Analysis of Japanese Posted Land prices with the Generalized Thermostatistics

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Abstract

The posted land prices of Japan in recent 6 years after the collapse of the bubble economy are analyzed. The distribution of land prices and changes of them per year can be regarded as a result of the complex interactive activities of markets. In this sense, the land price formation process is a target of the econophysics problem. We observe that a function borrowed from the recent proposed generalized thermostatistics serves as tracking the change of the cumulative distribution of the absolute value of the change of land prices.

1. Introduction

The issue of the formation process of land prices is worth analyzing as a econophysics problem because the land is traded under the market mechanism. The financial environment (ups and downs of interest rates etc.) affects both the stock prices and the land prices as the same real assets. Moreover, the fluctuations in the land prices determine the rise and fall of asset values of companies. Therefore the economic issues give influences on land prices and vice versa[1]. In view of this fact, statistics of the land price seems to have specific importance to construct a dynamical model. In this contribution of paper, we present an interesting empirical study on the Japanese posted land price (prices per square meters) based on the officially available data disclosed by the Ministry of Land, Infrastructure and Transport [2]. More precisely, we analyzed land price data of period $1995-2000$, during which each year's data contains more than 30000 places in total. On the other hand, a number of statistics of the empirical economic data such as stock prices and foreign exchange rates show interesting features which are worth analyzing in terms of statistical mechanics. For example, the power-law behavior appearing in the cumulative distribution in returns is most striking character. These power-law distribution can be attributed to the result of highly nonlinear interactions among constituent elements. Such a non-Gaussianity in distribution is incompatible with the conventional statistical mechanics formalism, which gives the exponential form. The seek for the alternative statistics, or the generalized statistical mechanics[3] has recently attempted to fit the real data in several research fields such as urban agglomeration[4], citation of scientific papers[5] and sparseness time interval distribution in Internet[6]. We here add another example to this scenario.

2. The Land price data and its distributions

Lands are mainly categorized into two groups (the urbanization promotion area and the urban regulating area) by the city-planning law. The urban promotion area is appointed lands which should be promoted urbanization preferentially and designedly to prevent them from developments in unregulated ways for the sake of better city formations. The urban regulating area, on the other hand, is forbidden to develop. In the period we analyzed, Japan is in the phase of down economy (the Nikkei stock average is continuing to decrease). Figure 1 shows the distribution of land prices in units of 10 thousand yen during *six* years in log-log scale.

We can see that two distinct regions which can be well approximated by straight line exist for all years. The slopes of the fitted lines for each regions fall into near -1 (solid line) and near -3 (broken line) respectively (Table.1). The border lies in around 20 thousand yen.

Including the period we analyzed, we show in Figure 2 the year-on-year percentage changes of the average price of lands from 1989 to 2001. After the crush of bubble economy in 1990, the average land price has been decreased and is continuing to decrease even now. The symbol $(+)$ denotes the average value of the land price of residential districts for three major metropolitan areas (Tokyo, Osaka and Nagoya), $(\times)$ that for other local areas, $(*)$ that of commercial districts for the three major metropolitan areas, $(\Box)$ that for other local areas. Corresponding distributions of the change of land prices be-

come highly asymmetric (Figure.3).The exponential decay for positive changes can be seen for all years, whereas the changes vary widely for larger percentage declines.

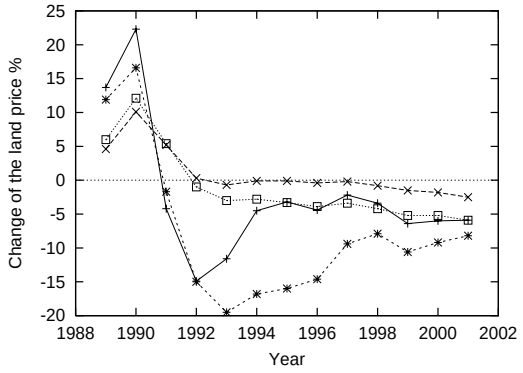

Figure 2: Annual percentage change of the average land price. For symbols, see the text.

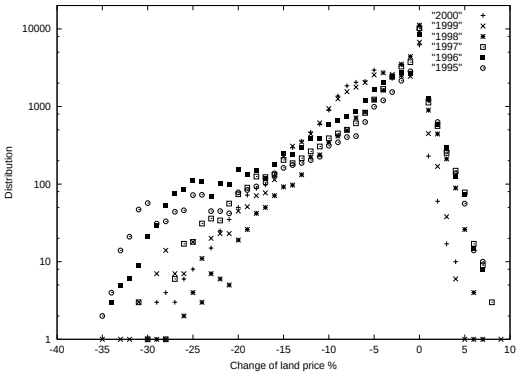

Figure 3: Distribution of the change of land prices.

Figure 1: Distribution of the land prices of 6 years.

Table 1: The power-law exponents of the distributions and the number of the average residential and commercial land.

Year	Region I	Region II	Total number of land
1995	-0.986	-2.83	30,000
1996	-0.977	-2.83	30,000
1997	-0.960	-2.92	30,300
1998	-1.01	-3.02	30,600
1999	-1.06	-3.07	30,800
2000	-1.10	-3.12	31,000

3. The generalized thermostatistics

Our analysis uses the exponential function parameterized by a real parameter q i.e., the q-exponential function[7, 8]. The q-exponential function is based on the generalized formalism in statistical mechanics[3], where example of such an entropy maximized to obtain the equilibrium distribution function is of the form,

$$S_q = \frac{1 - \sum_i p_i^q}{q - 1}. \quad (1)$$

In this framework, the normalized distribution function $p(x)$ as a result of the maximum entropy principle with

Figure 4: Comparison with the cumulative distribution of the absolute value of year-on-year percentage change of land prices for two years 1995 and 2000.

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