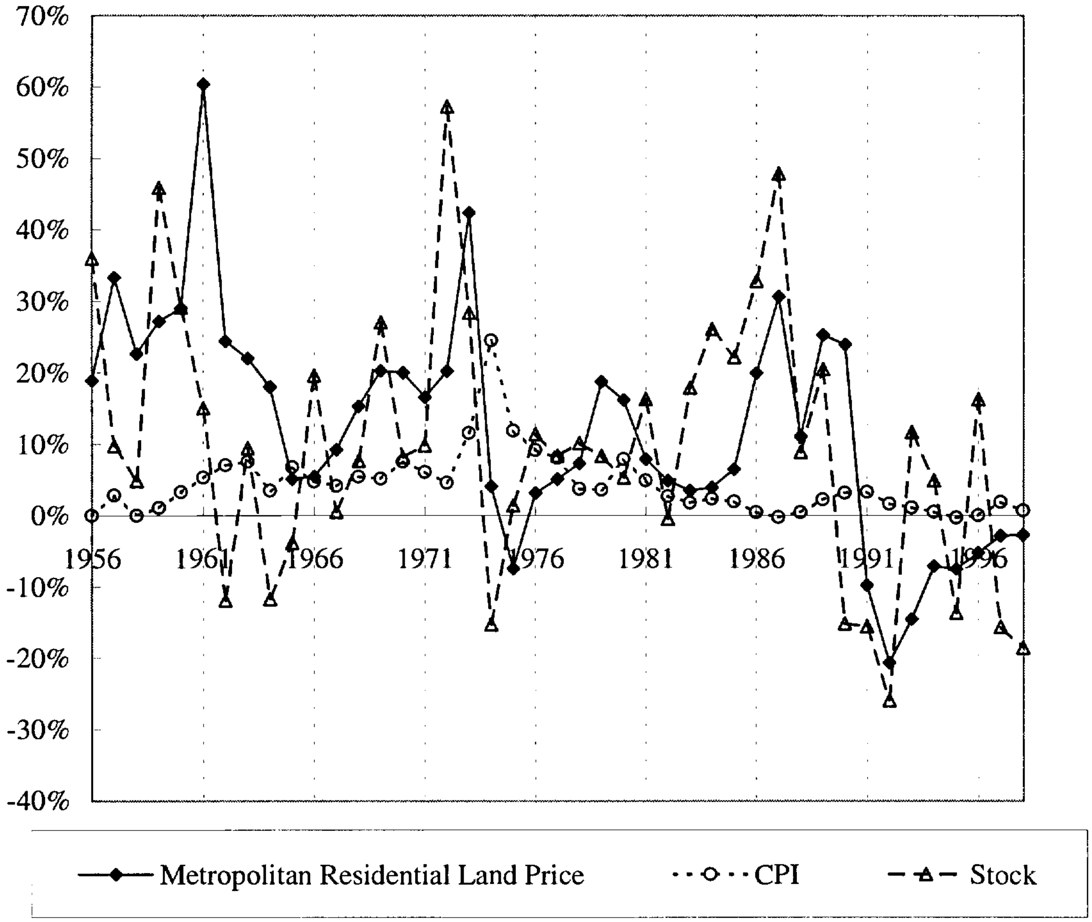
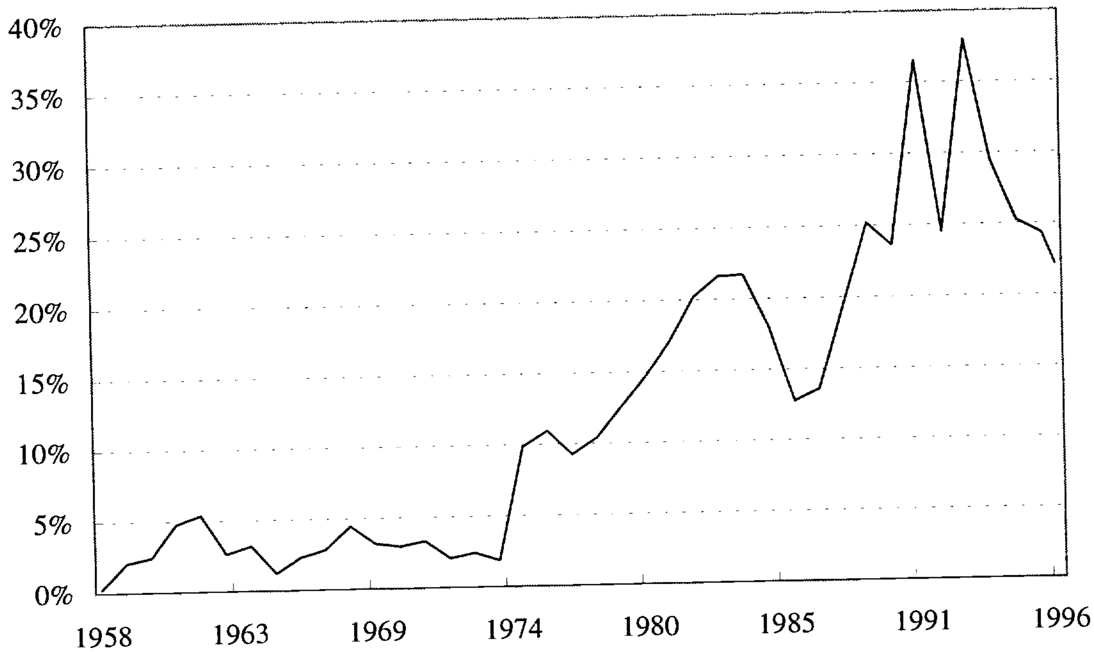


Figure 3
Contributuions of Tax Shelter Values to Residential Land Prices



Source: Authors' calculation from the estimated results of Table 4.

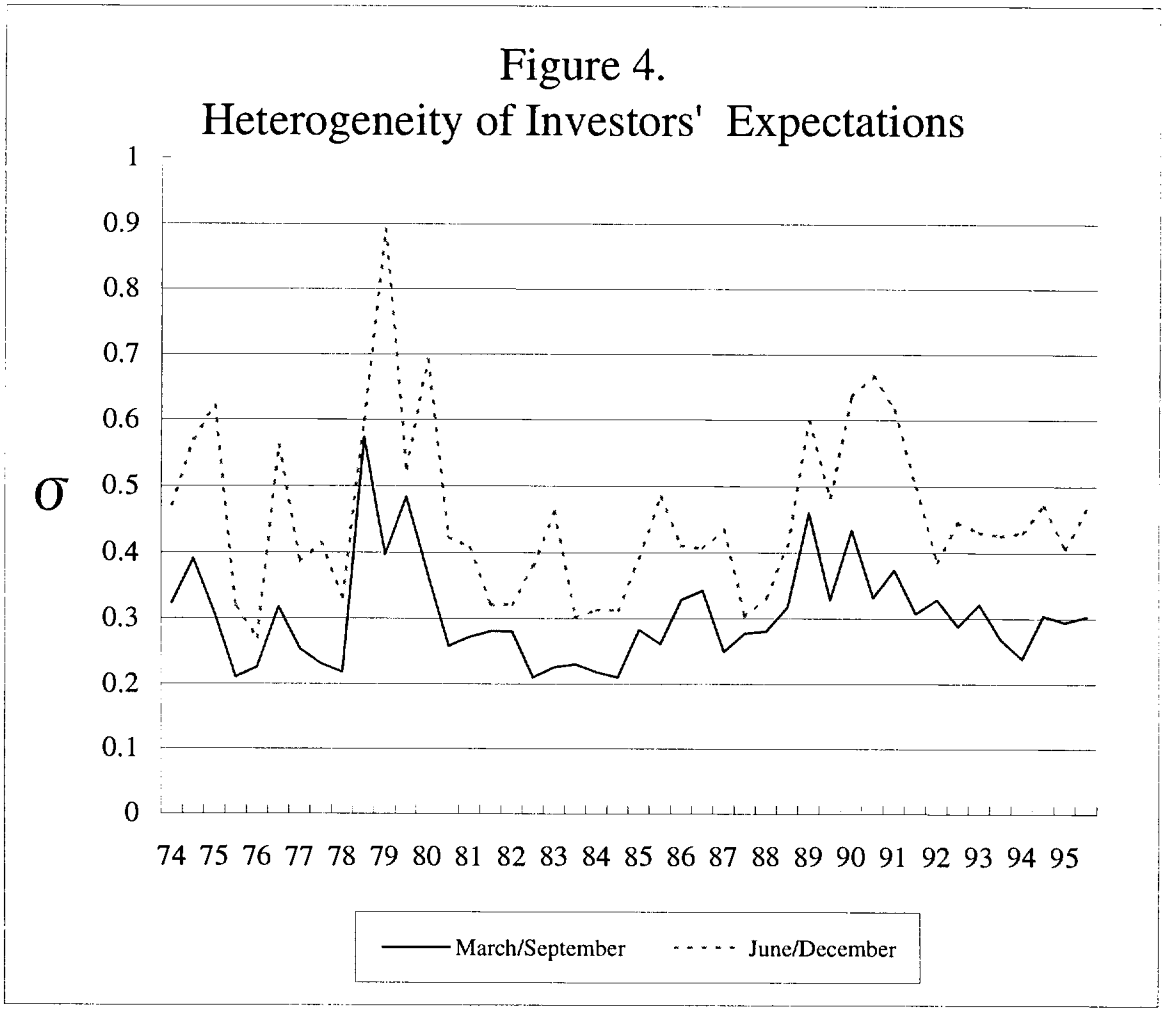


Figure 4.
Heterogeneity of Investors' Expectations
σ
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95
March/September
June/December