A mechanism leading bubbles to crashes

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The burst of the Japanese real estate bubbles in the early 1990s was the boom and bust at the maximum scale of the late twentieth century. The average land price was an increase of 550 percent between 1981 and 1991. By 1991, the total value of all Japanese property was estimated at nearly 20 trillion dollars. It was equal to more than 20 percent of the world's wealth. Theoretically, the Japanese could have bought all the property in America by selling off metropolitan Tokyo [1]. This anomalous appreciation of land price was created by the irrational exuberance of land speculation [2] that was fueled by a myth that the land prices could never go down in Japan. In 1991, however, the castle-in-air [3] bottomed drops out. Since 1991, the average land price continues to fall for 12 years until 2002. By 2002 the average land price fell by about 70 percent compared with the level in 1991.

Why did the bubbles of the real estates crash? Here we analyze the probability distribution of land price in Japan, and give an explanation of a mechanism leading bubbles to crashes. We investigate a database of the *assessed value of land* that is made public once a year by the Ministry of Land, Infrastructure and Transport Government of Japan [4], covering the 22-years period between 1981-2002. The data for each of the 22 annual intervals contains the data of the land prices over 10,000 points.

In Figure 1, we plot the cumulative probability distribution of land price (S) in the three years 1985, 1987, 1991 and 1998, which is the log-log plot of the cumulative probability as a function of land price. We find that the tail of the cumulative probability distributions of the land price in the high price range is well described by a power law distribution, $P(S > x) \sim x^{-\alpha}$. We

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use ordinary least squares (OLS) regression in log-log coordinates in order to determine the exponent α for the data of land prices for each of 22 years from the period 1981 - 2002. Overall, the power law distribution of land prices is very strong [5-7]. Figure 2 indicates the movement of the exponent α. The exponent α continued to decrease toward unity between 1981 and 1987, and during the period of the peak of bubbles from 1987 to 1991 the exponent α stuck around unity. In 1991 the bubbles crashed, and the trend has reversed and the exponent α continued to increase between 1992 and 2001. This finding suggests that the threshold value of the exponent α that gives cause to the burst of bubbles is equal to unity. We interpret it as follows. It is well known that the exponent α of the power law distribution can be considered as a measurement of wealth inequality on holding the real estate. The Gini coefficient (G), known as the index of wealth concentration [8], can be written as $G = 1/(2\alpha - 1)$. Theoretically the Gini coefficient ranges from zero, when all land areas have equal a price, to unity, when one land area has a highest price and the rest none. The exponent α close to unity means the Gini coefficient close to unity. Therefore the wealth inequality measured by the Gini coefficient on the land price increased drastically between 1981 and 1991, and particularly during the period of 1987 - 1991 the wealth inequality reached the breaking point. The real estate bubbles brought down intolerable inequality for the society. Accordingly increasing the wealth inequality acted as a trigger to cause the collapse of the real estate bubble.

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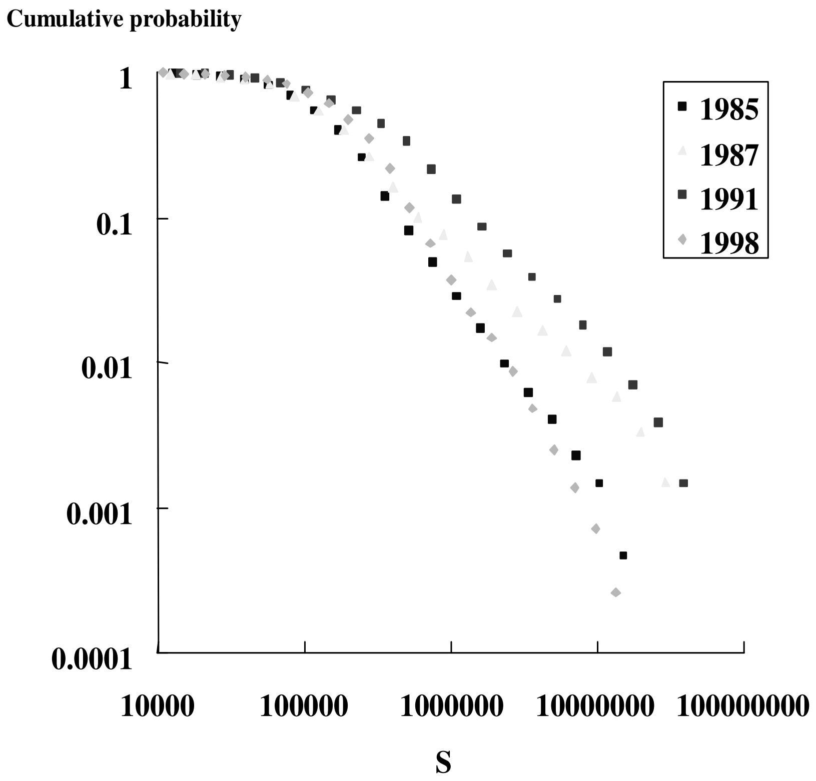

Figure 1: Log-log plot of the cumulative distribution of the land price for each of the four years, 1985, 1987, 1991, and 1998.

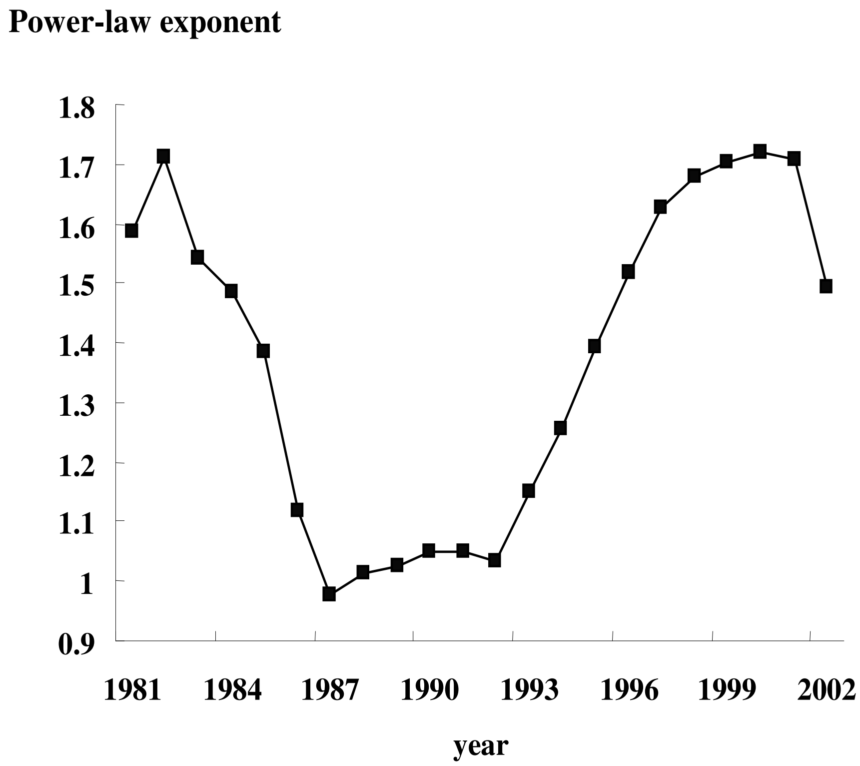

Figure 2: The dynamics of the power law exponent. The exponent is estimated by least square fit to data of the land price for each of the 22-year period 1981-2002.