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The Nature of Inefficiency in the Land Market: The Case of Japanese Farmlands

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THE NATURE OF INEFFICIENCY IN THE LAND MARKET: THE CASE OF JAPANESE FARMLANDS*

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ABSTRACT

The market for lands is sometimes regarded as being less efficient than are financial markets. This paper investigates sources of inefficiency of the land market, by examining the Japanese farmland market over past 80 years. It is shown that the extent of imperfect information of market participants is an important determinant of market efficiency. The market seemed efficient both in the pre-war period (in which well-informed large-scale landowners were important market participants) and the recent period (in which large-scale owner-farmers became increasingly important). However, the market was inefficient in the period immediately after the agricultural land reform (in which imperfectly-informed small-scale owner-farmers were principal market participants).

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1. INTRODUCTION

There is a good reason to regard that the market for lands ought to be less efficient than are financial markets (Case and Shiller (1989)). The land market is not a well-organized market like the New York Stock Exchange. The market is dominated by individuals who do not have detailed information about the market. Because of various transactions costs, carrying costs, and regulations in some cases, professionals find it relatively difficult to take advantage of profit opportunities in this market. Thus, the land market provides us with unique opportunity to assess the effect of various market imperfection on the efficient working of the asset markets.

I examine in this paper whether the Japanese farmland market is efficient or not, and if there are signs of inefficiency, I investigate what are likely causes of such inefficiency. There are several reasons to investigate the Japanese farmland market in order to analyze possible sources of inefficiency in the land market. The first is the quality of data. We need transaction price information of the land market, and there are transaction price data in the Japanese farmland market.[1] The second advantage of the Japanese farmland data is its coverage both in time and space. We have relatively reliable farmland transaction price data in all areas in Japan from 1913. The third and foremost advantage of the Japanese farmland market analysis is that the history of the Japanese farmland market allows us to assess the impact of market imperfection. The history of the Japanese farmland market can be decomposed into three distinctive periods due to the agricultural land reform after the Second World War, between which characteristics of market participants and the magnitude of transactions costs were quite different. Thus, we can evaluate

the effect of imperfect information and transaction costs on the efficiency of the market, by comparing various periods and various areas.

This paper applies a simple random-walk test of efficiency to the Japanese farmland prices. First, the test is performed to the nationwide as well as ten regional real average prices of rice fields during the pre-war period (1914-1936), the period immediately after the agricultural land reform (1948-1968), and the recent period (1971-1990). Then, the test is also applied to forty-six prefectural data in order to find cross-sectional difference in the efficiency of the farmland market.

I obtained three major findings. First, as an overall assessment, the farmland market was weak-form efficient (or at least the behavior of prices was consistent with weak-form market efficiency) both in the prewar era and the recent period. This suggests that the farmland market tends to be efficient in spite of various transactions costs and informational deficiency described before. However, the farmland market was clearly inefficient during the period immediately after the land reform, in which absentee landlords were forced to sell their farmlands to small sharecroppers in very low real prices and prohibited from participating in the market. Thus, the dominance of small owner-farmers with little market information was sufficient to cause the market inefficiency in this period.

The second finding is that there was a tendency toward inefficiency in the farmland market close to urban areas (especially three metropolitan areas, that is, the Tokyo, Osaka, and Nagoya areas) in the period immediately after the land reform. This indicates possible influence of the urban land market on the farmland market.

Thirdly, I found a strong spill-over effect of real price increases across near-by prefectures in the period of inefficiency. This suggests

that the major cause of inefficiency is not imperfect information of market participants about their own local market, but imperfect information about nearby local markets.

This paper is organized as follows. In Section 2, the concept of market efficiency is discussed and a brief description of the Japanese farmland market is presented, which examines the effect of the land reform on the efficient working of the market. In Section 3, I explain the data employed in this study, and test market efficiency using these data. The major findings are contained there. Section 4 concludes the paper.

2. MARKET EFFICIENCY AND THE JAPANESE FARMLAND MARKET

Efficiency of the Asset Market

The efficiency I test is weak-form efficiency. The asset market is described as weak-form efficient if trading rules based on historic information cannot yield net excess returns. If it were possible to make extraordinary profits simply by finding patterns in asset prices in the past, every market participant tries to do it, and any profits would disappear in the scramble. Thus, efficiency requires that there is no exploitable opportunity based on the past history of land prices. This is weak-form efficiency because information utilized is the past history of asset prices, which seems to be easily obtained by market participants.

In order to give more structure to the notion of weak-form efficiency, let us consider a simple constant-expected-return model.[2]

If (1) market participants are not averse to risk, (2) they discount future returns at a constant rate (r), (3) all transactions costs can be

ignored,[3] and (4) market participants know the past history of the market, then all assets would have the same constant expected real return in equilibrium. The real asset price (p_t) at the beginning of period t would be equal to the real dividend on the asset during the period (z_{t+1}) plus the real price at which the asset can be sold at the beginning of the next period (p_{t+1}). These are the benefits from owning the asset. Thus,

$$(1) \qquad p_t = E_t(z_{t+1} + p_{t+1})/(1 + r),$$

where $E_t(z_{t+1} + p_{t+1})$ denotes the expected value of the future dividend and the future real price conditional on information available to market participants at the beginning of period t.

Let us define the real rate of return R_{t+1}^* such that

$$(2) \quad R_{t+1}^* = (z_{t+1} + p_{t+1} - p_t)/p_t.$$

From (1) it is evident that

$$(3) \qquad E_t R_{t+1}^* = r,$$

which implies

$$(4) \qquad R_{t+1}^* = r + v_{t+1},$$

where v_t is a forecast error, which is by definition serially uncorrelated. Consequently, in this model, $R_{t+1}^* - r$ and $R_t^* - r$ must be uncorrelated, because $v_{t+1} = R_{t+1}^* - r$ and $v_t = R_t^* - r$ are uncorrelated. Thus, under the

assumptions made earlier, the coefficient b of the following regression equation

$$(5) \qquad R_t^* = a + bR_{t-1}^* + u_t$$

must be zero, where u_t is the disturbance. Thus, if the market is efficient, the real rate of return must be serially uncorrelated.

In the following sections, I apply this version of weak-form efficiency test to the Japanese farmland market. However, we do not have reliable data about farmland rents z_t even in recent periods, although we have relatively reliable data about the price of farmlands. (The reason of this deficiency in data will be discussed in the next section.) Consequently, I was obliged to use the rate of change in the real price of farmlands (the rate of real capital gains) as a proxy of the total real rate of return. That is, in the following analysis, I use the following regression equation

$$(6) \qquad R_t = a + bR_{t-1} + u_t, \text{ where } R_t = (p_{t+1} - p_t)/p_t,$$

and examine whether b is significantly different from zero. This is the test of determining whether the price follows random walk or not.

Before proceeding with analysis, one caveat on the nature of this test may be due. The rejection of the hypothesis that b = 0 does not necessarily imply the market is inefficient. This is because the hypothesis that b = 0 is a joint-hypothesis of risk neutrality, constant discount rate, negligible effect of farmland rents, and finally, market efficiency.[4] Thus, in order to argue that the rejection implies market inefficiency, we need a strong, clear-cut, and robust rejection of the hypothesis which are unlikely to be

reversed by changes in the risk attitude of market participants, in the discount rate, and in the farmland rent.

The Japanese Farmland Market

In this section, I briefly review the history of the Japanese farmland market and examine its implication on the efficiency of the market.

The twentieth-century history of the Japanese farmland market was fundamentally influenced by the Second World War and the following agricultural land reform. Before the war, many Japanese farmlands were sharecropped. For example, in 1941, 43% of all rice fields were sharecropped, and the rate was 38% in other fields. Owner-farmers were only 28% of all farmers in Japan. There was virtually no restriction on farmland transactions before 1938 in which the Agricultural Adjustment Law was enacted to regulate usage of agricultural lands for other purposes than farming in order to increase food production at the time. There were many transactions of farmlands in those days. In one estimate, 2% of the total farmlands were transacted each year.[5]

The agricultural land reform after the Second World War was carried out as a means of "democratization" of rural communities. The farmland reform that began in 1946 was aimed to counter the large-scale land holding by absentee landlords at that time, and to improve economic conditions of impoverished sharecroppers in rural Japan in order to restore political stability there. After the reform, the sharecropped rice fields dwindled to just 14% of all rice fields in 1949, and the share of owner-farmers increased to 55% of all farmers.

The core of the agricultural land reform was summarized in the Agricultural Land Law of 1952. It was based on the so-called "owner-farmer principle." In order to prevent large-scale land holdings by absentee

landlords, there were three types of regulations on the transactions of farmlands in this law. First, the transfer of ownership of farmlands must be reported to the local agricultural committee and must be approved by the governor of the prefecture. Second, the use of farmlands for other purposes than farming must also be reported to the committee and approved by the governor. In addition, there was a cap on the holding of farmlands.

However, it should be noted that there was no regulation on transaction prices in this law. Thus, the law did not prevent market transactions between owner-farmers. Table 1 depicts market transactions of farmlands after 1956. There were a substantial number of transactions, although the ratio of the transacted area to the total farmlands was between 0.7% and 1.2% compared with 2% before the war. Thus, the major impact of the agricultural land reform was not on prices but on market participants. Before the war, large-scale landowners were important market participants, while after the land reform, small-scale owner-farmers dominated the market.

After 1960 in which the era of high economic growth began, the regulation on farmland transactions has been weakened in various ways. For example, in the 1962 amendment of the Agricultural Land Law, the cap of farmland holdings was lifted for a certain class of farmers, and in the 1970 amendment the cap was completely abolished. From 1975, certain transactions of farmlands were exempt from the Agricultural Land Law regulation. The 1980 amendment relegated the right of approval to local agricultural committees. Along with this gradual de-regulation, the number of owner-farmers having larger than 3 ha was steadily, though very slowly, increased. Table 2 shows that the number of those large-scale farmers was more than quadrupled between 1955 and 1986, and the change was accelerated after 1965.

This brief history of the ownership market of Japanese farmlands reveals that there are three distinctive periods; the pre-war period in which large-scale land owners were major market participants, the period of the land reform in which sharecropper-turned small-scale owner-farmers emerged as principal market participants, and the recent period in which large-scale owner-farmers became increasingly important in the market. It should be noted that there was no regulation on prices. Thus, if there is difference in the behavior of prices between the periods, it must be due to the difference in market participants.

What does this history imply for the efficiency of the farmland ownership market? First, market participants' information about the market was likely to be drastically different between three periods. In the pre-war period, major market participants were wealthy landlords who were likely to have detailed information about the market. By contrast, during the period of the land reform, market participants were restricted to sharecropper-turned owner-farmers and small-scale owner-farmers, whose ability to gather market information was quite limited. However, in the recent period, the share of large-scale owner-farmers was increasing. These large-scale owner-farmers were likely to have detailed information about the market. Thus, from the informational point of view, we expect weak-form efficiency in the pre-war and recent periods, and inefficiency in the period of the land reform.

In addition to this informational implication, the transaction regulation clearly implied a large transaction cost. Thus, we expect that the period of the land reform was more inefficient than the prewar period where there was no regulation on transactions. Because of the gradual de-regulation after 1960, the transaction cost due to the regulation in the

recent period was likely to be much smaller than the period of the land reform. The recent period was likely to be less inefficient than the period of the land reform.

In the next section, I first examine the plausibility of the above argument by applying the weak-form efficiency test to the nation-wide data of farmland prices in the pre-war period, the period of the land reform, and the recent period. Then, I investigate the nature of inefficiency by using prefectural data.

Before proceeding, a remark on farm rents may be due. So far, I have considered the ownership market of farmlands, and have shown that the transaction regulation based on the Agricultural Land Law was not the one on transaction prices. By contrast, the regulation on the rental market of farmlands was rent regulation, and farm rents were tightly controlled by the government.

Before the land reform, there was no regulation on farm rents and sharecropping was wide-spread. In this sharecropping, farm rents were paid in kinds and often set at a very high level. Since the outset of the land reform, rental prices of farmlands were heavily regulated, because the control was considered to be necessary to prevent land owners from setting high farm rents by using their superior bargaining power. Rental prices of farmlands was tightly controlled by the Agricultural Land Law until 1970. Even after 1970 when the control was in principle abolished, the control was partially remained until 1980 when the rent control was finally abolished.

Because of persistent rent controls in the farmland rental market, the farmland rent data, even though they represented actual farmland rents paid by tenants, were not likely to represent true market rents. They were a mixture of regulated rents and black-market rents. This why I am obliged to

use the rate of change in the real farmland price as a proxy of the total real rate of return on the farmland and to ignore the farmland rent data altogether in the following analysis.

3. DATA AND MAIN RESULTS

3.1. Data about Farmlands

The data source for farmland prices is Survey on Farmland Prices and Farm Rents conducted by Japan Real Estate Institute. There are two distinctive features in this data set. First, these price data are based on actual transaction prices. Second, farmland prices reported in this survey are prices of farmlands strictly for farming.

Survey on Farmland Prices and Farm Rents was initiated in 1913 by Nihon Kangyo Bank.[6] After the establishment of Japan Real Estate Institute in 1959, the institute has been conducting the survey. I briefly explain the procedure of the survey conducted by the Institute. In early days when Nihon Kangyo Ginko conducted the survey, data collection was more rudimentary than the one described below, but the procedure was qualitatively the same.

Each year the Institute send questionnaires to city, town, and village offices, agricultural committees, and in some cases farmers in all prefectures, which are selected on the basis that they have first-hand knowledge about local market conditions. For example, in the 1989 survey, 1,706 municipalities were surveyed. Among them, 1337 municipalities responded (78% response rate). The rate of response is stable over years.

In this survey, two kinds of farmlands are considered: rice fields ("ta") and other fields ("hatake"). They are classified in three broad

categories: excellent, good, and poor. Local officials and farmers are asked to report the price of them per ten ares in each category. They are also asked to report prices of the fields that are strictly for farming, not those which may be used for other purposes than farming in the near future.[7]

Local officials and farmers are asked in this survey to report the normal transaction price[8] of these farmlands in their locality in March of the year. The normal transaction price is the price that "both buyers and sellers consider appropriate." (Thus, for example, purchase prices determined by the government under the Agricultural Land Law were excluded.) Because all transaction prices are in principle reported to local agricultural committees, there is a good reason to consider that those respondents have considerable knowledge about the transaction prices of farmlands in their locality.[9]

The institute publishes the simple arithmetic average of farmland prices for all forty-three prefectures except Tokyo, Kanagawa, and Osaka, although the institute published the average for all prefectures until 1968.[10] In the averaging procedure, the institute carefully excludes all prices of farmlands that may be converted to residential, commercial, or industrial lands in foreseeable future. In Tokyo, Kanagawa, and Osaka, almost all farmlands are considered to be eventually converted into residential, commercial, or industrial lands in foreseeable future. This is why the institute excluded Tokyo, Kanagawa and Osaka altogether in its publication after 1969.

In addition to the prefectural averages, the institute also publishes the nation-wide and ten regional averages. However, the coverage of the nation-wide and regional averages is different between before 1968 and after

1969 for the reason described above. Before 1968, the nation-wide and regional averages included Tokyo, Kanagawa, and Osaka, but after 1969 these three prefectures were excluded from the averages.[11]

The institute publishes the nominal average price of rice fields ("ta"), and that of other fields ("hatake"). The series go back to 1913 in the case of rice field prices. I selected rice fields (ta) of the "good" category as our subject of investigation because they constitute a major part of the Japanese farmlands.

Using the data just described, I constructed the real nation-wide, regional, and prefectural average prices of rice fields by dividing the nominal price of the rice field by the nation-wide wholesale price index.[12]

3.2. Inefficiency of the Japanese Farmland Market Immediately After the Land Reform

I first performed the weak-form efficiency test on the nation-wide average of the rice fields in three periods; the pre-war period (1914-1936), the period immediately after the land reform (1948-1968), and the recent period (1971-1990). It should be noted that the choice of the end year of the land-reform period, 1968, is somewhat arbitrary. This year is chosen because there is discontinuity in the nation-wide average price series in this year. As noted above, Tokyo, Kanagawa and Osaka were included in the series before 1968, while they were excluded after 1969. However, 1968 may be a good choice, because it divides the post-war period almost evenly.

The movement of the nation-wide average real farmland price index is summarized in Table 3, and its rate of change in the whole period between 1914 and 1990 is depicted in Figure 1. Table 1 shows that the farmland prices declined from 1914 to 1936. This decline is one manifestation of the

plight of rural communities at that time. When the land reform began in 1946, the real farmland price plummeted, and the real price in 1948 was just 1/6 of that in 1936. By contrast, the real price increased sharply after the land reform. The real price in 1990 is almost forty-six times as high as that in 1948.[13]

The movement of the nation-wide real average farmland price shown in Figure 1 reveals that there is sharp difference between the three periods. The movement in the pre-war period is very volatile compared with the recent period. This might be due to measurement errors in the early data. The price movement during the period immediately after the land reform shows remarkable persistence, and strongly suggests inefficiency. By contrast, the recent price movement shows little persistence, suggesting market efficiency.

The regression analysis reported in Table 4 confirms the observation. It is evident from this table that we have a strong positive serial correlation of the rate of change in the real farmland price in the period immediately after the agricultural land reform. The coefficient b is significantly different from zero, and the magnitude of the positive correlation is large. This coefficient implies that 1% increase in the real price this year leads to 0.6% increase in the next year.[14] By contrast, the coefficient b of the pre-war period and the recent period show little persistence, suggesting market efficiency.

The analysis of the ten regional average prices, which is not reported here, shows a remarkable similarity of the regional average prices to the nation-wide average price. The b coefficient of the pre-war regression and the recent-period regression is small and insignificant in all regions. By contrast, the regression in the period immediately after the land reform

shows a positive, large, and significant b coefficient except for Hokkaido (northern-most part of Japan) and Shikoku (southern part of Japan).

The above result strongly supports the argument advanced in the previous section that imperfect information of small-scale owner-farmers and high transaction costs due to the transaction regulations caused market inefficiency. In the following section, I examine the nature of inefficiency in this period by analyzing prefectural data.

3.3. The Nature of Inefficiency: The Effect of Urbanization and the Cross-Prefectural Correlation

In the period immediately after the land reform (1948-1968), the same weak-form efficiency is tested to the prefectural real average-price data in forty-six prefectures. Table 5 reports prefectures having statistically significant coefficient b. Twelve prefectures show apparent inefficiency. (One may consider that this number is too small because the nation-wide and most regional averages exhibit clear inefficiency. I will come back this issue later in this section.)

These inefficient farmland markets tend to be concentrated in the central part of Japan, where industrialization and accompanying urbanization were most apparent during the period (1948-1968). Among twelve prefectures, all but one (Fukuoka) are in the central island (Honshu). Moreover, Fukuoka was the most urbanized prefecture outside the central island. In addition, Gunma and Chiba are near the Tokyo metropolitan area, Gifu and Mie are close to the Nagoya metropolitan area, and Kyoto is near the Osaka metropolitan area.

One possible explanation of this result is the influence of the urban land market on the farmland market. Note that farmlands under consideration

were those only for farming. The data gathering procedure described earlier carefully excluded farmlands that might be converted into residential, commercial or industrial lands. However, it was often observed in Japan that zoning and other regulations are changed under political pressures. The regulations on farmlands were no exception. In this case, some farmers having better access to information might bid up farmlands close to urban areas, anticipating future regulatory changes which allowed farmlands to be converted into residential or industrial lands. Because of rapid economic growth of that period, prices of urban lands were much higher than those of farmlands, and the conversion of farmlands to urban lands yielded a large capital gain if the conversion was granted. However, because of high transactions costs due to heavy transaction regulations of that period, those informed farmers could not exhaust all profit opportunities. Then, information about possible regulatory changes diffused gradually among farmers, and newly informed farmers could still find profit opportunities. Thus, the combination of high economic growth, political pressures on regulations and high transactions costs were likely to cause inertia in price increases and inefficiency of the farmland market near urban areas.

The efficiency test based on autocorrelation, however, reveals only a part of inefficiency in this period. The market inefficiency in this period was characterized by cross-prefectural correlation as well as autocorrelation. This is demonstrated in Table 6. In this table, the rate of change in the real farmland price of four prefectures in the Tokyo metropolitan area was regressed on the lagged real-price change of near-by prefectures. The result showed that there was strong cross-prefectural correlation between the prefectures. By contrast, the weak-form efficiency test based on autocorrelation revealed only one (Chiba) out of the four

prefectures was apparently inefficient. Similar results were obtained in other metropolitan areas. This strong cross-prefectural correlation and the lack of autocorrelation also explain why only twelve prefectures out of forty-six ones were detected to be inefficient by the weak-form efficiency test based on autocorrelation, although the nationwide and regional averages clearly showed inefficiency.[15]

The lack of autocorrelation and the strong cross-prefectural correlation suggest that market participants during this period had relatively good information about their local markets but that they did not know much about near-by markets. The cross-prefectural correlation has been often found in the Japanese land market. For example, a strong cross-prefectural correlation (diffusion of price increase from Tokyo to other prefectures) was pointed out in the recent surge (1986-1989) of urban land prices.[16]

4. CONCLUDING REMARKS

In this paper, I have examined weak-form efficiency of the Japanese farmland market. Although the farmland market was likely to be subject to higher transactions costs than the urban land market, the overall assessment of the data indicated that farmland price behavior was not inconsistent with weak-form efficiency in the pre-war period (in which well-informed large-scale landowners were important market participants) and the recent period (in which large-scale owner-farmers became increasingly important). However, the market was apparently inefficient in the period immediately

after the agricultural land reform (in which imperfectly-informed small-scale owner-farmers were principal market participants). These results suggested that the extent of imperfect information of market participants is an important determinant of market efficiency. If most participants are imperfectly informed, then the market is likely to be inefficient. However, if there are well-informed market participants, the market is close to be efficient even though the number of those informed market participants is small. Thus, the experience of the Japanese farmland market supports the view held by many economists that wide-spread imperfect information is necessary for the market to be inefficient.

I have also examined the nature of inefficiency in the period immediately after the land reform, and have found a strong cross-prefectural correlation of price changes compared with rather weak autocorrelation. This implied that cross-prefectural imperfect information was likely to be one of the major causes of inefficiency. This implies that even in the inefficient market, market participants had relatively good information about their own local market, but that they did not know conditions of near-by markets. In addition to cross-prefectural correlation, I have found a strong effect of the urban land market on the farmland market. It has been suggested that high economic growth, uncertainty about regulations, and high transaction costs contributed to the inefficiency of this period.

The results obtained in this paper shed light on the current debate about whether land prices in Japan can be justified as prices based on market fundamentals. The non-rejection of market efficiency in the recent period suggests that, as an overall assessment, farmland prices in Japan are consistent with market fundamentals prices, although there are several exceptions where the effect of urban land markets is strong. Thus, the

result of this paper is consistent with the results of Furue and Mizoguchi (1990) who showed that prices of at least a half of Japanese farmland can be considered as market fundamentals prices.

Although the rejection of efficiency in the period immediately after the land reform is strong and persuasive, the non-rejection of efficiency in the recent period is at best suggestive because of the inherent limitation of the analysis that we only have a small number of samples. Moreover, the non-rejection of the efficiency is perfectly consistent with rational bubbles, which deviate from market fundamentals. Further research is needed to settle down the debate.

NOTES

1. By contrast, most urban land price data in Japan are evaluated prices based on the estimate of real estate appraisers.

2. The following discussion is due to Flood and Hodrick (1990).

3. Transaction costs include commission fees, transaction taxes, and capital gain taxes.

4. The weak-form efficiency itself does not depend on the risk-neutrality of market participants nor on the constancy of the discount rate. In fact, a variant of the test can also be derived from the capital asset pricing model (CAPM) and one-factor arbitrage pricing theory (APT) model, where market participants are assumed to be risk averse and discount rate may change from time to time. See, for example, Linneman (1986) and Case and Shiller (1989) for the test of efficiency in the United States housing market. However, because of the problem of data availability, so far I cannot perform this kind of more sophisticated tests of efficiency to the Japanese farmland market.

5. See Ishii and Kawai (1991; p.75).

6. Originally, it surveyed only farmland prices, but after 1921 it also surveyed farm rents.

7. The procedure is explained in detail in Tuchiya (1975).

8. The term the Institute uses is "Chuyo Jiyu Torihiki Kakaku (Reasonable Free-Trasaction Price)".

9. However, it should be noted here that those reported prices are not the weighted average of <u>all</u> farmlands of their locality but the simple arithematic average of the transaction prices which are considered by the respondents as normal prices.

See Ishii and Kawai (1991) for a more detailed discussion about the data.

10. I ignore Okinawa Prefecture, because its series began only recently.

11. In addition, there is a break in the data due to the addition of Okinawa Prefecture. However, because this constitutes a small change in the national and regional averages, we ignore its effect in the following analysis.

12. I use the pre-war-year-base wholesale price index published by the Bank of Japan.

13. However, this increase did not match the increase in real urban land prices during the same period. The real urban residential land price in 1989 was seventy-nine times as high as that in 1948. The figure is based on the Japan Real Estate Institute urban residential land price index.

14. Note that if the measurement error is present in the series, which is likely in the land price series, we obtain spurious negative correlation between R_t and R_{t+1}. Thus, the strong positive correlation in the period immediately after the land reform is all the more remarkable.

15. Thus, the most appropriate test of weak-form efficiency is to test cross-sectional correlation as well as autocorrelation. Unfortunately, however, I cannot perform this type of weak-form efficiency tests because the number of samples is too small compared with the number of prefectures.

16. See Nishimura (1990).

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TABLE 1
TRANSACTIONS OF FARMLANDS: SELECTED YEARS
Unit=1,000ha

YEAR	1956	1966	1976	1986
Total Farmlands	6,012	5,995	5,536	5,358
Transacted Farmlands	43.6	74.9	47.3	35.2
Transacted/Total (%)	0.72%	1.25%	0.85%	0.66%
Number of Transactions	353,216	369,720	213,106	158,509

Source: Ishii, Hiroo, and Kazushige Kawai, Kokukdo Riyo to Nochi Mondai (Land Usage and Farmland Problems), Table 2-6.

TABLE 2
SIZE OF FARMLANDS: SELECTED YEARS
Unit=1,000

YEAR	1955	1965	1975	1986
NUMBER OF FARMERS				
TOTAL	5,806	5,466	4,819	4,136
Smaller than 1.5 ha	5,221	4,803	3,878	3,460
	89.92%	87.87%	80.47%	83.66%
Larger than 3 ha	29	38	76	130
	0.50%	0.70%	1.58%	3.14%

Source: Ishii, Hiroo, and Kazushige Kawai, Kokukdo Riyo to Nochi Mondai (Land Usage and Farmland Problems), Table 2-9.

TABLE 3
NATIONWIDE AVERAGE OF FARMLAND PRICES: SELECTED YEARS
Unit=yen/10a

YEAR	1914	1936	1948	1968	1971	1990
Nominal Price	277	435	9,420	278,349	344,416	1,172,912
Wholesale Price Index	0.618	1.036	127.9	377.9	396.7	745.4
Real Price (1968=1)	0.61	0.57	0.10	1.00	1.18	4.65

Source: See text.

FIGURE 1

RATE OF CHANGE IN FARMLAND PRICES

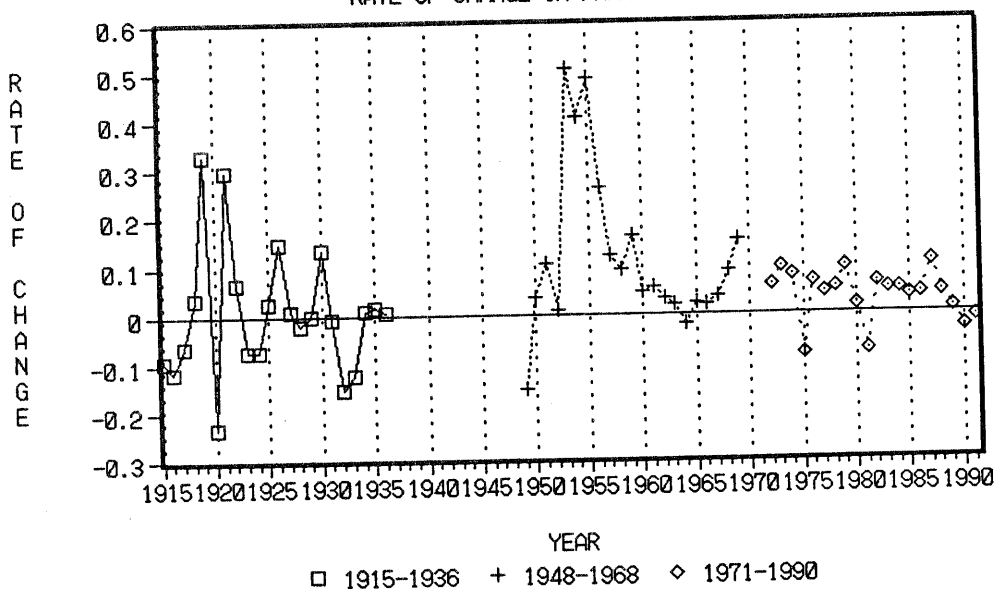

TABLE 4
EFFICIENCY IN DIFFERENT PERIODS
Rt = Rate of Change in the Nationwide Average of Real Price
Rt = a + bRt-1 + ut

	a (t-sta.)	b (t-sta.)	R2	No. Obs.
Before Agricultural Land Reform				
1915-1936	0.0057 (0.0428)	-0.197 (-0.901)	0.0390	22
Immediately After Agricultural Land Reform				
1948-1968	0.0509 (0.3725)	0.6014 (3.3199)	0.3671	21
Recent Period				
1971-1990	0.0339 (0.6366)	0.0120 (0.0500)	0.0001	20

TABLE 5
PREFECTURES HAVING INEFFICIENT FARMLAND MARKET
1948-1968

Rt = Rate of Change in Prefectural Average of Real Price
Rt = a + bRt-1 + ut
No. of observations 21

	a (t-sta.)	b (t-sta.)	R2
Akita	0.063 (0.306)	0.552 (2.929)	0.311
Gunma	0.071 (0.404)	0.473 (2.596)	0.262
Chiba	0.084 (0.427)	0.576 (3.587)	0.404
Toyama	0.088 (0.475)	0.545 (3.331)	0.369
Ishikawa	0.069 (0.399)	0.527 (2.938)	0.312
Fukui	0.102 (0.499)	0.438 (2.393)	0.232
Nagano	0.057 (0.325)	0.657 (4.109)	0.471
Gifu	0.068 (0.464)	0.522 (2.867)	0.302
Mie	0.060 (0.380)	0.511 (2.600)	0.262
Kyoto	0.072 (0.386)	0.516 (2.869)	0.302
Tottori	0.063 (0.286)	0.460 (2.319)	0.221
Fukuoka	0.078 (0.442)	0.552 (3.088)	0.334

TABLE 6
NATURE OF INEFFICIENCY: 1948-1968

Cross-Sectional Correlation
$R0,t = a + b1\ R1,t-1 + b2\ R2,t-1 + b3\ R3,t-1$

	a (t-sta.)	b1 (t-sta.)	b2 (t-sta.)	b3 (t-sta.)	R2
		Kanagawa	Saitama	Chiba	
Tokyo	-0.141	1.862	1.638	-0.798	0.409
	(0.547)	(2.799)	(1.887)	(-0.949)	
		Tokyo	Saitama	Chiba	
Kanagawa	0.040	-0.043	0.256	0.480	0.603
	(0.153)	(-0.695)	(1.101)	(2.522)	
		Kanagawa	Tokyo	Chiba	
Saitama	0.108	0.216	-0.060	0.301	0.228
	(0.205)	(1.014)	(-0.822)	(1.589)	
		Kanagawa	Tokyo	Saitama	
Chiba	0.055	0.023	-0.088	0.886	0.611
	(0.169)	(0.137)	(-1.276)	(4.801)	

Autocorrelation
$R0,t = a + b1\ R0,t-1$

	a (t-sta.)	b1 (t-sta.)	
Tokyo	0.261	-0.107	0.012
	(0.391)	(-0.482)	
Kanagawa	0.124	0.067	0.005
	(0.541)	(0.301)	
Saitama	0.125	0.303	0.126
	(0.606)	(1.655)	
Chiba	0.084	0.576	0.404
	(0.427)	(3.587)	