

# The Development of a Land Price Index Based on Appraisal Data for the Tokyo Area

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## 1. Development of a New Land Price Index and Its Objective

In the past, we have taken a critical stance toward the use of land prices as an indicator for real estate investment.<sup>1</sup> First, while properties can have as many as five land price quotations, none of them is a suitable indicator in terms of publication frequency and calculation method. Second, we think that real estate prices (particularly for commercial real estate) should reflect the capitalized value calculated for the land and structure together. However, because of the scarcity of commercial real estate transactions in Japan, and the fact that most transaction data is not publicly available, more time is needed to develop a real estate index based on capitalized value.

As the next best alternative for a real estate investment indicator, we have developed a new land price index that taps into the abundant appraisal data compiled by Sanyu Appraisal Corporation (*hyojun kakaku*: values of standard lots), and minimizes arbitrariness by using statistical methods.<sup>2</sup>

The index has the following characteristics: (1) it draws on the actual appraisal data used in land transactions, (2) it adopts a hedonic index approach to take into account characteristics that change over time (quality) of the appraised land, and (3) it is compiled quarterly and is thus practical.

**Figure 1 The Major Land Price Indexes**

Index	Issuer	Survey/release frequency
Published Land Prices	Ministry of Land, Infrastructure and Transport	Annual/annual
Standard Prices	Prefectures	Annual/annual
Price changes of representative lands for publication of land prices	Ministry of Land, Infrastructure and Transport	Quarterly/semiannual
Roadside land values for inheritance tax	National Tax Agency	Annual/annual
Urban Land Price Index	Japan Real Estate Institute	Semiannual/annual
Residential land prices by train line for 4 metro areas	Housing Times	Annual/annual
MRD Land Values	Misawa Home Research Institute	Annual/annual

## 2. Data Source and Estimation Method

### (1) Data Source

In compiling the index, we drew on standard price data based on appraisals and surveys spanning from the start of fiscal 1994 (94Q2) to the end of 2000 (00Q4).

We focused on residential, commercial, and industrial land in the cities and wards of the Greater Tokyo area, which consists of the four prefectures of Tokyo, Kanagawa, Chiba, and Saitama.

To make the index more stable, we limited the area coverage in two ways: (1) the nearest train station must be within one hour from a hub station in Tokyo-to, or within 45 minutes of a hub station in the three other prefectures, and (2) the land must be within 1,200 meters of these stations. This brought the number of plots to 25,309.

### (2) Estimation Method

Due to the uniqueness of each piece of land, the development of a land price index must take into account such factors as the distance to the nearest train station and that station's proximity to the hub station, as well as the zoning classification and floor area ratio. For example, several years ago, when prime real estate formerly occupied by corporate dormitories began flooding the residential land market due to corporate restructuring, the average sales price of land surged. Considering that real estate prices were supposed to have bottomed out, such prime properties could have been sold for even more before the corporate restructuring, and this can be confirmed by the price decline in the quality-adjusted index. Thus by taking quality into account, distortions caused by market phases can be corrected, and we can track price movements more accurately based on land characteristics.

In developing the index, we adopted a hedonic index approach that adjusts for product characteristics. Specifically, we compiled the land price index adjusted for quality by estimating the following equation, and then substituting in the average land characteristics. The equation is characterized by having many composite variables with quarterly dummy components so that the index can take into account location, land use, and other factors.

$$\begin{aligned} \log L = & a_0 + \sum_i a_{1i} x_i + \sum_{j,k} a_{2jk} DM_{jk} + \sum_l a_{3l} DQ_l + \sum_{i,j,k} a_{4ijk} x_i DM_{jk} \\ & + \sum_{j,k,l} a_{5jkl} DM_{jk} DQ_l + \sum_{i,j,k,l} a_{6ijk} x_i DM_{jk} DQ_l \end{aligned}$$

where:

$L$  : Land price (yen per square meter)

$a$ : Coefficient

*x*: Distance to nearest train station (meters), width of front road (meters), ratio of floor space to land area (%), minimum traveling time by train to the nearest hub station (minutes), minimum traveling time by train to hub stations in the three prefectures of Kanagawa, Saitama and Chiba.

*DM*: Dummy variables for land use zoning, location, train line, nearby hub station, nearby hub stations in 3-prefecture area.

*DQ*: Dummy variable for quarter

Estimation results obtained from the above equation were found to be statistically sufficient.<sup>3</sup>

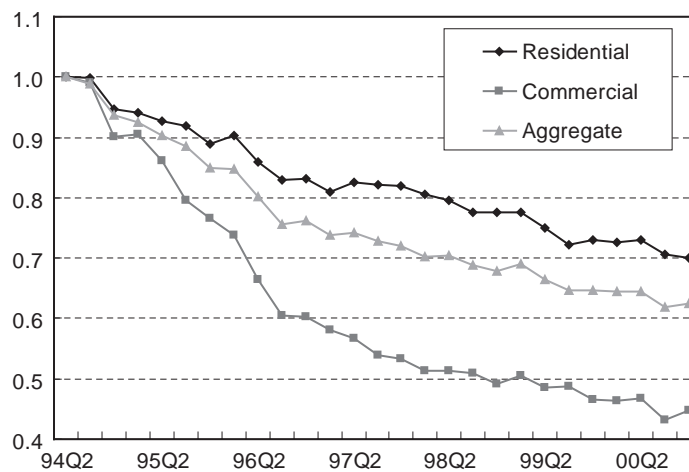
### 3. Discussion of the Land Price Index Results

#### (1) Results of the Land Price Index Calculations

Using the above estimation method, we calculated the land price index and obtained results for residential and commercial land, as shown in Figure 2 (data for Figures 2 to 4 are posted in Figure 12).

To reveal price trends, the index is standardized to 94Q2 (with a value of 1.0). As of 00Q4, the price of residential land had declined to 0.7, commercial land to 0.45, and the overall price to 0.63. In particular, there is a sharp decline in mid 1996. The downtrend has abated overall, but has still persisted as of late.

**Figure 2 Land Price Index for Residential and Commercial Land**

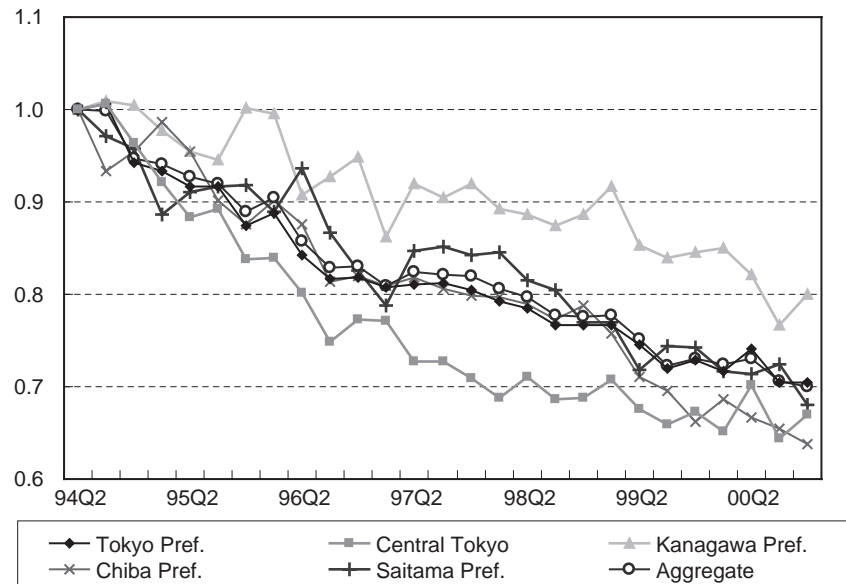


In the same way, the land price indexes for residential and commercial land are shown by prefecture in Figures 3 and 4.

For both residential and commercial land, the decline is smallest for Kanagawa Pref., and is particular-

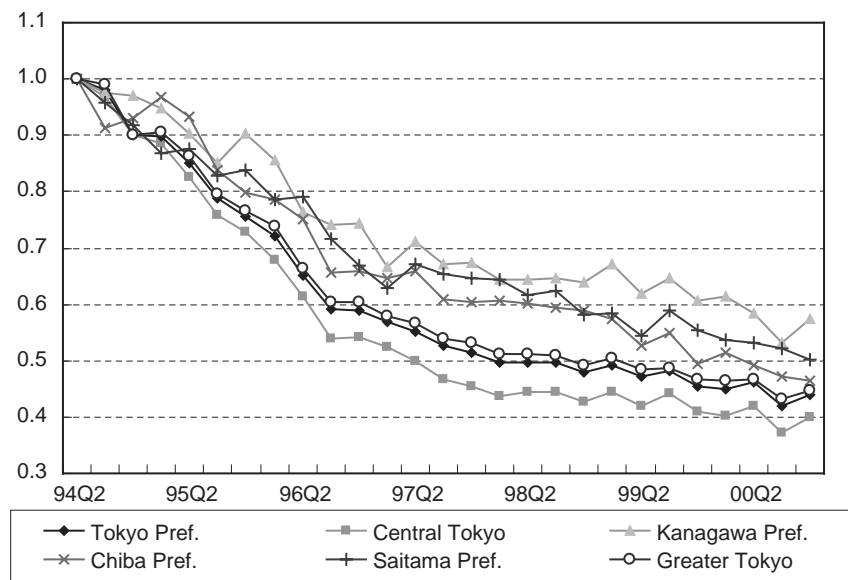
ly pronounced for central Tokyo. However, while the relative positions of the prefectures do not change for commercial land, there is a noticeably sharp decline for residential land in Chiba from 1999.

**Figure 3 Residential Land Price Index by Prefecture**



Note: Central Tokyo consists of the following wards: Chiyoda, Chuo, Minato, Shinjuku, Bunkyo, Taito, Shibuya, and Toshima.

**Figure 4 Commercial Land Price Index by Prefecture**



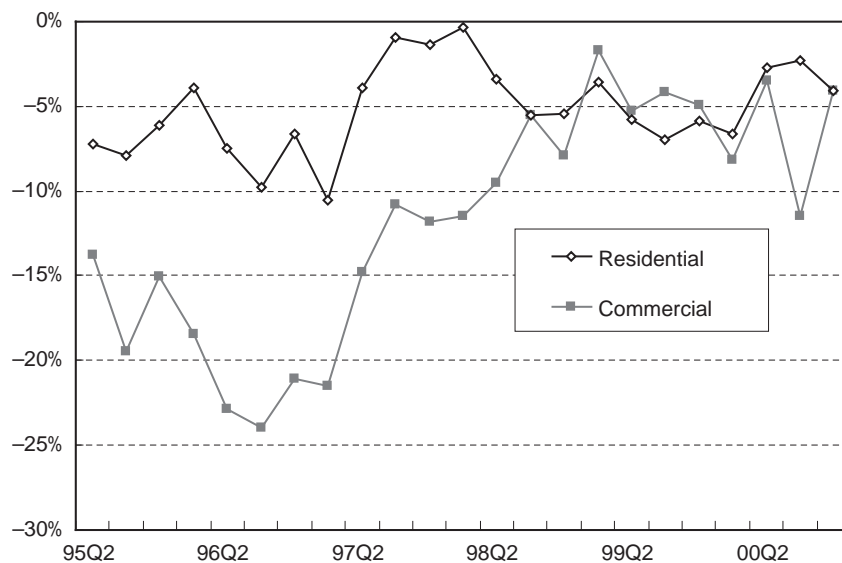
Note: See Figure 3.

## (2) Trend in Land Price Fluctuation

We next look at land price movements in more detail. The year-on-year change in land prices is shown in Figure 5.

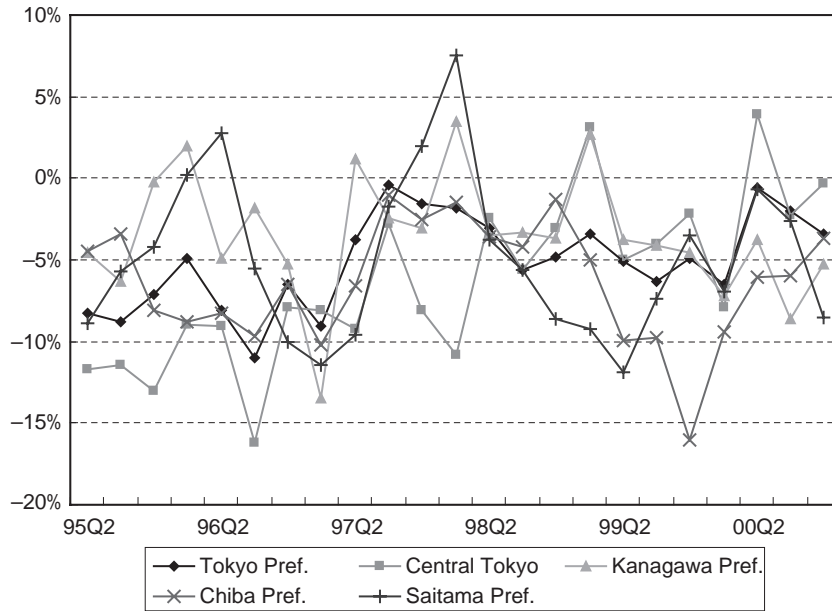
For both residential and commercial land, price changes have been consistently negative from 1995 onward. While the average decline in residential land prices has been shrinking in the medium term, commercial land prices have also improved significantly from a 20% decline in 1996 to an approximately 5% decline in mid 1998. However, from 1999 to 2000, commercial land prices plunged once again, and became destabilized as well.

**Figure 5 Rate of Change in Residential and Commercial Land Prices (yoy)**

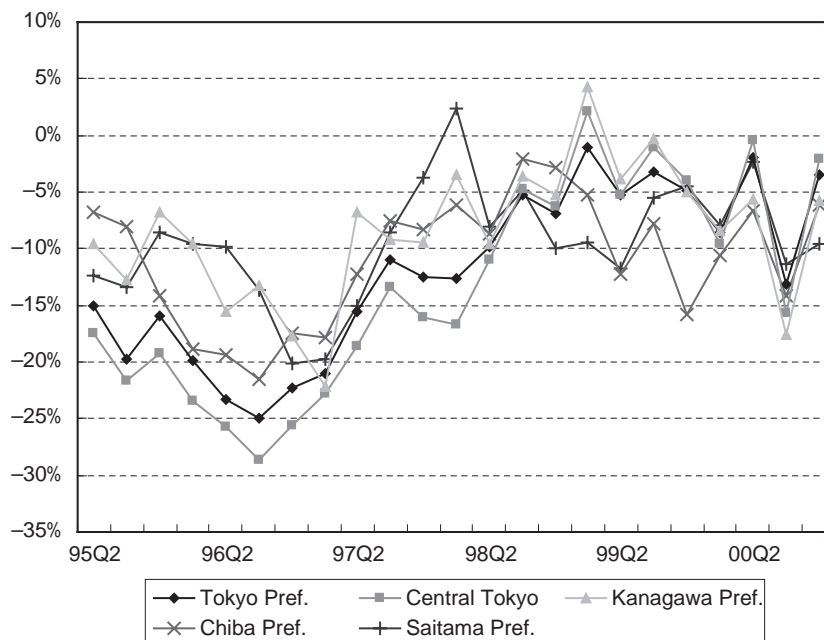


Changes in residential and commercial land prices are shown by prefecture in Figures 6 and 7. Although commercial land prices follow the same cyclical pattern in all prefectures, residential land prices do not necessarily coincide.

**Figure 6 Rate of Change in Residential Land Prices by Prefecture**



**Figure 7 Rate of Change in Commercial Land Prices by Prefecture**



Recently, residential land prices have been characterized by large declines for Saitama Pref. (from 98Q3 to 99Q4) and Chiba Pref. (from 99Q2 to 00Q3; Figure 3). On the other hand, the decline in residential land prices in Tokyo Pref. has been easing, and this is due to the sharply slowing decline in central Tokyo.

In this way, trends in residential and commercial land prices vary greatly by prefecture. For a closer look, we divided the Greater Tokyo area into twelve districts, and calculated correlation coefficients of the price changes in each district (Figure 8).<sup>4</sup>

Compared to commercial land, the correlations of residential land prices across districts are weak; 33 of the 66 cells (50%) have a correlation coefficient of under 0.2, and another 16 have negative values. In particular, Yokohama City has a low correlation with other districts. On the other hand, southwestern Tokyo has a strong correlation with the rest of the Greater Tokyo area.

For commercial land, correlations across districts are strong, and the correlation coefficient is 0.5 or greater in 50 cells (78%). This is thought to reflect the characteristic that returns on commercial land are affected less by location and commercial district than by the overall economic situation at any given time.

**Figure 8 Correlation Coefficients of Price Changes of Residential and Commercial Land by District**

**Residential land**

	Central Tokyo	SW Tokyo	NE Tokyo	Tama	Yokohama City	Kawasaki City	Rest of Kanagawa Pref.	Chiba/Tokyo border	Chiba City	Rest of Chiba Pref.	Saitama/Tokyo border	Rest of Saitama Pref.	Greater Tokyo
Central Tokyo	1.000												
SW Tokyo	0.383	1.000											
NE Tokyo	-0.126	0.292	1.000										
Tama	-0.164	0.597	0.474	1.000									
Yokohama City	0.075	0.190	-0.430	0.143	1.000								
Kawasaki City	-0.017	0.749	0.206	0.656	0.210	1.000							
Rest of Kanagawa pr.	-0.215	0.219	0.262	0.546	0.059	0.433	1.000						
Chiba/Tokyo border	0.111	0.436	0.506	0.378	-0.077	0.399	0.241	1.000					
Chiba City	0.110	0.102	0.425	0.201	-0.284	-0.054	0.099	0.569	1.000				
Rest of Chiba pref.	0.000	0.223	0.356	0.505	-0.068	0.113	0.452	-0.163	0.122	1.000			
Saitama/Tokyo bord.	0.051	0.696	0.446	0.780	-0.008	0.581	0.252	0.263	0.058	0.342	1.000		
Rest of Saitama pr.	-0.256	-0.006	-0.053	0.064	0.064	0.345	0.113	0.002	-0.171	-0.400	0.215	1.000	
Greater Tokyo	0.447	0.903	0.264	0.627	0.183	0.741	0.215	0.494	0.158	0.172	0.627	0.127	1.000

**Commercial land**

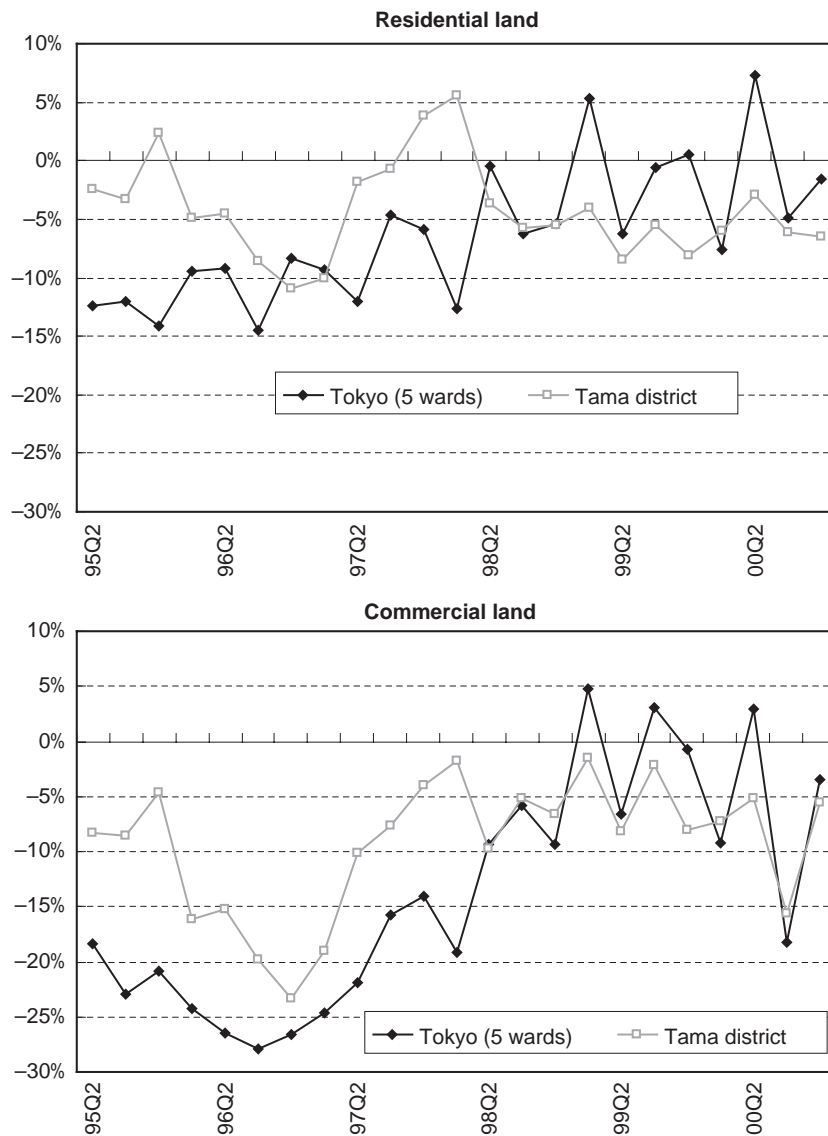
	Central Tokyo	SW Tokyo	NE Tokyo	Tama	Yokohama City	Kawasaki City	Rest of Kanagawa Pref.	Chiba/Tokyo border	Chiba City	Rest of Chiba Pref.	Saitama/Tokyo border	Rest of Saitama Pref.	Greater Tokyo
Central Tokyo	1.000												
SW Tokyo	0.879	1.000											
NE Tokyo	0.797	0.879	1.000										
Tama	0.724	0.877	0.882	1.000									
Yokohama City	0.760	0.732	0.574	0.702	1.000								
Kawasaki City	0.494	0.761	0.609	0.693	0.444	1.000							
Rest of Kanagawa Pr.	0.629	0.744	0.795	0.830	0.603	0.663	1.000						
Chiba/Tokyo border	0.672	0.740	0.804	0.739	0.477	0.540	0.650	1.000					
Chiba City	0.484	0.488	0.599	0.550	0.278	0.226	0.443	0.856	1.000				
Rest of Chiba Pref.	0.360	0.485	0.550	0.651	0.334	0.341	0.599	0.265	0.297	1.000			
Saitama/Tokyo bord.	0.572	0.809	0.762	0.829	0.449	0.758	0.618	0.565	0.344	0.493	1.000		
Rest of Saitama Pr.	0.158	0.208	0.090	0.208	0.186	0.412	0.320	0.077	-0.054	-0.208	0.318	1.000	
Greater Tokyo	0.979	0.914	0.807	0.766	0.737	0.599	0.658	0.692	0.474	0.374	0.630	0.228	1.000

Notes: Shaded areas indicate a correlation coefficient of at least 0.7. See endnote no. 4 for a description of districts.

Incidentally, the standard prices released this September show that land prices have bottomed out in central Tokyo, and are rising in some locations.

Comparing price changes in the five central wards in Tokyo (Chiyoda, Chuo, Minato, Shinjuku, and Shibuya) and the Tama district, we see that in the Tama district, both residential and commercial land prices have been falling faster than in central Tokyo since early 1999 (Figure 9). In particular, with the price decline of residential land slowing down in central Tokyo, the difference with Tama is growing. For commercial land as well, prices have been declining by less in central Tokyo than in Tama since 1999, but not enough to confirm a bipolarization similar to residential land.

**Figure 9 Bipolarization of Land Prices: Central Tokyo and Tama District**



Note: The five central Tokyo wards are Chiyoda, Chuo, Minato, Shinjuku, and Shibuya.



### (3) Comparison to the Representative Lands Price Index

Finally, we compare our index to the index of price changes of representative lands (*daihyo hyojunchi hendoritsu*), which is derived from the only government land price surveys that are conducted quarterly (although results are released semiannually).

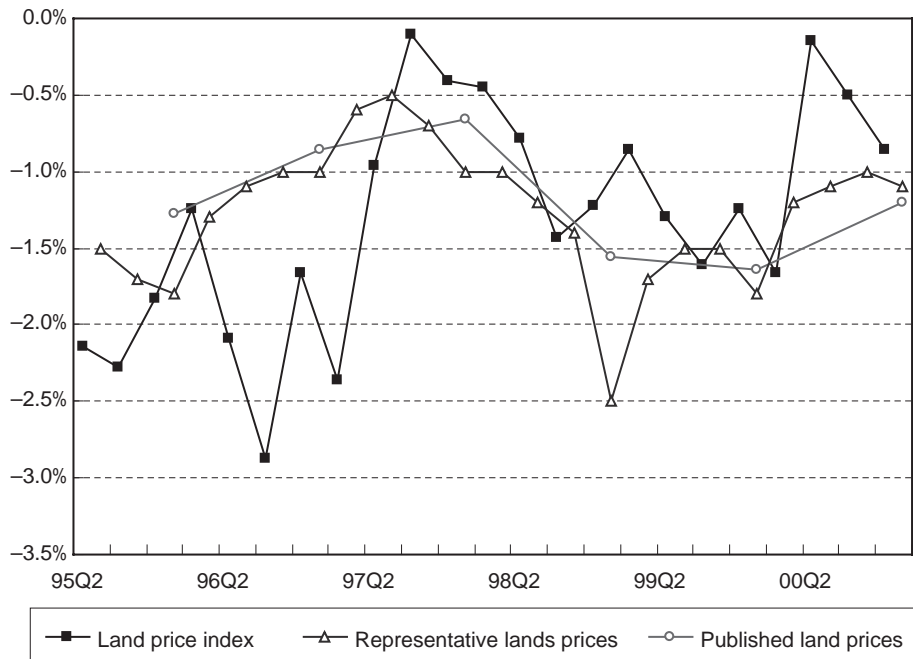
The representative lands price index, which is released by the Ministry of Land, Infrastructure and Transport simultaneously with published land prices (*koji chika*) and standard land prices (*kijun chika*), tracks average quarterly price changes of selected, unspecified locations in major metropolitan areas by district.<sup>5</sup> The index, which is available on the Internet but not in print, is updated twice a year, and considered a reference for confirming quarterly land price trends after the fact.

In Figures 10 and 11, we compare land price trends for Metropolitan Tokyo (Tokyo Pref.) obtained from our index, the representative lands price index, and the published land prices. For our index, year-on-year changes have been converted into a quarterly rate. We calculated the rate of change from year-on-year data because doing so is statistically simple to process, and also includes seasonal adjustment.

As expected, when converted into quarterly rates of change, the published land prices and representative lands prices move together very closely. While our index shows sharp declines for residential land from 96Q2 to 97Q1, this is not reflected in the representative or published prices. In addition, for most of the period from 1997 onward, the decline in representative prices exceeds that of our index. With regard to commercial land, our index declines by more from 1996 to mid 1998, while the representative prices decline by more from 1998.

Thus compared to our index, the representative lands prices show smaller declines from 1996 to mid 1997, and higher declines from 1998. Considering that our index is based on appraisal prices (values of standard lots) and more accurately depicts market changes, the rates of change in representative lands prices and published land prices appear to be inappropriate for use as investment indicators.<sup>6</sup>

**Figure 10 Comparison of the Land Price Index and Official Indexes for Residential Land in Tokyo Pref.**



**Figure 11 Comparison of the Land Price Index and Official Indexes for Commercial Land in Tokyo Pref.**



## 4. On the Periodic Release of the Land Price Index

We developed the land price index in the hope of contributing to the growing need for real estate market data, particularly since none of the investment indicators available today reflect market transaction prices. While the index data presented here only covers to the end of 2000, from the beginning of 2002, we plan to release the latest results on a quarterly basis.

**Figure 12 The Land Price Index (standardized to 94Q2)**

	Residential land						Commercial land						Aggregate
	Tokyo Pref.	Central Tokyo	Kanagawa Pref.	Chiba Pref.	Saitama Pref.	Greater Tokyo	Tokyo Pref.	Central Tokyo	Kanagawa Pref.	Chiba Pref.	Saitama Pref.	Greater Tokyo	
94 Q2	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
94 Q3	1.006	1.007	1.009	0.934	0.971	0.998	0.980	0.969	0.976	0.912	0.957	0.990	0.989
94 Q4	0.942	0.964	1.004	0.954	0.958	0.947	0.900	0.901	0.970	0.930	0.918	0.901	0.938
95 Q1	0.934	0.922	0.977	0.987	0.887	0.941	0.899	0.885	0.948	0.969	0.869	0.906	0.925
95 Q2	0.917	0.883	0.954	0.955	0.911	0.928	0.850	0.825	0.904	0.932	0.876	0.862	0.903
95 Q3	0.917	0.892	0.945	0.902	0.916	0.919	0.788	0.758	0.852	0.838	0.829	0.797	0.885
95 Q4	0.875	0.838	1.002	0.876	0.918	0.890	0.756	0.728	0.904	0.799	0.839	0.765	0.850
96 Q1	0.888	0.839	0.996	0.901	0.889	0.904	0.720	0.679	0.857	0.786	0.786	0.739	0.847
96 Q2	0.843	0.802	0.908	0.876	0.937	0.858	0.652	0.613	0.763	0.751	0.791	0.664	0.802
96 Q3	0.816	0.748	0.928	0.814	0.866	0.829	0.591	0.540	0.740	0.657	0.716	0.605	0.755
96 Q4	0.818	0.772	0.949	0.819	0.826	0.831	0.588	0.542	0.744	0.660	0.670	0.604	0.762
97 Q1	0.808	0.771	0.862	0.809	0.788	0.809	0.569	0.524	0.666	0.646	0.630	0.580	0.738
97 Q2	0.810	0.728	0.919	0.818	0.847	0.825	0.551	0.499	0.711	0.659	0.671	0.566	0.742
97 Q3	0.812	0.727	0.905	0.806	0.852	0.821	0.526	0.468	0.672	0.608	0.655	0.540	0.728
97 Q4	0.805	0.709	0.920	0.799	0.842	0.820	0.514	0.455	0.674	0.605	0.646	0.533	0.719
98 Q1	0.793	0.687	0.892	0.797	0.846	0.806	0.497	0.437	0.643	0.607	0.645	0.513	0.702
98 Q2	0.785	0.711	0.887	0.789	0.815	0.797	0.497	0.444	0.643	0.602	0.617	0.512	0.703
98 Q3	0.767	0.686	0.875	0.772	0.804	0.777	0.498	0.445	0.647	0.595	0.623	0.510	0.688
98 Q4	0.767	0.687	0.886	0.788	0.770	0.775	0.479	0.426	0.639	0.588	0.581	0.491	0.678
99 Q1	0.767	0.708	0.916	0.757	0.769	0.777	0.492	0.446	0.671	0.575	0.584	0.505	0.691
99 Q2	0.745	0.675	0.853	0.710	0.718	0.751	0.471	0.421	0.618	0.528	0.544	0.485	0.665
99 Q3	0.719	0.658	0.839	0.696	0.744	0.722	0.482	0.441	0.646	0.549	0.589	0.488	0.646
99 Q4	0.729	0.672	0.845	0.662	0.743	0.730	0.455	0.410	0.607	0.495	0.555	0.466	0.647
00 Q1	0.717	0.652	0.850	0.686	0.716	0.725	0.450	0.403	0.615	0.514	0.538	0.464	0.644
00 Q2	0.741	0.701	0.821	0.667	0.713	0.731	0.461	0.419	0.583	0.492	0.532	0.468	0.645
00 Q3	0.705	0.644	0.767	0.654	0.725	0.706	0.419	0.372	0.532	0.471	0.523	0.432	0.619
00 Q4	0.704	0.670	0.800	0.638	0.680	0.700	0.439	0.401	0.573	0.464	0.502	0.447	0.626

### Notes

1. See Toru Matsumura, "Preparing the Information Infrastructure for the Real Estate Securitization Market," *NLI Research*, August 2000, pp. 11-19.
2. The land price index was developed jointly with Sanyu System Research Institute. Cooperation was also received from Hideo Nakano of Senshu University and Takako Ide of Seikei University.
3. R-squared = 0.8901; degrees of freedom = 24,577; F value = 281.381; D.W. = 1.8283. Coefficients are omitted due to the large number of variables. However, the t-values of the major variables are sufficient.
4. Districts are defined as follows.

Central Tokyo wards: Chiyoda, Chuo, Minato, Shinjuku, Bunkyo, Taito, Shibuya, Toshima.

Southeast Tokyo wards: Shinagawa, Meguro, Ota, Setagaya, Nakano, Suginami, Nerima.

Northeast Tokyo wards: All other wards not mentioned above.

Tama district: Municipalities in Tokyo Pref. excluding wards, towns, and villages.

Rest of Kanagawa: Cities in Kanagawa Pref. other than Yokohama and Kawasaki.

Chiba-Tokyo border cities: Ichikawa, Urayasu, Chiba, Funabashi, Matsudo, Narashino, Kashiwa, Nagareyama, Yachiyo.

Rest of Chiba: Cities other than in Chiba-Tokyo border.

Saitama-Tokyo border cities: Urawa, Omiya, Tokorozawa, Sayama, Yono, Warabi, Toda, Kawagoe, Kawaguchi, Hatogaya, Asaka, Shiki, Wako, Niiza, Fujimi, Kami-Fukuoka.

Rest of Saitama: Cities other than in Saitama-Tokyo border.

5. "Price changes of representative lands for publication of land prices" (*daihyo hyojunchi hendoritsu*) are released simultaneously with the official published land prices in March; another index called "price changes of representative lands for the Prefectural Land Price Survey" (*shitei kijunchi hendoritsu*) is released with the Prefectural Survey's standard land prices in September. With both types of representative lands surveys, average percentage changes are calculated for selected locations that are left unspecified. While the survey methods and selected locations of the two data series do not necessarily coincide, their continuity and consistency are maintained through adjustments, thus enabling us to treat the two data series as one "representative lands prices" data series.
6. The correlation coefficients between our index (for Tokyo Pref., year-on-year change) and the simple quarterly averages of the appraisal data used in compiling the index were 0.65 for residential land, and 0.55 for commercial land. For reference, the correlation coefficients between the representative land prices (time-adjusted by averaging over two periods) and average values of the appraisal data were 0.13 for residential land, and 0.22 for commercial land.