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Distortion in Land Price Information
— Mechanism in Sales Comparables and Appraisal Value Relation —

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Abstract

This paper investigates the nature and magnitude of distortion in land price information publicly available in Japan, especially in the Published Land Price of the Japanese Government. After examining characteristics of various land price information in Japan, we construct hedonic price indexes based on both actual transaction prices and Published Land Prices, and compare them to find possible distortion in the governmental price information. We find a large and systematic discrepancy between actual transaction prices and Published Land Prices, suggesting serious problems in the governmental information system. We also consider possibility of structural change in the Japanese real estate markets, and examine its effect on price indexes.

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Introduction

Boom and bust of land prices during the age of the so-called 'bubble economy' has affected the general economy, our economic system as well as our whole life in Japan. We wonder how much land prices rose during the boom period and have fallen thereafter, and where they stand now.

This sounds like an easy question to answer but in fact that is not the case. The first problem is the existence of many different types of land price indices making it difficult to decide which land price index should be analysed. Secondly, appraisal values provided by the qualified appraisers are, in many cases, the source of land price information. Those land prices differ each other as once cynically quoted "four prices for one property". Thirdly, transaction prices on which the appraisal work relies are never disclosed to the public. The adverse effect of these practices cannot to be overestimated.

The competition in securitised real estate and J-REIT markets has become harder. The real estate market and the financial market have worked closely. The Japanese property market, however, has often been criticised for lacking in information and transparency. Moreover, both domestic and foreign investors regard this as an obstruction for development of new trends. In practice, improving land price information is necessary to avoid confusion and to raise market awareness. In the mean time, more new real estate price information is becoming available. Consequently, the real estate market itself seems to be confused since people in the market cannot evaluate fully the quality of the enormous amount of information.

It is necessary to be able to measure market risk, especially risk related to price, in order to develop the real estate market. It is also crucial for public bodies to make an effort towards enabling information disclosure. Under current conditions where we cannot have more crucial information disclosed by public bodies, it is essential for us to understand the errors incurred in the available information, particularly in the published land prices produced by several public bodies. It is unlikely that full information in the market becomes available in the future, even if some of the information is disclosed in the near future. Therefore, the current published land prices will remain important. Hence the issue of errors in the available market information will continue to be a serious one.

This is a problem known as the 'valuation error' and has been studied in Japan as well as overseas. Cole, Guilkey and Miles (1986), Jeffries (1997), for example, statistically checked the difference between transaction prices and appraisal values. Crosby (2000) is an international comparative study of the impact on valuation accuracy by different social structures across different countries. Geltner, Graff and Young (1994), Geltner (1997, 1998), Bowles, McAllister, and Tarbert (2001) dealt with the impact of appraisal error on real estate indices and showed a time-lag structure in appraisal-based indices. In Japan, Hidano et al. (1992, 1995, 1999) revealed the existence of time lag in the index based on '*Published Land Price'* (PLP). The range of coverage in the *Published Land Price Survey* by the Ministry of Land, Infrastructure and Transport (MLIT) is very wide and unparalleled in the world.

Other than the technical aspects of appraisal practices, the independence of appraisers is a serious issue. Gallimmore and Wolverton (1997), Kinnard, Lenk and Worzala (1997) and Wolverton (2000) suggested the possible bias caused by the client and appraisal fee structures that are based on appraisal values. The fee for published land appraisal is uniform across all surveyed sites in Japan.[1)] However, we cannot deny the possibility of bias caused because of the structure of public finance.[2)]

In our opinion, our discussion should be based on transaction price information since transaction prices are the base of all land price information. We summarised the different types and characteristics of the land price information available and explained their statistical meanings (Chapter 2). We then developed land price indices based on transaction price information in the Tokyo area using the Hedonic Approach. For the commercial sector, the database was constructed on transaction information in three core Wards in Tokyo, namely Chiyoda-Ward, Chuo-Ward and Minato-Ward. For the residential sector, we focused on Setagaya-Ward, which is a well-known residential area in Tokyo. In those areas we collected as much historical transaction information as possible. We then carried out an empirical analysis investigating these hedonic transaction price-based indices and the two most frequently used land price indices in Japan namely the *Published Land Price* (PLP) produced by the MLIT and the *Urban Land Price Index* (ULPI) published by the Japan Real Estate Institute.[3)] Furthermore, we compared the transaction-based index with another hedonic-based index constructed on the PLP in order to analyse any bias in the PLP, (Chapter 3).

Land price information and characteristics

There are several kinds of land price indices. This situation was once described as “four prices for one property”. Therefore it is necessary to make clear what ‘land price’ means, what kind of information is available and what characteristics that information has before undertaking any analyses of those indices.

One of the authors of this study summarised land price information about seven years ago (Nishimura 1995). The amount of information, especially from private institutions, has significantly increased since 1995. This is partly because traditional land information is not sufficiently suitable for new types of real estate markets, and partly because the public bodies have not provided the satisfactory data.

The information produced by various government bodies are *Published Land Price* (PLP) produced by the MLTI, *Land Price Survey* (LPS) produced by each Prefecture, *Land Price for Inheritance Tax* (LPFIT) produced by the National Tax Agency, *Land Price for Property Tax* (LPFPT) produced by

1) Appraisers received 67,270 Yen for appraisal work in each case in the 2002 survey. There is no possibility of bias in this fee structure.
2) The link between property tax and Published Land Price may be an incentive for keeping appraisal values high during times of financial strains within local governments.
3) Classic studies using sales comparables include Nakajima (1990) and Hidano (1992, 1995, 1999).

local municipal offices. From private institutions we have, *Urban Land Price Index* (ULPI) produced by Japan Real Estate Institute, *Residential Land Price Survey* (RLPS) produced by the Housing Loan Corporation, *Land Price Map of Tokyo Metropolitan Area* (LPMTMA) produced by the Association of Tokyo Real Estate Business, *Land Price Survey in Big Urban Regions* (LPSBUR) produced by Misawa Institute, *Land Price Map* (LPM) produced by Tokyu Real Estate Development and *Land Price Table* (LPT) produced by Jutaku Shimpo. Additionally, Nissei Life Research Institute has produced *Land Price Index in Tokyo Metropolitan Area* with Sanyu System Real Estate Financial Institute, and RECRUIT has developed their *Recruit Residential Price Index/RRPI.*

Many of these information series are land prices or land indices based on appraisal values given by qualified appraisers. Other information sources are estimated prices given by local specialists rather than actual transaction evidence. Therefore, it is crucial for us to establish the extent of preciseness and accuracy of the underlying real estate appraisal and appraisal-based indices. While this problem has been discussed as the 'valuation error' problem in many countries, the problem is thought to be greater in Japan where appraisers have less contact with market evidence than in many other countries.

One of the common problems giving rise to valuation error is lack of information in periods of changing market conditions. Generally, fewer transactions happen when the market is changing. Valuation error can be bigger with fewer transaction data. Appraisers may make mistakes in choosing comparables when market moves up or down drastically.

Secondly, it is much more difficult to evaluate a survey point where information in that locality is few or rare. This problem is closely linked to the first one. Since we have no systematic way of collecting transaction comparables, this issue can be more serious.

Thirdly, there is a problem related to the time lag between the time of information collected and the appraisal date. This is more obvious for the *PLP*. The appraisal date of the *PLP* is 1st January every year. The dates of transactions for sales comparables are mostly a few months earlier than the appraisal date. Appraisers adjust the information by way of 'time adjustment'. The error related to this adjustment becomes significant since they are required to forecast a long period under inefficient data collection system.

Empirical analysis of real estate indices precision

We examined the above issues statistically using our transaction price database.

First of all, we established hedonic-based land price indices. Real estate asset is a heterogeneous and its price depends on the type of the nearest station, distance to the nearest station and CBD area, floor to site ratio, site area and so on. Therefore, we need to control for those characteristics in order to observe a set of time-series price data. After making the necessary statistical adjustments for differences in factors of each sample, we tested the characteristics of *the PLP* series, the main source of land price information in Japan, as well as the *ULPI*, a traditional land price information source

supplied by Japan Real Estate Institute.

Comparing the transaction-based index and the *PLP* index, the latter followed the former with a time lag in the boom period. This is clearer in the case of commercial land index. In 1982 and 1986, the *PLP* index continuously rose while the transaction-based index dropped. This pattern suggests that the *PLP* index has tried to fill the lag in the following years. With regard to residential prices, the implied growth rate of the transaction-based index was smaller than that of the *PLP* index by late 1970s. Then the *PLP* index caught up with the transaction-based index between 1981 and 1983 when the former was stable and the latter went up. It has been pointed out that the survey points had been replaced between 1981 and 1983 so that they could close the gap between the *PLP* series and what actually happened in the market. So the growth rate of the series did not show actual market growth but a 'catch up rate' to reality.

In comparison with the *ULPI,* our analysis suggests that the index has a different peak time and a different timing of land price rises from our index. This is believed to be have been caused by the smoothing effect of the appraisal process. Consequently, we conclude that it is more problematic to use the *ULPI* to understand land price trends than the *PLPI*. The problem would be more serious when the gap in regional differences becomes bigger as a result of urban city regeneration policy.

Further analysis of the *PLPI* was undertaken to investigate the magnitude of valuation error in the statistics. In this analysis, we divided our observed period into three parts, namely, the pre-bubble era, the bubble era and the post-bubble era. Our index based on the hedonic function was developed to cope with this structural change in the market. Then the comparison between this index and the *PLPI* was carried out.

It is important to know to how much extent our index and the *PLPI* are different when we use the *PLP* statistics to understand the market trend. Also it affects other appraisals, as in the case in bad-loan appraisal since it is legally required to refer to the *PLP*.

In the Tokyo core area, estimated value to price ratio – we call this V/P ratio hereafter - of commercial site was estimated at 80.84% in 1975. This had fallen to 46.41 % by 1981. Then, the V/P ratio rose rapidly in 1982 and 1983 to 69.55%. After the bust of the bubble, the ratio went over 100% (104.24% in 1993) and as high as 120% in 1999. In Setagaya Ward, the V/P ratio for residential land was 92.85% in 1975 and dropped to approximately 60% in 1980 then rose continuously until 1983. It was about 80% during the bubble era (78.44% in 1986) and then soared in 1992. Again it increased in 1998 and 1999 (115.55% in 1999).

We believe that these analyses have statistically supported the proposition that there is a bias in land price information available in Japan. While we seek to re-generate urban areas and sort out bad loan problems in the financial sector, the increase of liquidity in real estate market is an extremely important activity. The realisation of more liquidity in the real estate market depends on the success of

market value appraisal and pricing mechanisms. This problem can be resolved or, at least, reduced by an organised system of collection of transaction prices.

At the same time, we have few empirical studies on this issue due to lack of disclosure of transaction price information within our real estate market. It is an urgent requirement that government bodies should organise and disclose the relevant information to the same extent as in the Western countries so that we can improve market transparency through research.

1. Type and characteristics of land price information

We have several kinds of information on land prices. This was once described as a situation of ”four prices for one property”. Therefore, it is necessary to make it clear what ‘land price’ means, what kind of information is available and what characteristics the information has.

One of the authors of this study summarized land price information available about seven years ago (Nishimura 1995). The amount of information has significantly increased since 1995. We therefore summarised the information again based on that study.

1.1. Multiple prices for one property

We have land price information published by government offices. They are *Published Land Price* by the MLTI, *Land Price Survey* by each prefecture, *Land value for Inheritance Tax* by National Tax Office and *Land value for Property Tax* by each municipal office.

Additionally, private think tanks have produced their own research. There are; *Urban Land Price Index* issued by Japan Real Estate Institute, Residential Land Value Survey by the Housing Loan Corporation, *Tokyo Metropolitan Land Price Map* by the Association of Tokyo Real Estate Business, *Land Price Survey in Big Urban Area* by Misawa Institute, *Land Price Map* by Tokyu Real Estate Development and *Land Price Survey* by Jutaku Shinpo. Furthermore, Nippon Life Institute has developed *Land Price Index in Tokyo Area* with Sanyu System Real Estate Finance Institute, and Recruit published *Recruit Residential Price Index* or RRPI (See, Table 1).[4)]

The information is divided into two groups. The first group consists of information of which purpose is to monitor land market trend. The second one is regarding to land price estimate in certain areas.

The *ULPI* had been the only single index available for a long time while new indices such as *Land Price Index in Tokyo Area* and *RRPI* have recently joined the group. The methodology of index construction of *ULPI* and the other two indices are entirely different. The new indices are based on the hedonic approach as opposed to appraisal-based *ULPI*. Also they have appraised certain sites half-yearly to produce their *ULPI* while the other indices aim to investigate price level on appraisal values, market estimates or transaction information. Transaction information is classified into ‘asking price’ and ‘actual transaction price’.

4) Among institutional investors, return indices have been established such as IPD index in UK and NCREIF index in US. In Japan, STIX by Sumitomo Trust Bank and MTB-IKOMA index by Mitsubishi Trust Bank and Ikoma Data Service. See Matsumura (2001). Also see Shimizu (2000, 2001) for Recruit Residential Price Index.

Table 1- Real Estate Price Information in Japan

Survey	Organisation	Type	Frequency	Availability*
Public Land Price Survey	The Ministry of Land, Trafic and Infrastructure	Appraisal	Annual	1970
Land Price Survey	Prefectural and city goverments	Appraisal	Annual	1975
Assesed value for Inheritance Tax	National Tax Administration Agency	Assessment	Annual	1963
Assesed value for Fixed Asset Tax	Municipal governments	Assessment	Every three years	1950
Appraised Standard Housing Lot Price for Fixed Asset Tax	Municipal governments	Appraisal	Every three years	1994
Residential Market Price Survey	Housing Loan Corporation	Asking Price	Biannual(April & October)	1963
Land Price Map in Tokyo	Tokyo Realty Business Association	Market quote	Annual**	1968
Land Price Survey in Metropolitan Regions	Misawa Research Institute	Market quote	Annual	1979
Land Price Distribution Map	Tokyu Real Estate	Market quote	Annual	1962
Urban Land Price Index	Japan Real Estate Institute	Appraisal	Biannual(March & September)	1955
Recruite Residential Price Index	RECRUIT	Hedonic model	Monthly & Quarterly***	1989
Market Land Price Quote	Jhutaku Shinpo	Market quote	Annual	1959
Sales Comprables	Real Estate Appraisal Association	Sales transaction	-	-

*Availability means that the data is available from this year.

**It started in 1968. The second survey was undertaken in 1972. Then every two years until 1980 and annualy since 1981.

***Sub-index for regions. Weekly-index is also available for information.

Table 1 shows that the data provided by public bodies tend to use appraisal values while the private institutions use data observed in the market. Also land values for tax purposes are provided for each street rather than individual sites, although they are both based on appraisal values. Furthermore, appraisal methodology varies for each survey.

In summary, there are several types of price information. One is transaction price information. We also have appraisal value information such as *PLP*. Then there are information on assessed land value for tax purposes such as inheritance tax and property tax.

1.2. Transaction price & comparables, appraisal values & value for tax purposes

We have a few types of real estate price such as transaction price, appraised price and land value for tax purposes, which we investigate in detail in this section.

1.2.1 Transaction prices and transaction data

Generally, ‘price’ means ‘transaction price’ in economic activities. However, we must bear in mind the fact that there is a gap between ‘asking price’ and ‘contract price’ in the real estate market since each transaction price is decided finally through individual negotiation.

It is very difficult to collect transaction price information in Japan compared to the Western countries. However, there is limited number of transaction price information, which is called ‘transaction comparables’ or *Torihiki Jirei* in Japanese. These sales comparables are basic information for real estate appraisal and collected by the qualified appraisers in order to provide the *Published Land Price Survey* or for their own business uses. The process of collecting those comparables

depends on local practice and the purpose of collection. A typical case can be described as below.

The appraisers start identifying the transactions. Although we may approach brokers to get the information, it brokers are legally prohibited from disclosing information that they have known through their business activities to a third party. Thus they are not allowed to disclose transaction information to the real estate appraisers. Even if the real estate appraisers run brokerage business, they must not use such information. Real Estate Information Network System, REINS, by which brokers exchange transaction information is also subject to legal regulation. Consequently, we need to pursue alternative ways.

In general, real estate transaction has been registered at local registry office. But it is impossible to get the registered information. The registry office sends the information as a 'registration completion letter' to local tax department. The appraisers are have special permit to investigate the information to identify transactions happened in a particular area to establish sales comparables for *PLPS*. Then, they look into the registered record to know names of the seller and buyer and send questionnaire to both parties involved in the transaction under the name of local association of real estate appraisers. Once they have got responses, the qualified appraisers add other information such as site factors including the width of road it faces, grade of road, grade of and distance to the nearest station, town planning regulation and any conditions on transaction. In this way they have it as a transaction comparable record and share it between them. Strictly speaking, however, the comparables are not accurate land price information for several reasons.

The number of vacant land transaction is not so large. The majority of real estate is traded in the form of land and building. The appraisers have collected transaction price information as land and building value in the response. Then they have to take off the value of building from the total transaction price to reach the land price as residual value. This means that the land price depends on how they estimate the building value. As a result, land prices are derived from the appraisers' 'filter' and are not pure transaction prices.[5)] Also, the survey relies on the questionnaire and the response rate is limited and variable.[6)] The accuracy of the suggested information in the response is also uncertain. It takes time to collect the information and leads to the time lag problem especially when the market change is rapid. We should take extra care with our analyses since the data may have lots of such problems.[7)]

In some western countries such as US, UK, Germany and France where the real estate finance

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5) Among the sales comparables, not a few lack some important information such as total transaction price and building value as we discuss later. Furthermore, building value estimates can vary significantly across appraisers.

6) Shimizu(1998) shows that return rate of questionnaire survey in Setagaya-prefecture is about 20%. (The sample includes Part Ownership of Building).

7) They have argued the requirement for property information disclosure for a long time. Japan should disclose transaction price to the market participants under a certain systematic arrangement, as in the US, UK and Germany.

market is believed to be more advanced, the transaction price information is systematically collected and disclosed through formal land registration system.

Having compared with those countries, technical advancement in Japanese appraisal methods has been sought after for a long time. But it would also be important for us to reduce the burden of information collection by establishing an appropriate system.

1.2.2 Appraisal value

In Japan, an appraisal value is formally defined as a value estimated by the qualified appraisers. The Japanese real estate appraisal framework was established in 1963 (38th Year in Showa). The system is underlined by law for Real Estate Appraisal (No 152 of 38th Showa). This law requires the appraiser to evaluate value of real estate by using three appraisal methods, if applicable, namely 'the cost approach', 'the income approach' and 'the comparison approach'. In practice, however, the value based on the comparison approach is heavily weighted when valuing matured urban sites, although they say that weight shifts towards the income approach in recent years.

The Ministry of Construction (Now MLTI) implemented the appraisal system in Japan in response to an enquiry. The enquiry's purpose was to set up policies in order to enhance land price stability, to increase liquidity in real estate transaction, to raise security of acquisition of development site and increase efficiency in land planning. The Building Site Committee discussed these issues and made several recommendations.[8)]

When the appraisal system was put in place, the real issue was how to control the problematic land price inflation. In response to this, the term '**fair** value' was used followed by a long standing debate as to whether the fair value is '*sollen*' price or '*sein*' price in nature.[9)] In July 1980, the Association of Real Estate Appraisers in Japan defined the Fair Value as 'the fair price of marketable real estate in a rational and open market'. It is also described as 'the price achievable between multiple sellers and buyers without prejudice and with open market knowledge where demand and supply interact without any hindrance.

The latter part of the definition allows the appraiser a wide degree of discretion in appraisals when the real estate market changes drastically where there are a limited number of sellers and buyers. This leaves the reliability of the appraisal rather dependent on the integrity of the appraiser.

1.2.3 Land values for tax purposes

There are a number of property-related taxes and assessments for them. Each municipal head carries out valuation for local property tax. Prefectural governor undertakes valuation for property acquisition tax. While the director of the tax office does valuation for inheritance tax and gift tax, the local tax

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8) Please refer to Kobayashi (1964) in detail.

9) Kadowaki (1981), pp49-53.

office estimates the value for registration tax. Because the purpose and the underlying considerations for each assessment differ, these subjective valuations are often not consistent with each other.

This caused a problem of assessment of local property tax and inheritance tax for which valuation was undertaken by the individual municipal governments. The assessment was inconsistent between local governments also across different property types. Moreover, there were significant gaps in assessed values under the two taxes, which developed into serious social problems.

In the Basic Land Law 1989 and the Comprehensive Land Policy Promotion Outline 1991, it was pointed out that the co-ordination of assessment procedures was necessary. Since 1992 the value for inheritance tax has been set at 80% of the PLP level while the value for property tax is set at 70% of the PLP.

The situation is more complicated for those property taxes where the assessment value is not always the taxable value. In order to avoid sudden increases in tax charges, the assessment value has been smoothed through a 'rate of burden' adjustment. The taxable value, affected by previous values, still remains lopsided. In 1999, the ratio between taxable value and assessment value was, on average, 51.17% for commercial land. (This ratio is called 'contribution ratio' in local government finance.) However, the ratio is between 20% and 40% for 27.1% of commercial land and in the extreme case it is only under 20% for 1.5% of commercial land.[10)]

As shown above, it is PLP that gives a base for land valuation for official uses. It is also the base of appraisal for private transactions. Consequently, the accuracy of the PLP affects all appraisal work.

1.3. *Published Land Price* and *Urban Land Price Index* - characteristics

In this section we summarise the characteristics of the *Published Land Price* statistics produced by the Ministry and the *Urban Land Price Index* produced by Japan Real Estate Institute.

1.3.1 Published Land Price

Published Land Price Survey was established in 1970 and its purpose is 'to give a benchmark for land transaction in general and to help with estimating the fair level of compensation given to those who give their land for public welfare purposes in order to achieve fair land prices.

Put it in a more detailed way, the PLP is used as a benchmark for: land transaction in private deals, real estate appraisal; valuation for public land acquisition, an estimate for compensation for compulsory land acquisition, price check for land transaction in Land Use Planning Law, and acquisition price in Land Use Planning Law. In practice, it represents the 'official land price'.

The fair market value per square meters of each surveyed site is published on 1st January every year (Rule 1 of Article 2-2). The Land Appraisal Committee assigns two qualified appraisers to each site

10) According to the Ministry of Public Management, Home Affairs, Posts and Telecommunications.

who decide the public price (Article 2-1).

The subject area for this survey is described in Article 2-1 in Published Land Law (No 49th, Showa 44th) as 'Urban Planning Area designated by Article 4-2, Town Planning Law (Law No 100, Showa 43rd) excluding Area Under Regulation designated by Article 12-1, National Land Planning Law (Law No 92, Showa 49th).

The appraisers use three approaches: Comparison Approach, Income Capitalisation Approach and Cost Approach and reconcile their estimates from each approach into one price (Article 4). In practice, however, these don't carry equal weight. The comparison approach has the greater weight in their calculations when valuing matured urban sites, although it is said that emphasis has shifted towards the income approach in recent years.

From the statistical point of view, the error incurred in the survey must have, in theory, decreased as the number of surveyed sites has increased. However, the number of appraisers responsible for the survey has not increased in line with the sample and hence the error incurred for each survey site can be bigger (There are 31,000 surveyed sites in 2001). The published land price has not been adjusted or revised once published. The error has accumulated over time. Some of survey sites could be replaced when the cumulative gap is too big to ignore. Consequently, only a small number of survey sites have long-term historical records.

1.3.2 *Urban Land Price Index*

Japan Real Estate Institute have published *Urban Land Price Index.* Its aim is to monitor average fluctuation of land prices in urban areas all over Japan on a macro scale. It is a valuable land price index, which enables us to understand long-term trends in land prices.[11)] Its current base year is end-March 1990. The methodology is described below.

The qualified surveyors at the Institute undertake appraisal of selected sites in 230 cities twice a year. The indices are then calculated based on the appraisal value of each sites. They have classified the urban area of each city into commercial area, residential area and industrial area. Each area is divided into three ranks as Upper, Middle and Low sections. They depict a representative plot in each rank. They also survey the highest land price in each city. Each city has ten surveyed sites on average.

The characteristics of this index are described as follows. It is based on appraisal values, is a long-term index (available since pre-war period) and aims to capture land price trends. However, it is impossible to validate how much representative and accurate the index is since the information underlying the surveyed sites is not fully disclosed. Furthermore, the valuation error in a single case can have a significant impact on the outcome since they take only 10 sites in each city.

11) Nippon Kangyo Bank started this index in September 1936 (11th Showa) and Japan Real Estate Institute has taken it over since March 1959 (34th Showa).

1.4. Valuation Error

It has been observed that there is a gap between PLP, ULPI and 'intrinsic' market price since both PLP and ULPI are both based on appraised land values. For example, Nishimura (1995) said: "appraised value lags behind market movement when significant market condition changes prevail" and "in fact PLP was believed to be at 80% of market price level in the late 1980s while it was above market price at the beginning of the 1990s". Mera et al. (1992) suggested the National Land Agency was suspected of manipulating PLP. In their study they suggest that the Agency "attempted to keep the PLP low in the late 1970s by applying a different appraisal approach" and that the Agency "returned to the original approach after they realised the adverse effect on the PLP".

We would put aside the suggestion by Mera et al. (1992). But we have to pay attention to the time lag problem suggested by Nishimura (1995) when using appraisal values. Hidano and others (1995) examined this time lag issue in valuations comparing a transaction price-based index with another index based on the PLP. However, they did not show the extent of the lag. Our new database enables us to measure the lag as well as the magnitude of the bias. In other words, we have attempted the empirical measurement of the valuation error.

We have known that there are three types of potential valuation errors. It is important to understand these to analyse appraisal values.

1.4.1 Valuation error 1 - Market change: Lack of information and valuation error

First of all, in our appraisal practice, the comparison approach carries the greater weight than the other approaches. The valuation accuracy depends on the number of available comparables, their precision and accuracy.

Generally, fewer transactions happen when the market changes rapidly, which leads to more uncertainty. The accuracy of valuation is more fragile when fewer comparables are available in the real estate market, which is itself not inherently a liquid market. The likelihood of errors incurred when choosing information increase when the market goes into a different stage. It is highly likely for the appraisers to mistakenly choose wrong comparables for appraisal when price rise or fall is drastic.

There are several confidential conditions attached to each transaction. This makes it difficult to judge if the 'abnormal' actual prices are the result of a particular condition of the deal or if they are signs of market change. In these circumstances some transactions are regarded as abnormal cases and ignored. In other words, there is a high probability that the appraisers discard 'abnormal prices' when they evaluate a 'fair value'. Consequently the appraisers cannot respond to price changes sensitively when the market moves faster than the appraisers can recognise. According to Gallimmore and Wolverton (1997), appraisers tend not to pick comparables, which do not follow the past trend, but to choose comparables with the smallest change.

1.4.2 Valuation error 2: The highest price?

The next issue occurs when they undertake appraisal of a real estate in an area where very few transactions have taken place for many years. For example, the appraisal of a real estate in a prime location demands good imagination, for example, when it is located in such a premium area where head offices of big listed companies are concentrated. The same is true for estimating a value of the best properties in an area since they are rarely traded. In these cases, the valuation largely relies on the valuers' analytical skills and imagination rather than using relevant evidence available. This may lead to big differences when a transaction in the area actually occurs.

For example, the land price of a site in the Ginza area becomes a matter for discussion, as it is the most expensive location in Tokyo or Japan. It may be imagined that the valuation of such a site would have a larger error than that of a site of average price.

1.4.3 Valuation error 3: Valuation on a future date

The effective date of the PLP valuation is 1st January. Their estimate rely on the comparables which are derived from transactions occurred several months prior to the date of valuation. The appraisers need to make 'time-adjustments' for comparables to fill the gap between the transaction date of the comparables and the appraisal date. The bigger the market change is, the more likely it is for the appraisers to make mistakes in their judgement of the time-adjustment rate as well as the estimated price. For the appraisal of the PLP on 1st January, the appraisers have to adjust a comparable for five months if the transaction happened in July of the previous year. Similarly, they have to adjust the comparable for another five months on the *Land Price Survey* produced by each prefecture as at 1st July each year should the transaction happen in February.

In some occasions, the error caused by the time-adjustment is doubled in a year. The appraisal for the PLP may include two types of errors. One type of error is to misread the market, which ends up in wrong selection of comparables. The other is caused by wrong time adjustment of the comparables.

It is not permissible for the PLP statistics to be corrected at a later point. The error, therefore, accumulates over time.

We have outlined some of the causes of valuation error within our appraisal practice. There are still other possible causes of problems. It is possible that the appraisers are reluctant to allow the PLP to show big falls in areas which fall under the jurisdiction of financially vulnerable local governments because tax income from property tax is linked to the PLP. The appraisal committee is under pressure when they drop prices. There is yet another contention that the PLP has, at times, been kept high so that public bodies may be able to acquire land for public purposes more easily avoiding disputes from landowners. This is a question of independence of appraisers from their instructors as Gallimmore and Wolverton (1997), Kinnard, Lenk, and Worzala (1997) and Wolverton (2000) suggested.

2. Real estate price indices precision – Empirical Analysis

The purpose of this section is to analyse statistical characteristics of land price information available in Japan. In order to analyse land price trends accurately, we need to observe a transaction price-based index which reflects differences in quality of different sites. In this section, firstly we constructed a hedonic based time series index. Secondly we established an index based on the PLP using the same methodology. Then we compared the two indices to clarify the characteristics of the underlying land price information. Another comparison with the *ULPI* was also carried out.

2.1 Database construction

We have constructed our database for statistical analysis as described below.

The information on the PLP has been more digitised and easier to obtain in recent years.[12)] We can have a lot of information on each site. These include address, registered lot number and residential location, price in the year as well as in the previous year and the rate of change, site shape including area size, width to depth ratio, road conditions such as width of road, direction and pavement condition, utility facilities such as water supply, drainage and gas supply, traffic conditions such as the nearest station and the proximity to the station, planning specification such as designated land use, floor to site ratio, building coverage ratio, height regulation and finally land use of surrounding area. We added the accessibility to CBD in order to cope with the wide range of investigated area.[13)]

Secondly, we collected actual sales transaction data. This data is, as we explained, open only to the qualified appraisers. Most of this data has been recorded on paper and it is difficult for us to get long-term historical records. In this study we have collected 8,315 commercial land transaction records in Chiyoda Ward, Chuo Ward and Minato Ward and 10,888 residential transaction records in Setagaya Ward and also made use of some other factors.[14)]

In the process of dealing with paper-based records, we have ignored double-counted data[15)], and data with special conditions in their contract. Then the data has been digitised. Many of these records still lack data on some important variables such as site area, road width, the nearest station and proximity to the station and floor to site ratio.[16)] We have brought in site area data incorporating it into the surveyed points for the period after 1987 using the Land Registration Notice from Land

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12) The digitised information on *Published Land Price* is available from Land Information Centre. All data is now sold at reasonable prices. We need to add location data by using GIS (Geographic Information System) for in-depth analysis. Alternatively we can download this information from their websites but only twenty survey sites for each time.

13) The construction of transport accessibility index has been well managed, e.g. Hidano (1992). However, the subject period of this study is relatively long (1974-1999) and frequent (quarterly). Therefore we gave up using the number of passengers at railway stations and the area population. Instead we used average time taken to travel from the nearest station to terminal stations such as Tokyo, Shibuya, Sinjuku, Ikebukuro, Ueno, Kasumigaseki and Otemachi during daytime. Please refer to Note 17).

14) The data is provided by the Ministry of Land, Traffic and Infrastructure for this study.

15) We found a good few cases with identical location and data for transaction with different transaction land prices. This is due to the difference in estimated building value as explained later.

16) This issue is crucial for the creditability of the transaction data collected by the appraisers. The authorities should

Transaction Data.[17)]

There are also clearly measurement errors among some of these categories, for example, in the data on width of road, the nearest station and proximity to the station and floor to site ratio. We plotted the survey sites on GIS map overlaid it on Zenrin's Residential Map and Road database and then re-measured those figures. From total sample, 1,738 cases of commercial land transaction and 2,897 cases of residential land transaction are excluded[18)] bringing the totals down to 6,577 and 7,991 respectively. We disregarded sample selection bias due to lack of information on bias.

2.2 Construction of hedonic land price index – Basic Models

We constructed a hedonic land price index based on the database described above and analyse its time trend.

There is no single real estate market as such and every real estate is different from each other. In *Published Land Price Survey*, the same sites, with some exceptions, have been repeatedly appraised, but most of the sites have not actually been transacted. In the transaction data, the same sites have not been sold and purchased repeatedly. Each site has different characteristics in terms of size, width of road, floor to site ratio, the nearest station, the proximity to the station and CBD.

These differences caused problems when building our index. We would take an example in the case where we try to monitor land price trend by an index made of average transaction price each month. If transactions are concentrated in city centres where sites have frontage onto the main streets and are close to a station or a CBD area, the average price in that month can be higher even if the real estate market in general shows a downward movement. Therefore we need to control for quality differentials of properties when we analyse real estate market in a time-series.

To control for the differences in quality, there are two approaches. One is the Repeat Sales Approach and the other is the Hedonic Approach. In our study, we did not use the repeat sales approach because there was not sufficient amount of observations. Moreover, the repeated transactions were very likely to be short-term speculative ones. We, therefore, used the hedonic approach.

We have developed a multiple linear regression model to explain land price/LP by proximity to the nearest station and CBD, surrounding environment, site size, floor to site ratio and so on. Then we established a land price index based on the price model.

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urgently tackle this kind of problem.

17) Land Registration Notice has been digitised in each prefecture since 1987. We use the data from Tokyo Metropolitan Government office.

18) The reasons for this exclusion are firstly we could not plot its location on the map since the information was not accurate enough and secondly we could not identify the transactions from Land Registry Notice record. Due to these , we could not measure the distance to the station and CBD. Shimizu (1998) pointed out the inaccuracy in the measuring of distance in the recorded transaction data.

The model is described as follows.

$$\log LP_{it} = a_0 + \sum_i a_{1i} \log X_i + \sum_k a_{2k} \cdot RD_k + \sum_{i,k} a_{3ik} (\log X_i)(RD_k) + \sum_t a_{4t} \cdot TD_t + \varepsilon$$

(Equation 1)

LP: land price of type i at time t
(1=sales transaction, 2= Publisehd Land Price), (t=1975…19
X: Main variables
LA:land lot size (m2)
RW: width of road frontage (10 cm)
ST: The distance to the nearest station (m)
AXX: Accessibility to CBDs(minutes)
YK:Floor to lot ratio (%)
RDk: railway dummy factor (k=0…K)
TDtl: time dummy factor (t=0…T)

Table 2 and Table 3 show the results of Transaction Price Model (TPM) and Published Price Model (PPM) respectively. Figure 1 indicates the estimated quarterly price change with time dummy factor.

In TPM, the adjusted R^2 of commercial site is 0.889 and that of residential site is 0.902. The adjusted R^2 of commercial site in PPM is 0.919 while that of residential site is 0.970. Both models fit very well, especially the PPM.

The PPM has a higher explanatory power than the TPM. We suppose one of the reasons is that transaction price data reflects actual conditions in the market and individual negotiations. This suggests that the Published Land Price data has been substantially adjusted in cross section thorough the appraisers' filter.

Our focus on TPM index shows that commercial land price started to rise in the beginning of 1983 while the residential land price index later in 1985. We can clearly see that commercial land price rose first and residential land followed thereafter. In addition the commercial land index started to fall significantly in late 1992 and reached their 1983 level in 1995. The residential land price index began to decline in 1991.

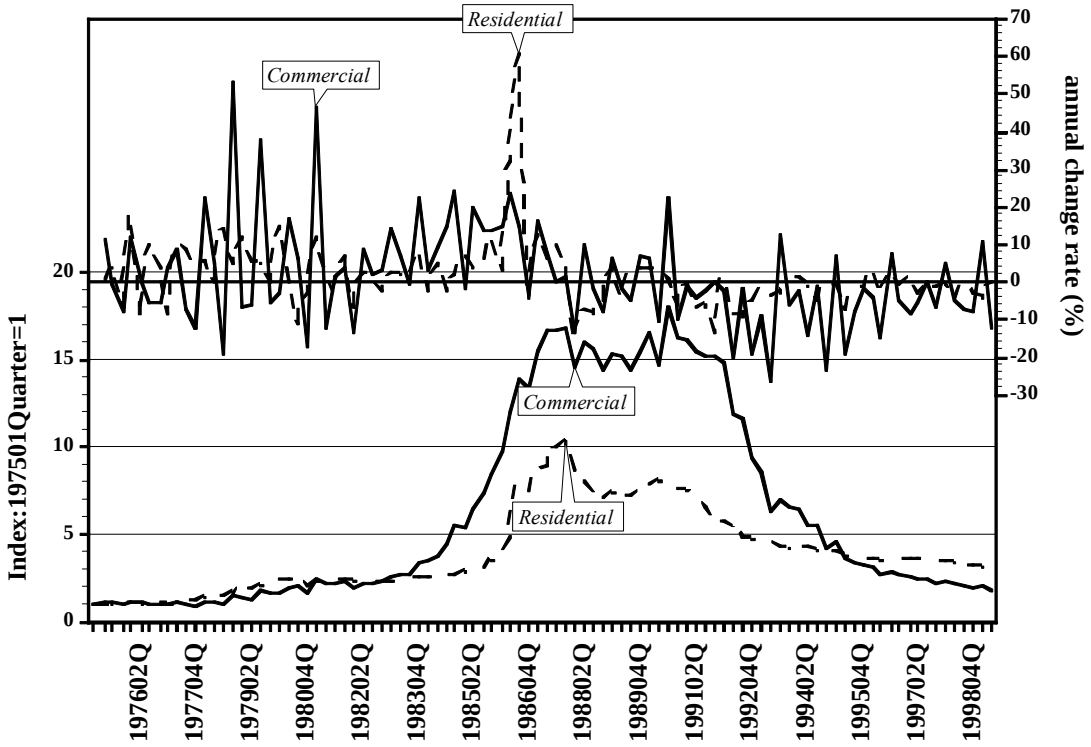


Figure 1 -Transaction Price Index

Table 2 – Transaction price-based Index: Estimate results

Dependent Variable:Log of Land Price per square Meter .Method of Estimation:OLS

Commercial Area(Chiyoda,Chuo,Minato Wards)

Variables(all in log except for dummies)	Coefficient	t-value
Property Characteristics		
Constant	9.734	43.965
LA:Lot Area(㎡)	0.092	11.047
RW:Front Road Widths(10cm)	0.303	38.960
ST:Distance to nearest station(m)	-0.063	-5.958
AC:Accessibility to Central Buisiness District*	-1.040	-20.627
YK:Floor Area Ratio/FAR	0.822	29.143
Raiway/Subway Line Dummy		
Ginza Line	-0.642	-2.173
Marunouchi Line	-3.110	-1.312
Hibiya Line	0.722	3.226
Tozai Line	-1.496	-2.478
Yurakucho Line	-0.392	-1.508
Asakusa Line	0.124	1.305
Mita Line	-0.804	-3.064
Shinjuku Line	0.201	1.715
Chuou Line	-1.789	-1.795
Soubu Line	0.149	5.240
Cross-term Effect by Railway Line Dummy		
LA × Yamanote	-0.056	-4.281
LA × Ginza	-0.035	-2.480
LA × Hibiya	-0.027	-2.189
LA × Chiyoda	-0.138	-3.800
LA × Asakusa	-0.061	-2.926
LA × Mita	0.055	2.367
LA × Shinjuku	0.025	1.553
RW × Murunouchi	0.815	1.682
RW × Yurakucho	-0.072	-2.920
RW × Mita	0.096	2.663
RW × Shinjuku	-0.071	-2.963
ST × Yamanote	-0.222	-12.183
ST × Ginza	-0.035	-1.539
ST × Hibiya	-0.108	-6.350
ST × Tozai	-0.052	-1.630
ST × Yurakucho	-0.146	-6.673
ST × Mita	0.060	1.675
ST × Chuou	0.064	1.554
YK × Yamanote	0.092	2.345
YK × Ginza	0.208	5.427
YK × Hibiya	-0.054	-1.825
YK × Tozai	0.316	3.167
YK × Chiyoda	0.536	3.878
YK × Yurakucho	0.233	5.918
YK × Chuou	0.260	1.577
AC × Yamanote	0.367	3.930
AC × Hibiya	0.194	5.538
AC × Chiyoda	-0.839	-2.570
Time Dummy		
other page	-	-

Adjusted R square=0.889

Number of Observations=6,577

Residential Area(Setagaya Wards)

Variables(all in log except for dummies)	Coefficient	t-value
Property Characteristics		
Constant	14.871	88.581
LA:Lot Area(㎡)	-0.074	-21.748
RW:Front Road Widths(10cm)	0.296	35.721
ST:Distance to nearest station(m)	-0.069	-13.463
AC:Accessibility to Central Buisiness District*	-0.372	-19.098
Raiway/Subway Line Dummy		
Ikegami Line	0.206	2.944
Ooimachi Line	0.484	7.627
Odakyu Line	0.437	8.539
Inogashira Line	0.434	5.307
Keio Line	0.733	6.652
Setagaya	-0.262	-3.721
Cross-term Effect by Railway Line Dummy		
LA × Odakyu	0.022	4.357
RW × Ikegami	-0.191	-3.481
RW × Mekama	-0.124	-3.903
RW × Ooimachi	-0.152	-9.877
RW × Toyoko	-0.070	-2.814
RW × Dentoshi	-0.069	-5.900
RW × Odakyu	-0.054	-4.388
RW × Keio	-0.028	-1.693
RW × Setagaya	-0.031	-1.462
ST × Ooimachi	-0.029	-3.894
ST × Toyoko	-0.057	-3.815
ST × Odakyu	-0.065	-10.790
ST × Inogashira	0.020	1.606
ST × Keio	-0.020	-2.213
ST × Setagaya	0.059	5.672
AC × Dentoshi	0.030	3.304
AC × Inogashira	-0.192	-7.752
AC × Keio	-0.134	-4.118
Time Dummy		
other page	-	-

Adjusted R square=0.902

Number of Observations=7,991

Base Line=Toyoko ,Denentoshi

*Distance measured by time(minuites) required from nearest railway/subway station to major terminals (Tokyo,Shibuya,Shinjuku,Ikebukuro,Ueno,Kasumigaseki,Ootemachi)

Base Line=Yamanote

Table 3- Published Price-based Index: Estimated results

Dependent Variable:Log of Published Land Price per square meter.Method of Estimation:OLS

Commercial Area(Chiyoda,Chuo,Minato Wards)

Variables(all in log except for dummies)	Coefficient	t-value
Property Characteristics		
Constant	11.883	29.046
LA:Lot Area(㎡)	0.175	14.894
RW:Front Road Widths(10cm)	0.312	18.719
ST:Distance to nearest station(m)	-0.255	-18.733
AC:Accessibility to Central Buisiness District*	-0.244	-2.397
YK:Floor Area Ratio/FAR	0.330	7.795
Cross-term Effect		
LA × Ginza	-0.087	-3.774
LA × Hibiya	-0.098	-4.113
LA × Chiyoda	0.070	6.136
LA × Asakusa	-0.082	-8.215
LA × Mita	0.056	4.141
LA × Shinjuku	-0.522	-5.090
LA × Soubu	-0.124	-1.599
RW × Tozai	0.068	3.106
RW × Shinjuku	0.354	5.794
ST × Yamanote	0.055	8.338
ST × Ginza	-0.053	-6.218
ST × Hibiya	-0.032	-3.603
ST × Asakusa	0.055	5.246
ST × Mita	-0.036	-2.623
ST × Soubu	-0.047	-2.461
YK × Shinjuku	0.280	4.011
AC × Ginza	-1.041	-4.486
AC × Hibiya	-0.129	-2.189
Time Dummy		
other page	-	-

Adjusted R square=0.919

Number of Observations=1,712

Residential Area(Setagaya Ward)

Variables(all in log except for dummies)	Coefficient	t-value
Property Characteristics		
Constant	13.804	103.550
LA:Lot Area(㎡)	0.097	12.429
RW:Front Road Widths(10cm)	0.221	15.711
ST:Distance to nearest station(m)	-0.181	-20.557
AC:Accessibility to Central Buisiness District*	-0.718	-19.257
YK:Floor Area Ratio/FAR	-0.049	-6.865
Raiway/Subway Line Dummy		
Ooimachi Line	0.634	4.326
Odakyu Line	-0.272	-2.225
Inogashira Line	0.870	6.504
Cross-term Effect		
LA × Ikegami	0.118	11.148
LA × Odakyu	0.032	2.965
LA × Inogashira	-0.041	-1.979
LA × Setagaya	-0.115	-6.487
RW × Mekama	0.047	2.159
RW × Ooimachi	-0.069	-3.888
RW × Denentoshi	0.065	6.313
RW × Odakyu	0.062	5.217
RW × Keio	-0.017	-1.520
ST × Ooimachi	0.077	4.519
ST × Denentoshi	0.012	1.525
ST × Odakyu	-0.024	-2.283
ST × Setagaya	0.134	8.598
YK × Mekama	0.072	3.813
YK × Ooimachi	-0.073	-4.270
YK × Odakyu	0.035	3.291
AC × Toyoko	0.222	11.158
AC × Toyoko	0.222	11.158
AC × Denentoshi	0.026	1.808
AC × Odakyu	0.118	6.000
Time Dummy		
other page	-	-

Adjusted R square=0.970

Number of Observations=2,620

Base Line=Ikegami,Mekama,Toyoko,Dentoshi,Keio,Setagaya

*Distance measured by time(minuites) required from nearest railway/subway station to major terminals (Tokyo,Shibuya,Shinjuku,Ikebukuro,Ueno,Kasumigaseki,Ootemachi)

2.3 Comparisons: Transaction Price-based Index and other indices

In this part, we compared the Transaction Price-based Index (TPI) with the Published Price-based Index (PPI). In order to see general market trend, we assumed a single function through the subject period and ignored any possible structural changes of the function, which we will deal with in a later section. Then the TPI was compared with the *Urban Land Price Index*.

2.3.1 TPI and PPI

First, for commercial land price, Figure 2 shows that PPI followed TPI with a certain time lag

since 1983 when land price increased. This result supports the hypothesis in Nishimura (1983).

Secondly, PPI rose while TPI dropped in 1982. This movement seems to show that PPI tried to fill the lag between the two indices and the same is true for 1986. The jump in price in that year is probably reflecting the fact that the published land price did underestimate the price change in the previous year. This suggests that we must be very careful when estimating real estate market trends using the published land price statistics.

Thirdly, Figure 2 shows the PPI rose steadily between 1987 and 1992 while the TPI once fell in 1988 and picked up in 1999. This explanation sounds more realistic to those who were involved in the market at that time. In fact it is possible to prove using the TPI that the asset price bubble started in the Tokyo area followed by the Osaka Area and the Chubu (Central) filtered through to the other provincial cities and then flooded back to Tokyo again.[19)]

During the bust of the bubble economy, there were big differences in the extent of the price drop for 1993 across the commercial land price indices. The PPI looks as if it tried to fill the gap since 1983. Currently, it is argued that the published land price is overestimated and beyond the market land price. The indices support this argument. The reason is that the published land price did not reflect the fall of the market price fully in 1993 and it still remains behind.

In terms of residential prices, Figure 3 shows that the growth rate of the PPI had been smaller than that of the TPI up to the late 1970s. However, the PPI did rise and finally caught up with TPI between 1981 and 1983 while the TPI was stable. It has been said that a third of the survey sites each year during those three years were reviewed and replaced by new sites in order to fill the gap.[20)] The degree of increase in the PPI was similar to the increase in the ratio of the published land price to transaction price. It would seem that the construction of the PPI in this period tells us that they made amends to their underestimate in its trend during the previous years, and that the implied rate of change did not reflect the actual real estate market movement. During the period of the bubble economy, as was in case of the commercial land price index, the PPI chased the TPI with a time lag.

2.3.2 TPI and Urban Land Price Index

We move to our analysis of the commercial land index and the residential land price index in the biggest six cities in the *Urban Land Price Index* (both indices are set to 1990=100).

Firstly, Figure 4 describes that the two commercial land price indices illustrate totally different pattern. The sample of TPI comes from the three core wards in Tokyo as opposed to the six biggest cities for ULPI. This is clearly shown in the bubble years when the sharp price rises happened in the

19) Tokyo Metropolitan Government (2000)
20) We were told that the Committee replaced one third of the surveyed sits for three years in order to change all of the previous samples.

Tokyo core wards followed by the surrounding wards, urban cities and further provincial areas.[21)]

The ULPI has been heavily smoothed when there are different rates of change between the surveyed areas as there are given no weight across the surveyed sites. This is the case in its residential price index too. The index has been smoothed especially in the late 1980s. Consequently, we must be careful for this smoothing effect while the UPLI has the advantage of being published biannually. Also the degree of error in the four ranks – highest, upper, middle and low - in each city has not been the same and the difference has changed from time to time.

Here we compare the averages and the standard deviations of TPI, PPI and ULPI (Table 4).

Table 4- Statistical Comparisons of TPI, PPI and ULPI

		Transaction price-based Index	Published Land Price-based Index	Transaction price-based Index	ULPI
Terrm		1976-1999(annually)		9/1975 - 9/1999(bi-annually)	
N=		24		48	
Residential Land	(Average)	7.44	8.26	2.64	1.47
	(Standard Deviation)	31.26	32.03	17.93	9.27
Commercial Land	(Average)	7.77	7.30	3.15	2.22
	(Standard Deviation)	30.19	26.27	13.32	6.50

TPI versus PPI (Annual)

In the residential land price index, the average and standard deviation of TPI is 7.44% and 31.26 respectively as opposed to 8.26% and 32.03 for the PPI. The coefficient of variance (SD/AV) of the TPI (4.20) is slightly larger than that of the PPI (3.88).

For the commercial land price index, the average and standard deviation of the TPI is 7.77% and 30.19 respectively as opposed to 7.30% and 26.27 for the PPI. The coefficient of variance (SD/AV) of the TPI (3.89) is slightly larger than that of the PPI (3.60).

TPI versus UPLI (Biannual)

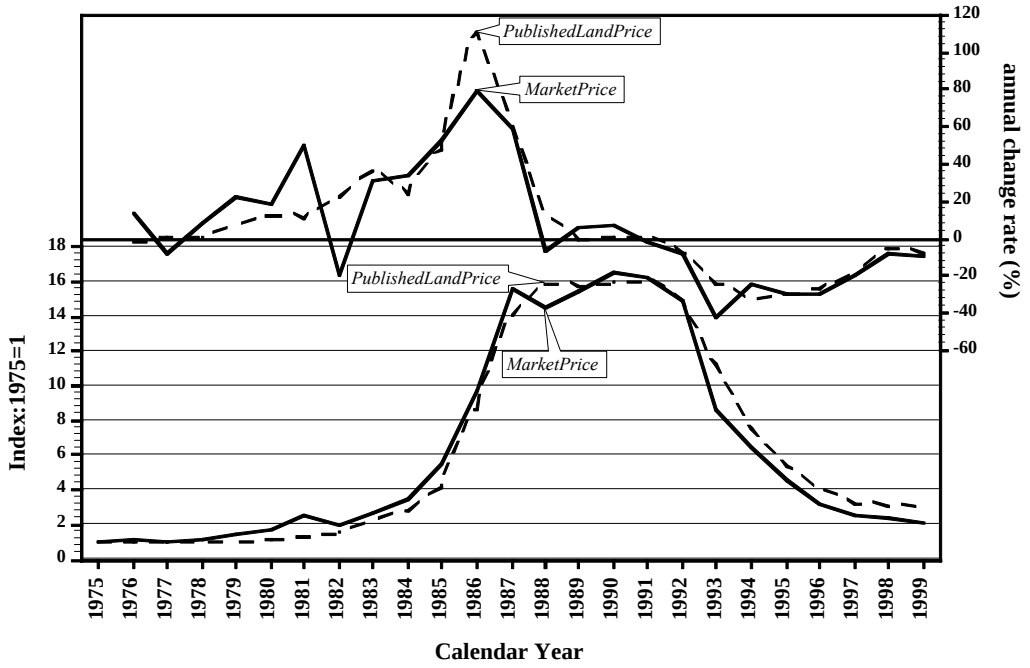
In the residential land price index, the average and standard deviation of the TPI is 2.64% and 17.93 respectively as opposed to 1.47% and 9.27 for the UPI. The coefficient of variance (SD/AV) of the TPI (6.80) is slightly larger than that of the UPI (6.30).

For the commercial land price index, the average and standard deviation of the TPI is 3.15% and 13.32 respectively as opposed to 2.22% and 6.50 for the UPI. The coefficient of variance (SD/AV) of

21) Tokyo Metropolitan Government (2000)

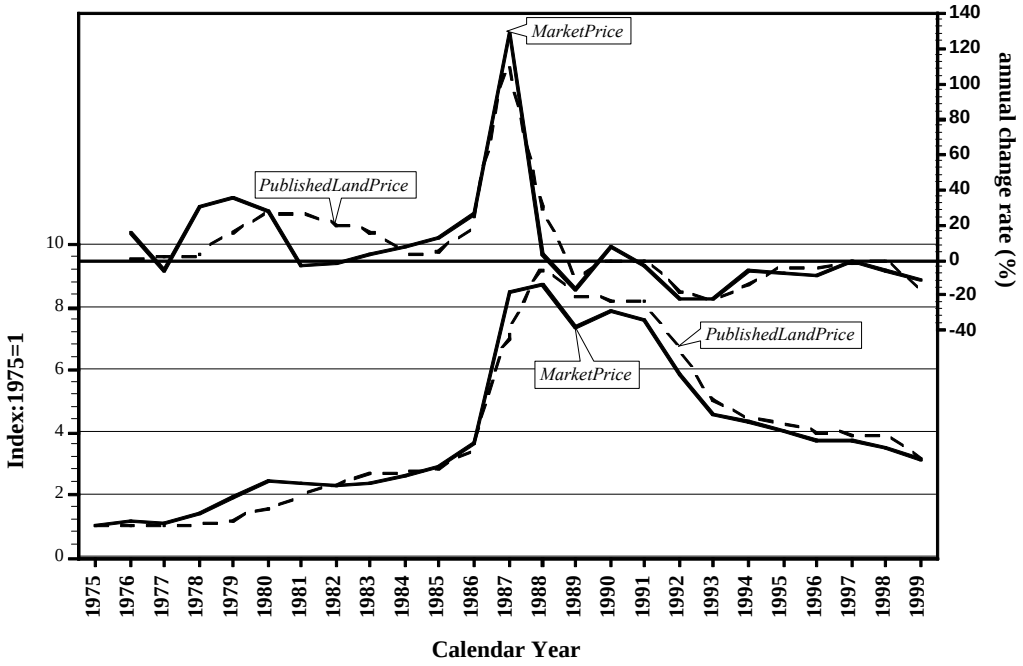
the TPI (4.23) is slightly larger than that of the UPI (2.93).

In conclusion, if we consider the growing variance of market growth in each region, it is fair to say that the PPI is more suitable when analysing local market movements although it is available only annually.



Time	Transaction Price		Published Land Price	
	Index	(t-value)	Index	(t-value)
1975	1.000	-2.364	1.000	-1.228
1976	1.141	-0.746	0.989	-1.375
1977	1.059	-2.554	0.994	-1.383
1978	1.148	-1.157	1.001	-1.281
1979	1.402	2.154	1.058	-0.470
1980	1.670	5.190	1.189	1.226
1981	2.517	9.040	1.330	2.829
1982	2.019	6.551	1.634	5.785
1983	2.639	11.453	2.235	10.291
1984	3.545	20.422	2.776	13.403
1985	5.431	28.008	4.111	18.993
1986	9.737	42.726	8.664	30.473
1987	15.539	55.426	14.127	37.626
1988	14.577	45.069	15.893	39.366
1989	15.456	50.163	15.733	39.224
1990	16.556	51.337	15.989	44.237
1991	16.197	39.314	16.161	39.601
1992	14.891	33.450	14.888	38.924
1993	8.596	22.296	11.240	36.624
1994	6.497	36.457	7.553	31.298
1995	4.558	28.884	5.377	26.131
1996	3.212	20.033	3.940	21.029
1997	2.580	14.955	3.185	17.578
1998	2.389	13.987	3.031	16.763
1999	2.161	11.467	2.815	7.711

Figure 2-Transaction Price-based index and Published Price-based Index: Commercial site



Time	Transaction Price		Published Land Price	
	Index	(t-value)	Index	(t-value)
1975	1.000	-18.668	1.000	-6.747
1976	1.157	-22.012	1.005	-6.511
1977	1.094	-23.170	1.027	-5.452
1978	1.427	-22.570	1.058	-4.094
1979	1.926	-8.981	1.225	2.631
1980	2.461	-7.208	1.550	13.794
1981	2.375	-13.581	1.931	24.744
1982	2.318	-18.602	2.306	33.248
1983	2.406	-15.779	2.670	38.732
1984	2.603	-8.798	2.742	39.988
1985	2.924	-5.371	2.866	42.037
1986	3.711	6.032	3.339	47.581
1987	8.497	46.204	7.016	82.588
1988	8.760	48.319	9.179	98.423
1989	7.356	38.273	8.317	93.736
1990	7.878	49.195	8.244	106.012
1991	7.580	40.312	8.196	93.032
1992	5.866	22.085	6.733	83.677
1993	4.598	15.497	5.069	73.265
1994	4.357	15.362	4.379	67.975
1995	4.073	14.184	4.194	66.986
1996	3.740	10.166	3.978	64.207
1997	3.733	10.143	3.913	63.152
1998	3.511	4.526	3.868	62.535
1999	3.115	-2.287	3.170	35.307

Figure 3-Transaction Price-based index and Published Price-based Index: Residential site

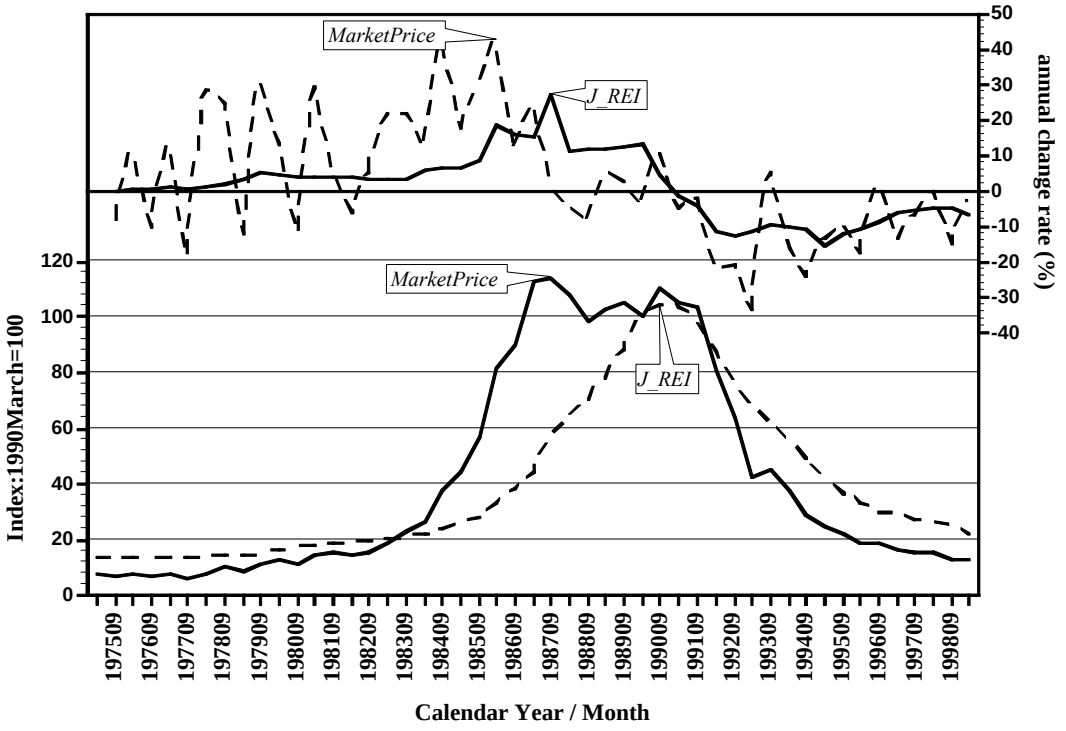


Figure 4- TPI and ULPI: Commercial site

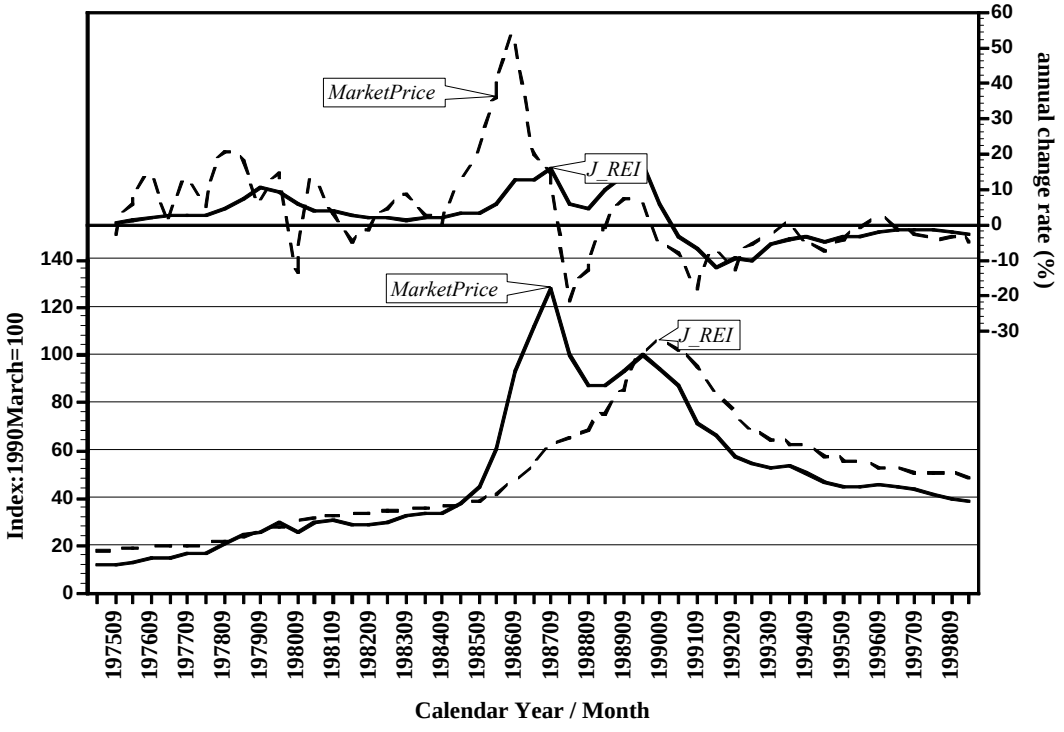


Figure 5- TPI and ULPI: Residential site

3. Establishing hedonic index under structural change

3.1 Detection of bubble era through structural change test

We then improved the model to investigate the temporal change of valuation error in the *Published Land Price*. In the previous section, the estimated scale dummy TD_{tl} was the most important factor in the comparison of those indices in different periods. However, we seek to improve the accuracy of the model when detecting the valuation error.

In that section, we assumed that there is a stable relation between price and variables in the long term in the Basic Models. But this assumption is problematic when we pursue the improvement of accuracy of the models. The subject period of this study is twenty years from 1975, which is a long time. Also this term includes the periods of boom and bust of the 'bubble economy' and hence it is unlikely that the underlying relationships had been stable.

In dealing with structural change of a hedonic function, Smith and Tesarek (1991) pointed out the difficulty of establishing a price index by a single model and that we should separate the data. Hidano (1992, 1995, 1999) used transaction data as we do in our study and allocated the observations into a period of six months and estimated an hedonic model for each subset of data. Then we put the data for a selected location into the model to produce an index. But this separation of data makes it difficult to compare the movement in different times since the coefficient of determination and the distribution of disturbance changes in accordance with time going. In this study, therefore, we identified breaking points of structural change for each coefficient by the structural change test. Then we put a cross factor into each term to estimate a single hedonic function model for producing an index.

In general, structural change test is an equality test of partial regression coefficient $\boldsymbol{\beta}_1$, $\boldsymbol{\beta}_2$ where a point of structural change is known and where the data is split into two parts thereof. The methodology of testing is different under different assumptions on the variance of error, namely either in the case of $\sigma_1^2 = \sigma_2^2$ or $\sigma_1^2 \neq \sigma_2^2$. We tested a linear model hypothesis where the variance of error is equal $(\sigma_1^2 = \sigma_2^2)$. When it is different $(\sigma_1^2 \neq \sigma_2^2)$, an asymptotic likelihood ratio test is carried out and the unknown parameter is sought by convergent calculation through the process $-2log$ (likelihood) chi-square dispersion (Amemiya (1985), Ono・Takatsuji・Shimizu (2002)).

However, it is reasonable to suggest that the subject period in this analysis should be divided into three parts, namely, "pre-bubble period", "bubble period" and "post-bubble period" since the subjective period includes the bubble economy period. We know there were two structural changes over this period but do not know about the changing points. Therefore, we estimated break points, *ta* and *tb*, on the basis of AIC (Akaike's Information Criterion) and the inclusion of two dummy variables: pre-bubble period dummy variable ($BB_{ta,tb}D$) and post-bubble period dummy variable

($PB_{tb}D$), then we examined the results using the *F* test.[22)]

Equation 1 is modified as below.

$$\log LP_{it} = a_0 + \sum_i a_{1i} \log X_i + \sum_k a_{2k} \cdot RD_k + \sum_{i,k} a_{3ik} (\log X_i)(RD_k) + \sum_t a_{4t} \cdot TD_t + \sum_i a_{6i} (\log X_i)(BB_{ta,tb}D) + \sum_i a_{7i} (\log X_i)(PB_{tb}D) + \varepsilon$$

(Equation 2)

$BB_{ta,tb}D : bubble - dummy$

$PB_{tb}D : post - bubble - dummy$

Assuming that the beginning of the bubble period was between 1980 and 1990 while the period ended after 1990 ($1980 \leqq ta < 1990$, $1990 \leqq tb$), we calculated 5,550 equations each, for both commercial land and residential land (11,100 models in total). In comparison with those models by AIC, we choose the following points as most appropriate points to estimate our functions.

Table 5- Results of structural changing points

	Bubble Era ($BB_{ta,tb}D$)	
	From (ta)	To (tb)
Commercial Land Model	1/1983	12/1995
Residential Land Model	10/1985	12/1991

22) Garcia and Perron (1996) showed how to identify the changing points for two structural changes. Jushan and Perron (1998) discussed the way of structural change test for unknown changing points of unknown frequencies. In our study, we used a simplified way in terms of tractability.

Table 6- Results of structural change test for different periods (F>Prob [23])

Commercial Land Model

	Pre-Bubble vs. Bubble	Bubble vs. Post-Bubble	Pre-Bubble vs. Post-Bubble
Lot size	0.0232	0.0001	0.0001
Road Width	0.0057	0.0001	0.0001
Distance to the Nearest Station	0.0090	0.0023	0.2324
Proximity to CBD	0.2072	0.0458	0.3282
Floor to Lot Ratio	0.0914	0.0320	0.0099
ALL*	0.0001	0.0001	0.0001

*Bulk testing on five variables above was carried out.

Residential Land Model

	Pre-Bubble vs. Bubble	Bubble vs. Post-Bubble	Pre-Bubble vs. Post-Bubble
Lot size	0.0001	0.0001	0.0001
Road Width	0.0001	0.4385	0.0001
Distance to the Nearest Station	0.0003	0.0465	0.0001
Proximity to CBD	0.0001	0.0001	0.0001
ALL**	0.0001	0.0001	0.0001

*Bulk testing on four variables above was carried out.

We should note that these points are based on AIC and need another test. The data is separated into three groups according to the break points suggested in Table 5. Each group is then differentiated into commercial land and residential land. Table 6 is the result of the F-test to examine structural change.

The probability of structural change varies for each variable. However, five variables (All: 5 variables) for commercial land and four variables (All four variables) for residential land show that structural change happened in the pre-bubble period, bubble period and post bubble period.

The commercial land price model shows that the bubble period spanned over 12 years, which lasted from the first quarter of 1983 until the last quarter of 1995. This period includes the time when the price rose and fell sharply and the slow down (see Figure 1). Thus this period shows the bubble period as one of violent movements in the market. In this sense, it would be more accurate to define it as the 'boom and bust period' rather than simply the 'bubble period'. Furthermore, the structure of the pre-bubble period differs from that of the post-bubble period. It seems that it would be wrong to think that the market went back to the previous situation after the burst of the bubble as is the impression often held.

In the residential land model, on the other hand, the rapid price growth period exactly matches with the "bubble period". The meaning of structural change is different in commercial land market and residential land market.

23) F>Prob shows the probability of equality of regression coefficients.

3.1.1 Estimating a hedonic function model under structural changes

We estimated the price models under structural change. Based on Equation2, for commercial land model, we put a bubble period dummy variable between the first quarter of 1983 and the fourth quarter of 1995 and a post-bubble (and burst) dummy variable after this period. We also included other variables such as plot size, road width, proximity to the nearest station and to the city centre and floor to site ratio.

Similarly, we put bubble dummy variable between the third quarter of 1985 and the fourth quarter of 1991, a post-bubble dummy variable after this period together with other variables such as plot size, road width, the proximity to the nearest station and to the city centre cross factors. The estimated models of land prices under structural change are shown inTable 7.

The commercial land price model suggests that the adjusted R square is 0.895. In comparison with the model without the cross factors such as the bubble dummy variable, their inclusion has improved not only the AIC but also the correlation coefficient,[24)] which shows higher explanatory power. The factors of plot size, road width and floor to site ratio are positive while the proximity to station and city centre are negative. This agrees with our intuition.

We investigated the cross factors of bubble-dummy and post-bubble dummy, estimated as coefficients to analyse temporal change. In terms of plot size, the cross factor with bubble dummy is + 0.083 while that of post-bubble dummy is + 0.060. This means that plot size affected land price more in bubble period than in pre-bubble period, but its effect weakened after bubble period. The effect of width of road frontage became stronger after bubble period as the cross factor with bubble dummy and post-bubble dummy is + 0.111 and +0.158 respectively. In Japan, the site with wider road generally is allocated a bigger floor to site ratio. This tells us that the preference for a site with wider road has higher potentials for development becomes stronger in the commercial market in the Tokyo three core wards. In other words, there is premium for site size. However, the importance of site size slightly decreased probably because more large size sites have been available in the market after the bubble period.

With regard to the impact of proximity to the station, the cross factor with bubble dummy is + 0.060, which implies that this factor is less significant than in the pre-bubble period. The cross factor with post-bubble dummy is + 0.031. Demand for sites located far from stations were strong during the bubble period and became weak after the bubble. On proximity to CBD, the cross factor with bubble dummy is - 0.318 and - 0.139 with post-bubble dummy. The proximity to CBD is a proxy for quality of networking. The preference for CBD became stronger in the bubble period than before and weaker in

24) It is generally held that too many variables are used when variables are selected by the coefficient adjusted for the degrees of freedom. In this study, the selection of the variables is made on the basis of the AIC first and then by Mallow's CP to ensure the improvement of the model.

the post-bubble period than in the bubble period. This result may be telling us that speculative investors purchased inconvenient sites for exploiting capital gains. This activity was not underlined by actual potential of land use, which shall be investigated in the future.

The residential land price model shows that the adjusted R square is 0.912. In comparison with the model without cross factors (such as bubble dummy variable), it has improved not only the AIC but also the coefficient, which has more explanatory power. The correlation of coefficient for the road width factor is positive as opposed to the proximity to the station and city centre being negative. This agrees with our intuition.

The effect of site size is a negative one except during the bubble period. The coefficient for the pre-bubble period is estimated at - 0.051. Then the cross factor for the bubble period turns out to be positive (+ 0.099). And after the bubble period, the coefficient becomes - 0.074 and is a bigger negative than in the pre-bubble period.

This result is different from Tabuchi's (1996). Tabuchi (1996) said that there was a 'lot premium' where $\partial LP / \partial L > 0$. However, in general appraisal practice and appraisals for property tax, it is thought that the opposite is true where $\partial LP / \partial LA < 0$. Our results match this practice.[25)]

In Tabuchi (1996), the hedonic model was based on the *PLP* in the Hanshin Region (West of Japan). In fact, the result from our residential model on the *PLP* (Table 8) suggests that there was lot size premium in Tokyo as well. This contradicts our result where there was evidence of scale demerit on site size on the transaction price-based hedonic model except in the bubble period. This suggests that the hedonic model estimates based on the PLP may have some bias.

The observation of site size effect gives us a lot of insight into our existing way of thinking. People in the real estate industry insist that residential land prices depend on the ability for housing acquisition. However, the larger a site is, the bigger its total cost. Hence site size is assumed to have a negative impact especially in the bubble period where price per land unit is expensive. The result, regarding premium for site size, is not in line with the hypothesis.

Also in valuation for property tax, it is assumed that large sites should be adjusted negatively to a standard size site since the large site includes a portion which is not saleable. This should be the case for pre- and post-bubble periods but not for the bubble period. A compatible explanation is that the special subtraction of transfer income for house moving encouraged people to move into Setagaya ward from core wards during the bubble period. The bigger the size of lots was, the more effective it became. As a result there was a positive impact from lot size.

25) In property tax assessment, the bigger plot size is negatively adjusted in addition to the adjustment for depth.

Table 7- Land Price Function under Structural Change

Dependent Variable:Log of Land Price per square meter .Method of Estimation:OLS

Commercial Area(Chiyoda,Chuo,Minato Wards)

Variables(all in log except for dummies)	Coefficient	t-value
Property Characteristics		
Constant	8.613	18.631
LA:Land Area(㎡)	0.017	1.600
RW:Road Width(10cm)	0.208	12.611
ST:Distance to the Nearest Station(m)	-0.081	-4.379
AC:Accessibility to City Core*	-0.983	-17.597
YK:容積率(%)	1.047	17.643
Raiway/Subway Line Dummy		
Ginza Line	-0.515	-1.841
Hibiya Line	0.635	3.000
Tozai Line	-1.033	-1.742
Asakusa Line	0.927	2.617
Cross-term Effect by Railway Line Dummy		
LA × Yamanote Line	-0.028	-2.483
LA × Marunouchi Line	0.170	4.178
LA × Chiyoda Line	-0.152	-4.405
LA × Asakusa Line	-0.062	-3.084
LA × Mita Line	0.067	2.943
LA × Shinjhuku Line	0.051	3.746
RW × Tozai Line	-0.060	-2.021
RW × Chiyoda Line	0.146	2.366
RW × Yurakucho Line	-0.066	-2.741
RW × Mita Line	0.074	2.091
RW × Shinjhuku Line	-0.051	-3.711
RW × Sobu Line	0.031	4.715
ST × Yamannote Line	-0.245	-13.607
ST × Ginza Line	-0.080	-3.533
ST × Hibiya Line	-0.128	-7.696
ST × Tozai Line	-0.078	-2.529
ST × Yurakucho Line	-0.159	-8.852
ST × Asakusa Line	-0.069	-2.466
ST × Chuo Line	0.014	2.404
YK × Yamanote Line	0.064	1.673
YK × Ginza Line	0.197	5.220
YK × Hibiya Line	-0.045	-1.531
YK × Tozai Line	0.301	3.065
YK × Chiyo Line	0.075	1.459
YK × Yurakucho Line	0.171	7.881
YK × Asakusa Line	-0.080	-1.711
AC × Yamanote Line	0.426	4.708
AC × Hibiya Line	0.200	5.846
AC × Mita Line	-0.221	-2.901
Cross-term Effect by Bubble Dummy**		
LA × BubbleDummy	0.083	6.884
RW × BubbleDummy	0.111	6.016
ST × BubbleDummy	0.060	3.123
AC × BubbleDummy	-0.318	-4.174
YK × BubbleDummy	-0.072	-1.174
Cross-term Effect by Post-Bubble Dummy***		
LA × Post-BubbleDummy	0.060	4.434
RW × Post-BubbleDummy	0.158	7.009
ST × Post-BubbleDummy	0.031	1.391
AC × Post-BubbleDummy	-0.139	-1.552
YK × Post-BubbleDummy	-0.487	-7.429

Adjusted R square=0.895

Number of Observations=6,577

Base Line=Yamanote, Marunouchi, Chiyoda, Yurakucho, Mita, Chuo, Sobu

Residential Area(Setagaya Ward)

Variables(all in log except for dummies)	Coefficient	t-value
Property Characteristics		
Constant	13.421	113.024
LA:Land Area(㎡)	-0.051	-8.662
RW:Road Width(10cm)	0.264	23.557
ST:Distance to the Nearest Station(m)	-0.065	-10.089
AC:Accessibility to City Core*	-0.407	-15.567
Raiway/Subway Line Dummy		
Ikegami Line	0.281	4.602
Oimachci Line	0.463	7.575
Toyoko Line	0.551	5.696
Odakyu Line	0.346	7.631
Inogashira Line	0.176	2.898
Keio Line	0.588	5.981
Setagaya Line	-0.296	-4.799
Cross-term Effect by Railway Line Dummy		
LA × Oimachi Line	-0.018	-2.241
LA × Odakyu Line	0.014	2.618
LA × Keio Line	-0.020	-2.406
RW × Mekama Line	-0.106	-3.708
RW × Oimachi Line	-0.146	-9.999
RW × Toyoko Line	-0.088	-3.667
RW × Denen Toshi Line	-0.083	-7.413
RW × Odakyu Line	-0.057	-4.835
RW × Keio Line	-0.054	-3.342
RW × Setagaya Line	-0.044	-2.196
ST × Mekama Line	0.037	5.579
ST × Oimachi Line	-0.022	-3.088
ST × Toyoko Line	-0.057	-3.986
ST × Odakyu Line	-0.057	-9.968
ST × Inogashira Line	0.028	2.415
ST × Keio Line	-0.021	-2.489
ST × Setagaya Line	0.060	6.116
AC × Denen Toshi Line	0.030	3.522
AC × Inogashira Line	-0.183	-7.754
AC × Keio Line	-0.120	-3.873
Cross-term Effect by Bubble Dummy*		
LA × BubbleDummy	0.099	12.880
RW × BubbleDummy	0.181	13.512
ST × BubbleDummy	-0.045	-6.118
AC × BubbleDummy	0.048	1.538
Cross-term Effect by Post Bubble Dummy**		
LA × Post-BubbleDummy	-0.074	-11.312
RW × Post-BubbleDummy	-0.011	-0.944
ST × Post-BubbleDummy	-0.002	-0.370
AC × Post-BubbleDummy	0.017	0.644

Adjusted R square=0.912

Number of Observations=7,991

Base Line=Mekama, Denen Toshi

*Average travel time during daytime including transfer between the nearest station to main terminal station

Main stations(Tokyo･Shinjhuku･Shibuya･Ikebukuro･Ueno･Kasumigaseki･Otemachi)

**BubbleDummy:1985 4th Quarter～1991 4th Quarter

***Post-BubbleDummy:1992 1st Quarter～

(Commercial Model)

**BubbleDummy:1983 1st Quarter～1995 4th Quarter

***Post-BubbleDummy:1996 1st Quarter～

Regarding the impact of road width, the cross factor with bubble dummy is + 0.181, which means at proximity had a greater impact than in the pre-bubble period. The cross factor with post-bubble dummy is -0.011. The effect became weaker than in the pre-bubble period. The impact of road width was strong in the bubble period because those sites that have potential for commercial use and for more efficient use were preferable.[26)] But the potential shrank after the bubble burst. We believe that a site in an area with a busier traffic road faces environmental problems and that the negative impact of the problem is taken into consideration.

With regard to the impact of proximity to a station, the cross factor with bubble dummy is -0.045 and the cross factor with post-bubble dummy is -0.002. Demand for sites located far from stations were strong during the bubble period and became weaker after the boom. The proximity to CBD was more important during the bubble period with the cross factor of + 0.048 and the effect became weaker in the post-bubble period (+0.017) as is the case of the proximity to the nearest station.

Since the burst of the bubble, the number of transactions in the residential market has increased significantly due to falling land prices and the tax advantage in place for encouraging house acquisition (Tokyo Metropolitan Government 1999). The region of high potential demand experienced more transactions in the residential market even in the less attractive areas in terms of traffic access.

3.2 The *PLP* versus Sales Transactions – A statistical test-

3.2.1 Valuation to Price ration – Accuracy of PLP

We examined the accuracy of the PLP by comparing it to the transaction price-based land price model responding to structural changes.

In Tokyo's three core wards, the number of surveyed sites in the survey for commercial land is 1,722 in total between 1974 and 1999 (i =1 to 1772). In Setagaya ward, the total for residential land is 2,620 for the same period. Having applied our transaction price model to each point in the *Published Price Survey*, we have calculated the ratio of PLP to the price implied by the model as follows.

At point i＝Published land price at i ÷ Hedonic price at i

The ratio of a published land price to an estimated transaction price of the site is, on average, 86.96% for commercial land and 94.18% for residential land respectively. The ratio for commercial land is lower than that of residential land by about 7% (Figure 6).

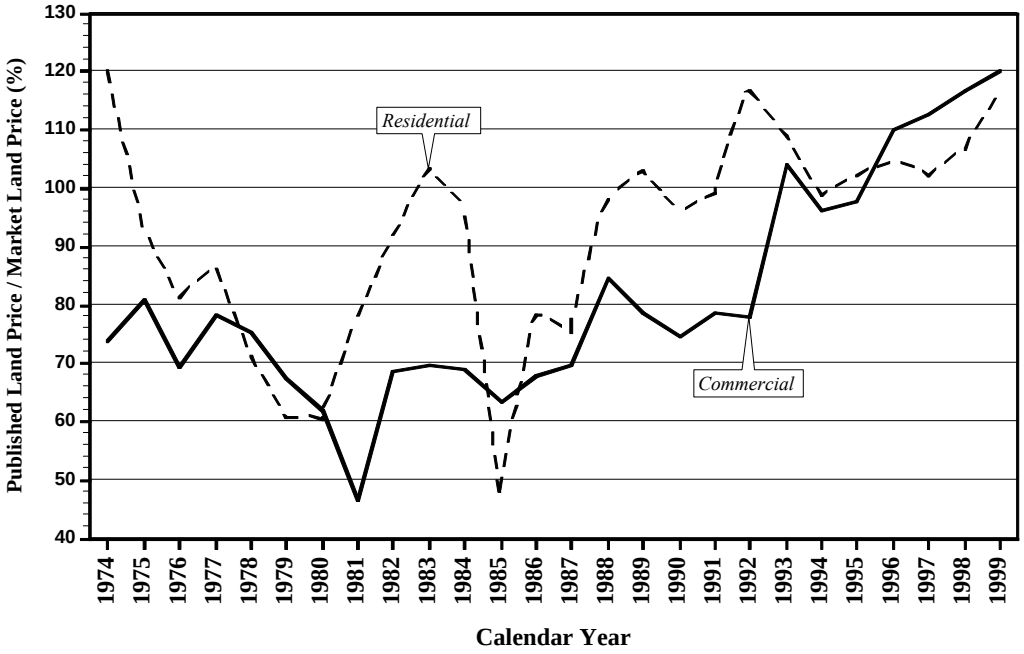
We then examined the ratio a on time-series basis（Figure 6）. For commercial land, the ratio had

26) Tokyo Metropolitan Government (1999) showed that a lot of residential land was converted into commercial use during the bubble period while a lot of commercial land was converted back into residential use after the boom.

been approximately 80% (80.84%) in 1975 and dropped to 46.40% in 1981. In 1981 and 1982, the ratio jumped to 69.55% and remained at about 70% to 80% between 1987 and 1992 (the bubble period). However, in 1993, the ratio went higher and above 100% to 104.24%%, which means that the published land price did not reflect the crash in real estate prices then. The ratio has remained at over 100% since 1993 and it was more than 120% in 1999.

On the other hand, in the Setagaya residential area, the ratio was 92.85% in 1975 and dropped to around 60% by 1980. As in the case of commercial real estate, the ratio increased in the beginning of the 1980s and stayed at around 80% during the bubble (78.44% in 1986). It then rose sharply in 1992 but remained at about 100% during the crash period. However, in 1998 and 1999, it was beyond 100% (115.55% in 1999).

In terms of variance in the ratios, the standard deviation and the coefficient of variation of the ratio within commercial real estate fluctuated in 1983, 1984 and in recent years, although it was more stable in the interim years. For the ratio for residential land, the variance became large in 1987 whereas the ratio itself was small. These periods corresponded to the buoyant years. For those years the ratio differed by large amounts between surveyed sites.



	Commercial Sites				Residential Sites			
YEAR	Average	Median	Standard Error	Number of Observatio	Average	Median	Standard Error	Number of Observatio
1974	73.88	68.51	35.13	41	120.26	117.47	16.67	75
1975	80.84	71.02	40.99	41	92.85	90.53	12.42	75
1976	69.46	59.81	35.73	41	81.23	79.15	10.58	75
1977	78.34	74.67	36.22	52	86.41	84.58	11.24	70
1978	75.25	71.37	34.51	52	71.12	69.52	9.91	70
1979	67.48	67.21	29.58	52	60.71	59.47	10.37	89
1980	61.94	61.04	25.65	52	60.51	57.77	11.80	89
1981	46.40	46.86	19.50	50	76.82	76.65	14.46	98
1982	68.61	69.41	29.10	50	90.82	92.85	12.59	98
1983	69.55	64.78	36.61	50	103.28	102.18	14.26	81
1984	69.06	65.21	35.36	50	97.12	96.25	13.78	81
1985	63.36	59.21	29.93	50	46.83	46.69	5.74	81
1986	68.05	65.59	29.16	57	78.44	78.20	11.93	71
1987	69.86	73.39	27.71	57	75.23	75.04	19.84	77
1988	84.49	85.66	33.45	57	97.99	97.04	21.53	90
1989	78.56	80.28	31.28	57	102.91	102.73	21.07	90
1990	74.51	77.67	29.17	114	95.99	94.91	18.71	180
1991	78.76	82.83	31.16	57	99.22	98.68	19.20	90
1992	77.76	81.91	31.31	61	117.01	114.56	26.35	90
1993	104.24	107.03	39.98	81	108.83	106.35	21.74	110
1994	96.13	95.97	35.26	99	98.89	96.04	17.37	129
1995	97.92	97.51	34.85	109	102.01	99.72	16.17	144
1996	109.99	104.79	46.46	109	104.42	102.94	15.44	144
1997	112.76	103.65	55.52	111	102.40	100.87	14.73	141
1998	117.00	107.26	62.69	111	106.70	105.50	14.80	141
1999	120.02	106.55	69.28	111	115.55	114.67	15.54	141
Total	86.96	83.08	45.36	1,772	94.18	94.89	23.58	2,620

Figure 6- Time-series change of Value to Price Ratio

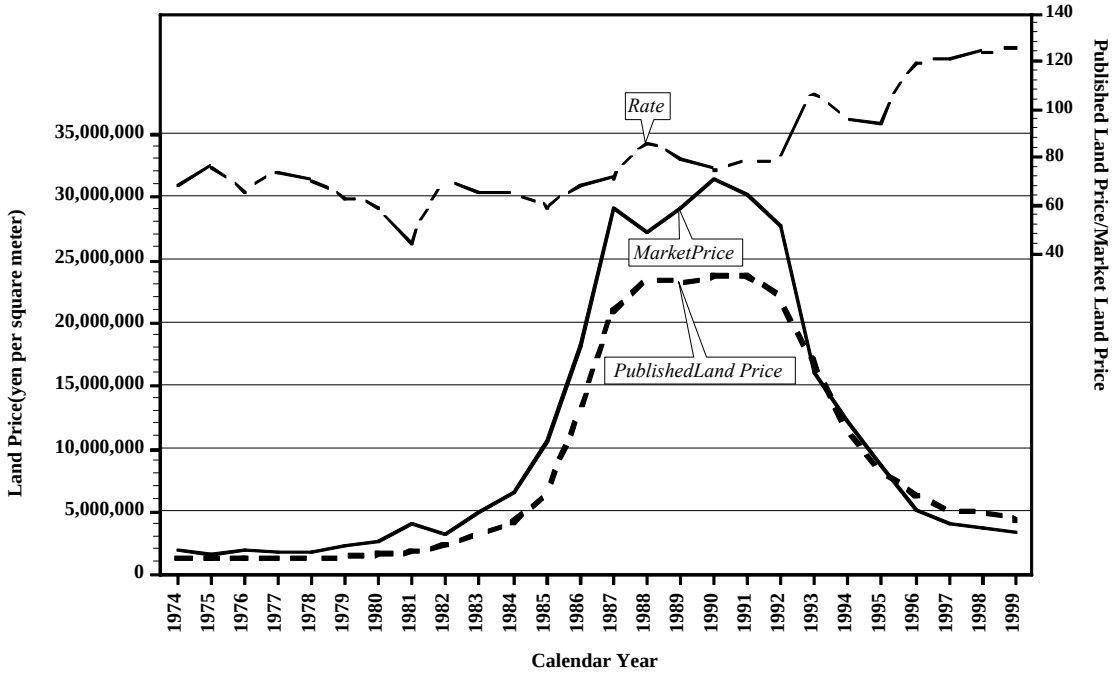
3.2.2 The transition of the ratios on certain points

We undertook a more detailed look at the value to price relationship. It is impossible to observe the

same point for published price since no single point has available continuous historical observations. In this study, we took two commercial and two residential survey points from the 1975 *Published Price Survey* and calculated their V/P ratios. We then established a function for the *PLP* under structural change (Table 8) through which we can have estimated values for the *PLP* after 1975. We could now compare the estimated PLP with transaction price for the same points.

The model based on PLP fits very well. The efficiency of the coefficient for the commercial land price model is 0.951 while that of the residential land price model is 0.968. The differences of the actual published land prices to the estimated transaction price were very small in 1975. The largest difference occurs at point 2 of commercial land where the model is underestimated by 3.85%. Thus the estimated published price is very close to the actual published land price.

Finally, we take 1975 as a base year and join our estimated PLP shifted by the difference of actual published price and estimated published price in 1975 to establish an index. The index is based on actual published price in 1975 and on estimated published prices in other years.



ID	Neighbourhood	Area	Land Value(Yen/m2) at 1975	Lot size	Road Width	Nearest Station	Distance to NS	FLR	Value/Estimate Ratio at 1975	Value/Estimate Ratio at 1987	Value/Estimate Ratio at 1999
Point 1	Small-sized retails and financial offices mix up	Chiyoda Ward	1,250,000	163m2	27m	Kanda	150m	800%	75.98%	58.63%	126.01%
Point 2	Retails and offices mix up	Minato Ward	1,270,000	133m2	10m	Omotesando	60m	700%	71.02%	63.14%	115.56%

Figure 7- Value to Price ratio on particular points: Commercial sites

Table 8- Published Land Price Model under Structural Change

Dependent Variable:Log of Land Price per square meter .Method of Estimation:OLS

Commercial Area(Chiyoda,Chuo,Minato Wards)

Variables(all in log except for dummies)	Coefficient	t-value
Property Characteristics		
Constant	4.370	6.693
LA:Land Area(m²)	0.060	3.335
RW:Road Width(10cm)	0.083	2.901
ST:Distance to the Nearest Station(m)	-0.063	-10.752
AC:Accessibility to City Core*	-0.257	-2.390
YK:容積率(%)	1.471	15.344
Raiway/Subway Line Dummy		
Yamanote Line	-7.442	-8.798
Ginza Line	-1.565	-1.985
Shinjhuku Line	32.209	9.358
Cross-term Effect by Railway Line Dummy		
LA × Yamanote Line	-0.078	-3.720
LA × Ginza Line	-0.079	-3.794
LA × Marunouchi Line	-0.033	-5.053
LA × Chiyoda Line	0.035	3.994
LA × Asakusa Line	-0.067	-10.102
RW × Yamanote Line	0.112	3.204
ST × Marunouchi Line	0.030	3.628
ST × Chiyoda Line	0.027	2.364
ST × Asakusa Line	0.045	6.174
ST × Mita Line	0.010	2.170
ST × Sobu Line	0.025	2.503
YK × Yamanote Line	0.673	6.002
YK × Ginza Line	0.829	7.635
YK × Shinjhuku Line	-1.918	-6.576
AC × Yamanote Line	0.047	1.599
AC × Ginza Line	0.388	5.559
AC × Shinjhuku Line	-1.099	-5.875
Cross-term Effect by Bubble Dummy**		
LA × BubbleDummy	0.043	2.247
RW × BubbleDummy	0.017	0.532
ST × BubbleDummy	0.024	3.753
AC × BubbleDummy	-0.280	-2.578
YK × BubbleDummy	-0.152	-1.413
Cross-term Effect by Post-Bubble Dummy***		
LA × Post-BubbleDummy	0.134	5.762
RW × Post-BubbleDummy	0.106	2.790
ST × Post-BubbleDummy	0.026	3.531
AC × Post-BubbleDummy	-0.266	-2.101
YK × Post-BubbleDummy	0.025	0.206

Adjusted R square=0.951

Number of Observations=1,772

*Average travel time during daytime including transfer between the nearest station to main terminal station

Main stations(Tokyo･Shinjhuku･Shibuya･Ikebukuro･Ueno･Kasumigaseki･Otemachi)

**BubbleDummy:1983～1995

***Post-BubbleDummy:1996～

Base Line=Marunouchi, Tozai, Chiyoda, Yurakucho, Asakusa, Mita, Chuo, Sobu

Residential Area(Setagaya Ward)

Variables(all in log except for dummies)	Coefficient	t-value
Property Characteristics		
Constant	13.488	86.975
LA:Land Area(m²)	0.006	0.379
RW:Road Width(10cm)	0.269	14.157
ST:Distance to the Nearest Station(m)	-0.134	-13.261
AC:Accessibility to City Core*	-0.421	-9.094
Raiway/Subway Line Dummy		
Toyoko Line	-2.967	-6.198
Odakyu Line	0.387	2.245
Inogashira Line	2.132	8.552
Keio Line	-0.577	-2.808
Setagaya Line	-1.821	-3.312
Cross-term Effect by Railway Line Dummy		
LA × Setagaya Line	0.090	4.910
LA × Toyoko Line	0.108	3.228
LA × Denentoshi Line	0.036	2.162
LA × Odakyu Line	0.074	4.294
LA × Keio Line	0.092	4.621
RW × Ikegami Line	0.231	4.225
RW × Oimachi Line	-0.230	-8.797
RW × Toyoko Line	-0.216	-3.070
RW × Keio Line	-0.284	-9.820
RW × Setagaya Line	-0.207	-5.949
ST × Mekama Line	0.051	3.232
ST × Oimachi Line	0.037	3.724
ST × Odakyu Line	-0.040	-3.192
ST × Inogashira Line	-0.077	-2.607
ST × Setagaya Line	0.168	8.294
AC × Toyoko Line	1.047	5.403
AC × Odakyu Line	-0.087	-1.628
AC × Inogashira Line	-0.504	-4.847
AC × Keio Line	0.216	3.799
AC × Setagaya Line	0.426	2.339
Cross-term Effect by Bubble Dummy**		
LA × BubbleDummy	0.095	6.490
RW × BubbleDummy	0.182	7.456
ST × BubbleDummy	-0.103	-8.505
AC × BubbleDummy	-0.210	-4.736
Cross-term Effect by Post Bubble Dummy***		
LA × Post-BubbleDummy	0.041	2.971
RW × Post-BubbleDummy	0.041	1.922
ST × Post-BubbleDummy	-0.011	-0.998
AC × Post-BubbleDummy	-0.058	-1.470

Adjusted R square=0.968

Number of Observations=2,620

*Average travel time during daytime including transfer between the nearest station to main terminal station

Main stations(Tokyo･Shinjhuku･Shibuya･Ikebukuro･Ueno･Kasumigaseki･Otemachi)

**BubbleDummy:1985～1991

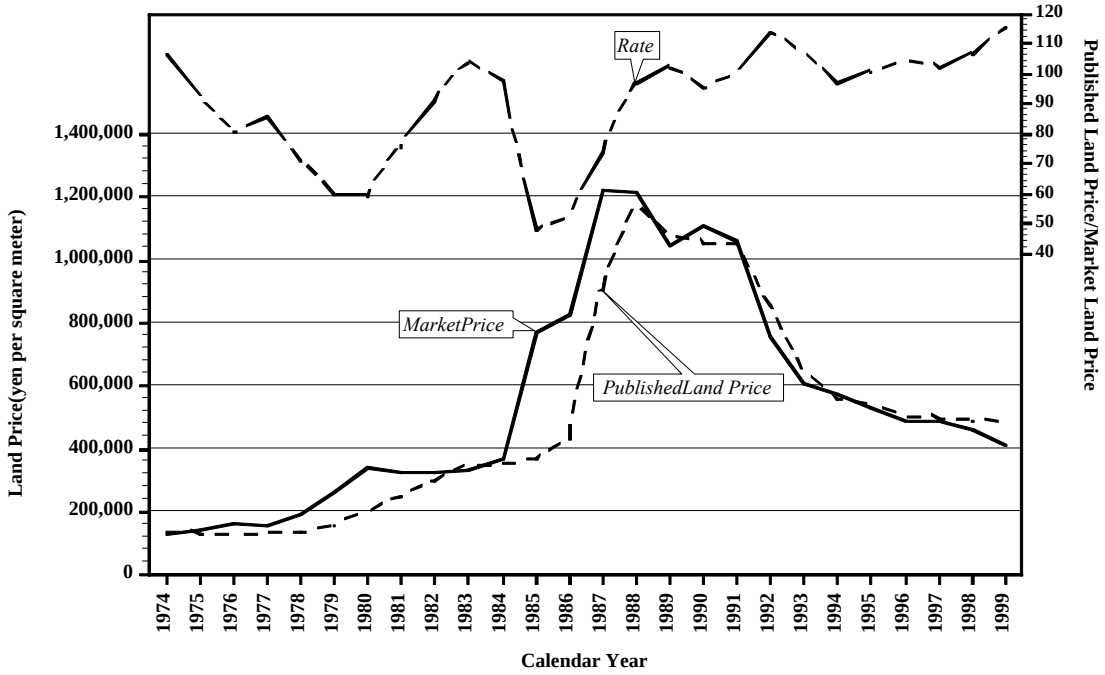
***Post-BubbleDummy:1992～

Base Line=Ikegami, Oimachi, Odakyu, Setagaya, Mekama

In our commercial land analysis, we took one point from an area of small retail shops in Chiyoda Ward and the other from a mixed area of retail and office properties in Minato Ward. Figure 7 shows

the price changes in point ONE.

We chose three periods, which are 1975, 1985 and 1999. The year 1985 is two years after 1983 when the bubble (-and bust) period is believed to had begun[27]. And the year 1999 is the latest sample year observed. The ratio of the published price to 1975 at point ONE and point TWO is about 75% and 71% respectively. The ratio reversed in 1985 where it is 58% at point ONE and 63.14% at point TWO. In 1999, it turns again and the ratio at point ONE is 126% and is 115% at point TWO. This reflects the fact that land price falls in the Omote-sando area in Minato Ward (for point ONE) have eased since IT business companies have been coming into the area whilst prices are lower in the Kanda area in Chiyoda ward (for point TWO) because the main occupiers there operate in the financial sector which is the sector that has been suffering.



ID	Neighbourhood	Area	Land Value(Yen/m2) at 1975	Lot size	Road Width	Nearest Station	Distance to NS	FLR	Value/Estimate Ratio at 1975	Value/Estimate Ration at 1987	Value/Estimate Ration at 1999
Point 1	Middle-sized detached houses are dominant	Setagaya Ward	129,000	264m2	3.5m	Soshigaya Okura	500m	150%	92.33%	73.60%	115.13%
Point 2	Middle-sized detached houses are dominant	Setagaya Ward	142,000	144m2	6m	Konoge	2600m	200%	101.08%	71.05%	119.74%

Figure 8-Value to Price ratio on particular points: Residential sites

27) We used the year 1985 since the estimate was not stable. This happens because there are big gaps

For residential land, we chose one point in a convenient location only 500 meters away from the nearest station of Odakyu rail line and the other from a quiet but not so convenient a situation of over 2.5 kilometres from the station. Figure 8 illustrates the price changes in point ONE.

Again we chose three periods, which are 1975, 1987 and 1999. The year 1987 is two years after 1985 when the bubble period in the residential market is believed to have begun.1999 is the latest sample year observed.

The ratios of the published price to 1975 at point ONE and point TWO is about 92% and 101% respectively, which says that the published price is almost the same as transaction price. In 1985, the ratio at point ONE is 73% and is 71% at point TWO. Then, in 1999, the ratio at point ONE is 115% and is 119% at point TWO. As in the commercial land market, the published price is beyond transaction price. In recent years, residential sites in less convenient locations (with long distances from a station) suffer more price falls in transactions[28)].

Conclusion –Requirement For Real Estate Information Assembly-

In this study, we have summarised the information on land prices in Japan and constructed our database on transaction comparables. Then having compared the published price statistics and the *Urban Land Price Index* with our hedonic price model based on transaction prices or the published land price, we outlined their characteristics as shown below.

We have seen the immensity of land price information especially from private institutions. However, most of the information is based on appraisal values and appraisal values have certain problems. Firstly, appraisal-based information has systematic problems. The accuracy of appraisals largely relies on the number of transactions, their accuracy and precision especially when the comparison approach is heavily emphasised. When the market changes structurally, the error caused by lack of transactions can be significant. Secondly, this method of information assembly can let in errors through time adjustment where there are long lags between the appraisal date and the survey date. Thirdly, as in case of the Published Land Price Survey, the appraisers can face a situation where they may lose their independence under political pressures.

The published price-based index has followed our transaction price-based index with a time lag during the bubble economy. This is clearer in the case of commercial land. The hypothesis raised in Nishimura (1995) has been statistically verified. When compared with the *ULPI* (Six Major Cities), the *ULPI* was demonstrably more difficult to use to understand land price trends. This is because the index is highly ‘smoothed’ and hence shows different peak periods and growth rates across several

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between the two cross factors, which are presumably the period of the dummy factors.

28) Ono and Shimizu (1998) pointed out that the Published Land Price could not reflect the structural change in the market in their research of those areas affected by the Great Hanshin Earthquake1992.

periods.

Further analysis was done on the *Published Land Price Index*. We investigated the ratio of published land index to transaction price index to show the magnitude of 'valuation error'. The ratio for commercial land in three core Tokyo wards was 80.84 % in 1975 and dropped to 46.40% by 1981. Then the ratio rose in 1982 and 1983 reaching 69.55%. However, it increased again after the burst of the bubble to 104.24% in 1993. In 1999, the published price was bigger than the transaction price index by approximately 20%.

With regard to the residential area, it was 92.85% in 1975 and dropped to around 60% by 1980. Then it rose, as with commercial land, around 1983. While it kept to about 80% during the bubble years（78.44% in 1986）, the ratio increased even more in 1992 during the bust years and was recorded at 115.5% in 1999.

In this paper, we have demonstrated that there are some fundamental problems with land price information in Japan. Especially now it is clear that the Published Land Price Survey has serious problems as described above. This is very important since the Survey, as a basis for authorised appraisal practice in Japan, has also affected other land information in many respects.

Error in land price information causes great problems considering the importance of land and building value within the Japanese economy. One example of this is the recent bad loan problems. The structural causes of this problem should be resolved as soon as possible, but, in the short term, it is important for us to identify the existence of errors and to clarify the nature of the bias and its magnitude retrospectively by estimating them before hand. None of other OECD countries conducts such a land price survey or has funds allocated within the national budget for this type of statistics.

The PLP is a benchmark for property tax and inheritance tax and forms the basis for compulsory land purchase for public purposes. Considering its nature, which constitutes public sector accountancy and public finance usage, it is necessary that the underlying information, transaction evidence or comparables in this case, be disclosed to the general public.

As the Basic Land Law clearly says and is the verdict of the Land Policy Council, it is absolutely necessary to assemble real estate market information and disclose the information. In the past, the real estate market was so inefficient that there were huge gaps between transaction price and 'fair market value' hence the importance of appraisal value information. However, nowadays we have more information and need more direct market information, such as transaction price data rather than filtered data, to improve market efficiency.

In many advanced countries where real estate finance markets are more sophisticated, sale transaction price information is available in the public domain. This enables market participants to make their decisions on the basis of their own risk profile and with better-informed research back up.

More and better research has become possible and a great deal of it goes on. An important area of research has been the ‘valuation error’ where there is now greater understanding in their market. In Japan we have enormous real estate related socio-economic problems including bad loan problems. It is urgently necessary for us to disclose land price information kept inside public administrations. We also need to establish a system in which we can restore reliability of the published price information and avoid risk caused by information error.

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