Factors Influencing Farmland Prices in Postwar Japan—An Approach Using Bits of Information Measure (BIM)

Chien-Hung Chen* and Jin-Jou Dai**

戦後日本農地価格の変動要因分析

—Bits of Information Measure によるアプローチ

陳 建宏*・戴 錦周** (台湾 朝陽科技大学)

本論文は Bits of Information Measure を応用し、農業所得、金利、物価上昇率、農業依存度、経営面積などの農地価格変動要因を分析することを目的とするものである。従来の回帰分析とは違い、Bits of Information Measure の分析により、各変数の提供された情報量を計算され、その重要さを比較することが可能となる。

実証結果によれば、戦後日本農地価格の変動要因について、1962～75 年にかけて殆どの都道府県では、農業所得が最も重要な要因となっている。つづく要因は

金利と物価上昇率である。しかし、1975 年以降、農地価格変動の最も重要な要因は農業依存度（地域の商業化や都市化の程度の代理変数）であった。一方、各地域の IIAR (Information Inequality Across Regressors) によると、1962～75 年にかけて、近畿、四国地域では、Bits of Information の分布の相違は大きく、九州と東北地域は小さくなっている。しかし、1975 年以降、近畿、東北地域では、Bits of Information の分布の相違は大きく、中国と東海地域は小さいことが分かった。

1. Introduction

Recalling the history of economic development, Japan had problems of “land use competition between agriculture and industry” and “agricultural land for non-agricultural uses.” The Japanese government adopted a policy based on “the New Urban Planning Law” in 1968 to partly satisfy land demand for urban housing, transportation, industry, and other non-agricultural uses. However, this policy converted a lot of farmland into non-farm uses and raised the farmland price, which resulted in developments adverse to the rural economy. Although there were several revisions in “the Agricultural Land Law,” ownership transfer and use conversion still face significant restrictions. Recently, under the framework of the World Trade Organization (WTO), trade liberalization has become an inevitable trend. In order

to survive, consolidation of farmland usage to lower production costs is an important strategy for competing with foreign agricultural products. However, high price of farmland is an obstacle to this consolidation.

The object of this article is to analyze the factors influencing farmland prices for Japanese prefectures and regions from the 1960s to the 1990s. Since the actual price diverges from the theoretical price based on returns on farmland after 1975, the entire postwar sample was divided into two groups with 1975 as the dividing line. A capitalization model including variables of net agricultural returns, interest rates, and inflation rates was applied to the first period, 1962–1975. For the second period, 1976–1996, interest rates and inflation rates were replaced with agricultural dependence and farmland sizes because capitalization models were no longer appropriate.

2. Literature Review

Most literature about farmland in Japan is from the

*, ** Department of Finance, Chaoyang University of Technology, Taiwan

perspective of institutions, laws and regulations, and policies; few use a quantitative approach. However, numerous empirical studies have been conducted in the U.S., as exemplified in Alston (1986), Burt (1986), Robison, Lins, and Venkataraman (1985), Featherstone and Baker (1987), Phipps (1984), Chow (1989), Campbell and Shiller (1987), Moss (1997), Falk and Lee (1998), and so on. Many of these studies use the capitalization model or the present value model that assumes the value of an asset should equal the present value of all expected future returns. Using this model, the farmland price or value and the factors influencing it were studied. Falk and Lee (1998) broke down the farmland price time series into permanent fundamental, temporary fundamental, and non-fundamental components. The approach was applied to Iowa farmland's annual prices from 1922 to 1994. They found that fads and overreactions played important roles in the short run, while permanent fundamental changes in these components dominated in the long run. Moss (1997) used a statistical informational approach to the study of the sensitivity of farmland prices to inflation, returns on agricultural assets and the cost of capital. He found that inflation was the major factor in farmland price change but the results were location-sensitive.

Besides, Kanoh and Murase (1999) used the land use options concept to explain the land price bubble in Japan in the late 1980s. The separation of the land price from its fundamental value was shown to be satisfactorily explained by the option property of land. Chavas and Thomas (1999) developed an arbitrage assets-pricing model under non-additive dynamic preferences, risk aversion and transaction costs. Both risk aversion and transaction costs were shown to have a significant effect on U.S. land prices for the period 1950–96. Adelaja et al. (1998) found that the rising land values in urban-influenced regions had adverse effects on the dairy industry in New Jersey, Pennsylvania, and New York. Hardie et al. (2000) studied the land use problem in the American South. Population, income, land values, prices, and costs in counties with different degrees of industrialization

significantly affected land use.

3. Model

Using traditional capitalization model for farmland (Moss, 1997) as the framework,

$$V(t) = R(t)/\rho(t) \quad (1)$$

where $V(t)$ is the value per acre farmland in period t , $R(t)$ is the return on farmland per acre, and $\rho(t)$ is the discount rate in period t . The average farm families' agricultural income per acre farmland and interest rates are used as proxy variables for $R(t)$ and $\rho(t)$, respectively. For purposes of empirical implementation, differentiating equation (1) with respect to t yields

$$\dot{V}(t)/V(t) = \dot{R}(t)/R(t) - \dot{\rho}(t)/\rho(t) \quad (2)$$

where $\dot{V}(t)/V(t) = \partial \ln(V(t))/\partial t$ denotes the change in the natural logarithm for farmland values or the percent change in farmland values. Likewise, $\dot{R}(t)/R(t)$, $\dot{\rho}(t)/\rho(t)$ denote the percent change in returns on farmland and the discount rate, respectively. The real interest rate is used as a proxy for $\rho(t)$ such that $\dot{\rho}(t)/\rho(t) = \dot{r}(t)/r(t) - \dot{i}(t)/i(t)$, where $r(t)$ and $i(t)$ are the nominal interest rate and the inflation rate, respectively. Consequently, equation (2) can be rewritten as equation (3):

$$\dot{V}(t)/V(t) = \dot{R}(t)/R(t) - \dot{r}(t)/r(t) + \dot{i}(t)/i(t) \quad (3)$$

Therefore, based on equation (3) an empirical model can be specified as:

$$DV_t = \alpha_0 + \alpha_1 DR_t + \alpha_2 Dr_t + \alpha_3 Di_t + \varepsilon_t \quad (4)$$

where $DV_t = \ln(V_t) - \ln(V_{t-1})$ is the percent change in farmland values and the following denotations are likewise:

$$DR_t = \ln(R_t) - \ln(R_{t-1}); \quad Dr_t = \ln(r_t) - \ln(r_{t-1}) \\ Di_t = \ln(i_t) - \ln(i_{t-1}); \quad i_t = \ln(CPI_t) - \ln(CPI_{t-1})$$

where V_t , R_t , r_t , i_t , and CPI_t are the farmland price, net agricultural return, interest rate, inflation rate and consumer price index in the t period, respectively; α_j ($j=0, 1, 2, 3$) is the regression coefficient and ε_t is

the error term.

Moss (1997) used the bits of information measure to analyze the explanatory power of economic variables for farmland price variations. According to "Statistical Information Theory" (Shannon, 1948), the bits of information for a statistic, y , is defined as:

$$I(y) = -\log_2(1-y), \text{ where } 0 \leq y \leq 1 \quad (5)$$

Since $1-R^2 = (1-r_{01}^2)(1-r_{01.2}^2) \dots (1-r_{0n.12 \dots (n-1)}^2)$, we can replace the y in equation (5) by the determination coefficient R^2 and get equation (6), which is a formula for calculating the total number of bits of information.

$$-\log_2(1-R^2) = -\log_2(1-r_{01}^2) - \log_2(1-r_{01.2}^2) - \dots - \log_2(1-r_{0n.12 \dots (n-1)}^2) \quad (6)$$

The bits of information for individual independent variables are as follows (using the first independent variable for example):

$$\bar{I}(r_1^2) = \frac{1}{n} [I(r_{01}^2) + I(r_{01}^2) + I(r_{01.2}^2) + I(r_{01.23}^2) + I(r_{01.3}^2) + I(r_{01.23}^2) + \dots] \quad (7)$$

where n is the number of items on the right hand side of equation (7). r_{01} is the correlation between the dependent variable and the first independent variable. $r_{02.1}$ is the partial correlation between the dependent variable and the second independent variable after the explanatory effect of the first independent variable has been removed. Other partial correlations are denoted in the same way (Anderson, 1984). Because the ordering of independent variables in the ordinary least squares will affect the partial correlation, the bits of information for an independent variable is defined as the arithmetic average of all of the possible orderings ($3!$, if there are three independent variables) of the squared partial correlations as in equation (7). BIM is used to measure how many "bits" of information on the change in the dependent variable an individual independent variable can make. The task is performed with the unique feature of the sum of the bits of information for individual independent variables equal to the total bits of information for the regression. The measure gives a more straightforward meaning in comparing the importance among the

independent variables, because it can transform an ordinal ordering into a cardinal ordering.

4. Data

The source for farmland prices, consumer price index and interest rates was the *Japan Statistical Yearbook*. The farmland prices were prepared by the Japan Real Estate Institute which, by removing the influence of transferring farmland uses made the data quite reliable. Therefore, the prices for paddy fields offered by the Institute were used in the paper. The data for cultivated land area, gross agricultural income, degree of agricultural dependence, agricultural income, and farm family income were from the *Farm Economics Survey*. The sample was composed of forty-six prefectures of Japan. Okinawa Prefecture was excluded because there was no data for it until its reunification with Japan in 1972.

5. Empirical Results

5.1 Regression Results

The farmland system and economic development were possible reasons for the difference between the actual farmland price and the theoretical price computed from agricultural returns on farmland. The "Construction of Agricultural Promotion Areas Law" was legislated in 1969, and it introduced some restrictions on transfer of farmland uses. However, the "Agricultural Land Law" was reformed and abolished the regulation of the maximum farmland-holding acres and the restriction on rents in 1970. The "Agricultural Land Use Promotion Project" was put into practice in 1975 and then the "Agricultural Land Use Promotion Law" was passed in 1980. These helped the liquidization of both owned and rented farmland. The above factors all might affect changes in farmland prices. However, according to "the Report on Prices of Agricultural Land Transactions" in the "National Chamber of Agriculture," actual farmland prices have diverged from theoretical prices since 1975. The fact was supported by the following results: the R^2 of the regression, with net agricultural returns, interest rates, and inflation rates as regressors, for the pooling

data across prefectures during 1962–1975 was 0.800 which means a close fit, whereas the R^2 for 1976–1996 was a distant 0.018. Thus, capitalization models were not appropriate for the second period. Therefore, the sample was separated into two sub-sets with 1975

as the dividing line.

The regression results of capitalization models for 1962–1975 are shown in Table 1. The influences of independent variables on the percentage of change in farmland prices for Akita Prefecture are 0.8434,

Table 1. Farmland Price Regression Results of Prefectures (1962–1975)

Region	Prefecture	Intercept	t-value*	Returns	t-value	Interest Rate	t-value	Inflation	t-value	R^2
Hokkaido	Hokkaido	0.0991	2.3549	0.1669	1.1390	1.4744	1.8572	-0.5483	-0.7394	0.5560
Tohoku	Aomori	-0.0387	-0.8790	1.2325	5.1087	-0.4988	-3.4330	0.0690	1.0098	0.8573
	Iwate	-0.0252	-0.8029	0.8253	6.2712	-0.2398	-1.4194	0.0227	0.3892	0.9581
	Miyagi	-0.0193	-0.2984	1.0065	3.1334	-0.3430	-1.1176	0.0874	0.7963	0.8700
	Akita	0.0154	0.2910	0.8434	4.2686	-0.9676	-4.0835	0.0376	0.3687	0.9366
	Yamagata	-0.0037	-0.0762	0.8653	4.3116	-0.7161	-3.2362	-0.0021	-0.0235	0.9328
Kanto-Tosan	Fukushima	-0.0245	-0.3899	0.9292	3.0918	-0.3731	-1.0384	0.0399	0.3568	0.8985
	Ibaraki	-0.0381	-0.6453	1.1340	4.1000	-0.4379	-1.3959	0.0774	0.7580	0.9323
	Tochigi	-0.0215	-0.4202	1.2871	5.6198	-0.3838	-1.2795	0.1505	1.6299	0.9599
	Gunma	-0.0482	-0.4048	1.2264	1.9272	-0.4958	-0.6838	0.1059	0.5744	0.8506
	Saitama	-0.0281	-0.4654	1.1801	4.2674	-0.2922	-0.7501	0.1065	0.9826	0.9450
	Chiba	-0.0319	-0.7527	1.3586	7.0803	-0.4312	-1.9244	-0.0367	-0.4581	0.9679
	Tokyo	0.2402	1.0946	1.6588	2.1515	0.1802	0.1596	-0.0716	-0.1656	0.5380
	Kanagawa	0.1626	1.0710	1.0755	2.1663	0.1565	0.1850	0.0454	0.1573	0.6168
	Yamanashi	-0.0537	-0.5579	1.1592	2.0016	-0.9142	-2.2296	0.0616	0.3822	0.8611
Hokuriku	Nagano	-0.0296	-0.8472	0.8199	6.0720	-0.2898	-1.3252	-0.0039	-0.0585	0.9660
	Niigata	-0.0112	-0.2737	0.8546	6.1428	-0.4662	-1.9589	-0.0119	-0.1490	0.9636
	Toyama	0.0178	0.2888	0.8008	2.9442	-0.6243	-2.0637	0.0073	0.0632	0.8715
	Ishikawa	-0.0374	-0.4828	0.9785	2.6989	-1.2386	-4.1074	0.0815	0.5854	0.8839
Tokai	Fukui	0.0052	0.1140	0.9431	4.6017	-0.8602	-4.5362	-0.0186	-0.2040	0.9214
	Gifu	0.0015	0.0282	0.8204	3.8858	-0.5071	-1.6995	0.0018	0.0172	0.9215
	Shizuoka	-0.0327	-0.4076	0.9929	2.3275	-1.0172	-2.7963	0.0086	0.0664	0.9008
	Aichi	-0.0120	-0.4421	0.5549	6.1715	-0.2259	-1.3793	0.0036	0.0705	0.9661
Kinki	Mie	0.0357	0.9126	0.7348	5.9060	-0.0950	-0.3794	-0.0119	-0.1511	0.9529
	Shiga	0.0062	0.0854	0.7000	2.4591	-0.9945	-3.0950	0.0319	0.2602	0.9117
	Kyoto	-0.0095	-0.1320	0.7028	2.2688	-1.3026	-4.5666	0.1082	0.8681	0.9026
	Osaka	0.2281	0.9283	0.7099	0.6032	-0.6976	-0.6464	0.0616	0.1433	0.2913
	Hyogo	0.0120	0.2531	0.8214	4.6926	-0.5031	-1.8102	0.0257	0.2839	0.9455
	Nara	-0.1023	-3.0238	1.6155	10.4066	-0.2349	-1.4696	0.1286	2.1602	0.9798
Chugoku	Wakayama	-0.0137	-0.2877	1.0684	4.8100	-0.7953	-3.4035	-0.0565	-0.5502	0.9510
	Tottori	-0.0064	-0.1854	0.6212	5.2516	-0.3921	-1.8089	0.0219	0.3334	0.9620
	Shimane	-0.0188	-0.4172	0.8168	4.9284	-0.4720	-1.9050	0.0504	0.6068	0.9452
	Okayama	0.0163	0.2423	0.5823	2.0803	-0.7171	-2.6162	0.1063	0.8808	0.8049
	Hiroshima	-0.0454	-0.9095	1.0630	5.1216	-0.7880	-3.7062	0.0501	0.5963	0.9594
Shikoku	Yamaguchi	0.0054	0.0870	0.9068	3.4587	-0.8724	-2.9551	-0.0206	-0.1762	0.9070
	Tokushima	0.0253	0.3235	0.4952	1.5389	-0.7829	-2.6442	0.1124	0.8668	0.7806
	Kagawa	-0.0214	-0.3477	0.8890	3.6880	-0.6502	-2.0819	0.1511	1.3537	0.9149
	Ehime	-0.0319	-0.7502	1.0977	5.9551	-0.8908	-4.3583	0.0816	1.0202	0.9662
Kyushu	Kochi	-0.0563	-0.9578	0.8318	3.7350	-0.3106	-0.8773	0.1327	1.3354	0.9283
	Fukuoka	0.0292	0.6328	0.6777	4.4956	-0.2681	-0.9547	0.0409	0.4600	0.9341
	Saga	-0.0057	-0.1188	0.8092	4.2107	-0.8002	-3.6725	0.0477	0.5303	0.9323
	Nagasaki	-0.0155	-0.2796	0.6892	3.0054	-0.6277	-1.9587	0.1041	0.9989	0.9203
	Kumamoto	0.0074	0.1895	0.7285	4.9735	-0.4670	-2.2340	0.0254	0.3542	0.9494
	Oita	0.0159	0.3773	0.8585	4.9921	-0.6477	-2.6406	0.0096	0.1156	0.9584
	Miyazaki	-0.0194	-0.2817	1.0687	3.7526	-0.3850	-1.0296	-0.0029	-0.0237	0.9072
Kagoshima	Kagoshima	-0.0104	-0.1894	0.9753	3.9594	-0.1430	-0.3636	-0.0399	-0.3728	0.9321

* The sample size is 14, the degrees of freedom are 10, and the critical t-value at the 5% level is 2.228.

−0.9676, and 0.0376, respectively. The t-values are 4.2686, −4.0835, and 0.3687, respectively. In other words, the coefficient estimates of net agricultural returns and interest rates were statistically significant

at 5% level and had the signs expected in the equation (3). That is, net agricultural returns had a positive influence on farmland prices, while interest rates had a negative influence. Moreover, in Akita Prefecture,

Table 2. Farmland Price Regression Results of Prefectures (1976–1996)

Region	Prefecture	Intercept	t-value*	Returns	t-value	Agri. Depn.**	t-value	Farm Size	t-value	R ²
Hokkaido	Hokkaido	0.0220	0.9227	0.0294	0.2146	−0.2229	−0.7019	−0.4479	−0.5842	0.0516
Tohoku	Aomori	0.0056	0.3286	0.1167	0.5106	−0.1672	−0.6607	−0.2711	−0.7072	0.1003
	Iwate	0.0112	1.0980	0.1791	1.1122	−0.1942	−1.1718	0.2351	0.9648	0.0859
	Miyagi	0.0174	1.1702	0.1332	0.6612	−0.1398	−0.7165	0.0033	0.0083	0.0373
	Akita	−0.0020	−0.0769	0.5894	1.7137	−0.7436	−1.7882	0.1285	0.1519	0.2279
	Yamagata	0.0259	1.1656	0.0006	0.0019	−0.0422	−0.1100	−0.5039	−0.8606	0.0754
	Fukushima	0.0130	0.9188	0.3372	1.5223	−0.4543	−1.8208	0.0194	0.0592	0.2426
Kanto-Tosan	Ibaraki	0.0175	1.8604	0.4799	2.4950	−0.5922	−3.2151	0.5058	2.2163	0.3834
	Tochigi	0.0222	2.6407	0.4136	3.2311	−0.3150	−2.2177	0.3503	1.7077	0.4205
	Gunma	0.0341	3.4747	0.0826	0.7149	−0.1497	−0.9822	0.0210	0.0902	0.0710
	Saitama	0.0113	1.0747	0.3253	1.8016	−0.4769	−2.4602	0.5974	2.0491	0.3294
	Chiba	0.0138	2.0714	0.4367	3.5951	−0.4917	−3.6932	0.2825	1.9166	0.4659
	Tokyo	−0.1592	−0.6695	−0.6426	−0.3162	−0.6171	−0.3149	−0.2552	−0.0982	0.1013
	Kanagawa	−0.1040	−0.6993	1.9767	1.1717	−0.1458	−0.0835	0.0146	0.0072	0.2250
	Yamanashi	0.0243	3.6778	0.2096	2.4009	−0.2819	−2.7654	0.2847	1.9261	0.3135
	Nagano	0.0293	3.6653	0.2242	1.7611	−0.3050	−2.3349	0.3467	1.6539	0.2478
Hokuriku	Niigata	0.0073	0.4055	0.4431	1.5958	−0.6255	−1.8833	0.6634	1.4103	0.1876
	Toyama	0.0317	3.3398	0.3083	2.2858	−0.2349	−2.0485	−0.1053	−0.4840	0.3253
	Ishikawa	0.0260	1.9787	0.5140	2.7207	−0.5740	−2.8473	0.1651	0.7550	0.3474
	Fukui	0.0157	1.3360	0.3425	1.8126	−0.4301	−2.2122	0.0349	0.1176	0.3158
Tokai	Gifu	0.0284	4.1503	0.3080	2.4723	−0.2815	−2.6563	0.3170	1.9801	0.2988
	Shizuoka	0.0198	3.4216	0.1009	1.2368	−0.1534	−1.7216	0.0570	0.3248	0.1837
	Aichi	0.0189	2.3519	0.0725	0.5603	−0.1707	−1.2819	0.1315	0.8137	0.1685
	Mie	0.0238	3.3429	0.1576	1.5735	−0.1944	−1.9877	0.0748	0.5729	0.2056
Kinki	Shiga	0.0329	3.1493	0.2085	1.6117	−0.1971	−1.5761	−0.0828	−0.3946	0.3057
	Kyoto	0.0362	3.1228	0.0425	0.2346	−0.0529	−0.3013	−0.1067	−0.4225	0.0709
	Osaka	−0.1703	−1.1118	0.0817	0.0517	−0.4813	−0.3182	1.2110	0.7467	0.0577
	Hyogo	0.0198	2.3860	0.5588	3.8609	−0.6109	−4.2818	0.3920	2.0026	0.5357
	Nara	0.0439	2.6388	−0.1837	−0.5457	0.1294	0.4360	−0.3880	−0.9334	0.0919
	Wakayama	0.0238	2.7009	0.0401	0.3675	−0.0978	−0.7671	0.0679	0.3717	0.0784
Chugoku	Tottori	0.0073	0.6038	0.5416	2.5698	−0.5624	−2.9929	0.5581	2.2045	0.3485
	Shimane	0.0120	1.6744	0.2328	2.1208	−0.2215	−2.2759	0.1761	1.3780	0.2341
	Okayama	0.0208	2.5283	0.3913	2.6682	−0.4331	−3.1131	0.3553	1.6846	0.3915
	Hiroshima	0.0229	2.8500	0.2290	1.2393	−0.2730	−1.6149	0.2759	1.2056	0.2454
	Yamaguchi	0.0115	1.0441	0.2894	1.5654	−0.2682	−1.4789	0.1936	0.6034	0.1795
Shikoku	Tokushima	0.0299	2.8478	0.2125	1.1527	−0.2777	−1.3214	0.0219	0.1569	0.1086
	Kagawa	0.0268	1.9317	0.6162	2.4623	−0.6867	−2.7077	0.6430	1.7990	0.3030
	Ehime	0.0157	1.5921	0.7099	4.2657	−0.8273	−4.3554	0.6738	3.0083	0.5356
	Kochi	0.0175	1.4553	0.2442	1.5688	−0.3462	−2.1660	−0.0116	−0.0556	0.2308
Kyushu	Fukuoka	0.0191	1.0505	0.1510	0.5468	−0.1875	−0.7141	0.0263	0.0614	0.0820
	Saga	0.0163	0.9463	0.2501	1.2042	−0.3506	−1.4720	0.4240	0.8605	0.1301
	Nagasaki	0.0229	1.9645	0.0650	0.3396	−0.1588	−0.8794	0.1532	0.5625	0.1384
	Kumamoto	0.0165	1.2146	0.5312	1.9747	−0.6380	−2.2606	0.5146	1.7109	0.2345
	Oita	0.0239	1.8012	0.1094	0.4658	−0.1789	−0.7448	−0.0810	−0.3169	0.1137
	Miyazaki	0.0042	0.2962	0.2232	1.1437	−0.5369	−1.9192	0.3446	1.0923	0.2041
	Kagoshima	0.0385	1.7052	0.2266	0.7018	−0.3020	−1.1725	0.0249	0.0440	0.1775

* The sample size is 21, the degrees of freedom are 17, and the critical t-value at the 5% level is 2.1098.

** Agri. Depn.=the degree of agricultural dependence=agricultural income/farm family income.

the absolute coefficient for interest rates was the largest. This means that the change in farmland prices was affected to the greatest degree by the change in interest rates. The return elasticity value ranked as second and the inflation elasticity was not significantly different from zero. The regression results for the other prefectures can be interpreted similarly. The determination coefficient, R^2 , of the farmland-pricing model for most prefectures was greater than 0.9 and this shows that the statistical fit was acceptable for most models. Some R^2 values were much lower but within reason. For example, Tokyo and Osaka are highly urbanized areas so their farmland prices might be affected by other economic factors. In Hokkaido, the natural, human, and economic conditions are very different from other prefectures, so the farmland price fluctuations might be different.

The spread between actual and theoretical prices was enlarged and capitalization models were no longer appropriate, because of the strength of farmers' agricultural-asset-holding property and higher expectation to transfer farmland uses after 1975. According to the Report on Prices of Agricultural Land Transactions in the National Chamber of Agriculture, the primary reasons for increasing Japanese farmland prices were the adoption of high revenue crops, land improvement, the stronger incentive for large-scale farming, road construction, the process of changing land use into housing, the increase in alternative land demand, the increase in willingness to hold on to assets, and so on. Among these reasons, the adoption of high revenue crops and land improvement are related to agricultural net returns. The increase in willingness to hold assets, road construction and the process of changing land use into housing are related to the degree of agricultural dependency. The stronger incentive of scale expansion is related to the land area of operation. Therefore, the model of farmland prices applied to the data across 1976–1996 was the one which had net agricultural returns, agricultural dependence, and farm sizes as its regressors.

The regression results are shown in Table 2. The t-

values of net agricultural returns for most prefectures were not statistically significant which means that farmland prices were less affected by the agricultural returns after 1975. Concerning the effect of agricultural dependency, the variable is supposed to have an adverse effect on the percentage of change in farmland prices. If we use (1—agricultural dependency) as an indicator, it can represent the degree of commercialization or industrialization in a prefecture or a region. The results of Table 2 show that most of regression coefficients of agricultural dependence were negative. A lesser degree of agricultural dependency means a greater degree of commercialization or industrialization such that the farmland price fluctuates more. In other words, an area with higher degree of commercialization or industrialization would have more fluctuating farmland prices. The farm size coefficient was positive in some prefectures. This means that there was a positive relationship between the change in farmland price and the change in farm sizes in these prefectures. Because larger farms had higher competitive advantages, farmers would have a higher incentive to purchase land for large-scale expansion such that farmland prices become more volatile.

5.2 Computation of the Bits of Information

Tables 1 and 2 show the regression results for various prefectures. If we want to know the information content the individual independent variables make, we can compute the bits of information of independent variables using equation (7). For example, Table 3 presents the process for calculating the bits of information for Akita Prefecture. The numbers on the bottom show that net agricultural returns, interest rates, and inflation rates could offer 1.7776, 1.8092, and 0.3921 average bits of information and the total bits of information for the regression was 3.9789 which is the sum of the former numbers. Here we see the basic feature of the information bits analysis, which keeps the sum of individual statistic values equal to the value of the total statistic. Of the 3.9789 bits of information the regression offered, 1.7776 bits were contributed by returns, 1.8092 bits were contributed by interest rates and 0.3921 bits were contrib-

Table 3. The Bits of Information for the Akita Prefecture Farmland Price Regression

Independent Variables			Bits of Information Provided			Total Bits of Information
Returns	Interest Rate	Inflation	Returns	Interest Rate	Inflation	
$I(r_{01}^2)$	$I(r_{02.1}^2)$	$I(r_{03.12}^2)$	2.1305	1.8267	0.0216	
$I(r_{01}^2)$	$I(r_{02.13}^2)$	$I(r_{03.1}^2)$	2.1305	1.5124	0.3360	
$I(r_{01.2}^2)$	$I(r_{02}^2)$	$I(r_{03.12}^2)$	1.6790	2.2782	0.0216	
$I(r_{01.23}^2)$	$I(r_{02}^2)$	$I(r_{03.2}^2)$	1.5967	2.2782	0.1039	
$I(r_{01.3}^2)$	$I(r_{02.13}^2)$	$I(r_{03}^2)$	1.5319	1.5124	0.9346	
$I(r_{01.23}^2)$	$I(r_{02.3}^2)$	$I(r_{03}^2)$	1.5967	1.4475	0.9346	
Average Bits of Information			1.7776	1.8092	0.3921	3.9789

uted by inflation. Therefore, net agricultural returns and interest rates provided most of the information about changes in Akita farmland prices.

Table 4 shows the informational contents of prefecture regressions during 1962–1975. The information shares, which equal the bits of information of individual independent variables divided by the total bits of information, are presented in columns 3–5. For instance, returns, interest rates and inflation rates could provide 44.68%, 45.47%, and 9.85% of bits of information in Akita Prefecture. Therefore, interest rates contributed the greatest information about the change in farmland prices. Returns and inflation were the second and third most important factors. Using the percentage of prefecture total bits of information to regional total bits of information as a weight, we can compute the weighted average share of information, which represents an average distribution of information bits among the three independent variables in a region. For example, returns, interest rates, and inflation rates could provide, on average, 55.58%, 34.32%, and 10.10% bits of information in the Tohoku region. Therefore, the factors influencing farmland prices in this region, according to the order of importance, were returns, interest rates, and inflation rates. We found that the ordering of factors in individual prefectures could be different from the ordering factors in the region.

The above results for all prefectures during 1962–1975, excluding the Hokkaido region, might indicate that returns explain the majority of the information on changes in farmland prices and show little influence from inflation. These facts are contrary to the results

from Moss (1997), who applied this model to U.S. farmland values and found that inflation was the most important factor. One possible reason is that Japan's laws and regulations for farmland transfer were so strict before 1975 that transfers to non-farm uses was difficult. Therefore, the return on farmland was the major factor influencing farmland prices in most regions.

The shares of information provided by independent variables in prefectures' regression model across 1976–1996 are presented in Table 5. Since capitalization models were not appropriate for the data after 1975, the independent variables were replaced with net agricultural returns, agricultural dependence, and farm sizes. Results in Table 5 show that, among the factors influencing farmland prices, agricultural dependence was the most important during 1976–1996. Variables of net agricultural returns and farm sizes ranked as the second and the third. There were many policy instruments and projects put into practice to facilitate the liquidization of farmland and to promote farmland usage. For example, the Agricultural Land Law was reformed in 1970 and the regulations about the maximum farmland-holding acres and rents were abolished. Then, the Agricultural Land Use Promotion Project was put into practice in 1975 and the Agricultural Land Use Promotion Law was passed in 1980. It seems that these laws did not have significant influences on farmland prices. A possible reason is because the increasing land demand for urban housing, transportation, industry, and other non-agricultural uses have strengthened farmers' agricultural-asset-holding property and increased

Table 4. Informational Contents of Prefecture Regressions (1962–1975)

Region	Prefecture	Share of Information			Total Bits of Information	Information Inequality with Respect to Region
		Returns	Interest Rate	Inflation		
Hokkaido	Hokkaido	0.1771	0.6072	0.2157	1.1747	—
Tohoku	Aomori	0.4811	0.3780	0.1409	2.8088	0.0140
	Iwate	0.6959	0.2297	0.0745	4.5766	0.0414
	Miyagi	0.5724	0.2940	0.1336	2.9430	0.0087
	Akita	0.4468	0.4547	0.0985	3.9789	0.0279
	Yamagata	0.5186	0.4010	0.0804	3.8945	0.0082
	Fukushima	0.5859	0.3120	0.1021	3.3006	0.0023
	Weighted Average	0.5558	0.3432	0.1010		0.0171
Kanto-Tosan	Ibaraki	0.6026	0.2931	0.1043	3.8850	0.0006
	Tochigi	0.6221	0.2543	0.1236	4.6385	0.0040
	Gunma	0.5156	0.3560	0.1285	2.7431	0.0221
	Saitama	0.6240	0.2682	0.1078	4.1855	0.0007
	Chiba	0.6952	0.2393	0.0655	4.9635	0.0145
	Tokyo	0.7215	0.1846	0.0939	1.1140	0.0272
	Kanagawa	0.6663	0.2211	0.1126	1.3837	0.0095
	Yamanashi	0.4188	0.4493	0.1319	2.8475	0.0837
	Nagano	0.6859	0.2505	0.0636	4.8773	0.0127
	Weighted Average	0.6191	0.2813	0.0997		0.0194
Hokuriku	Niigata	0.6654	0.2695	0.0651	4.7804	0.0590
	Toyama	0.5176	0.3901	0.0923	2.9605	0.0010
	Ishikawa	0.2775	0.5797	0.1428	3.1065	0.0986
	Fukui	0.4397	0.4663	0.0939	3.6688	0.0069
	Weighted Average	0.4952	0.4102	0.0946		0.0414
Tokai	Gifu	0.6000	0.3185	0.0816	3.6705	0.0011
	Shizuoka	0.4175	0.4912	0.0913	3.3339	0.0902
	Aichi	0.6863	0.2450	0.0687	4.8835	0.0091
	Mie	0.7265	0.2031	0.0705	4.4069	0.0263
	Weighted Average	0.6227	0.3006	0.0767		0.0317
Kinki	Shiga	0.3822	0.5233	0.0944	3.4935	0.0478
	Kyoto	0.2131	0.6396	0.1473	3.3601	0.2011
	Osaka	0.3860	0.4334	0.1805	0.4967	0.0435
	Hyogo	0.6192	0.3048	0.0760	4.1978	0.0211
	Nara	0.7084	0.1659	0.1257	5.6283	0.1048
	Wakayama	0.5389	0.3715	0.0897	4.3521	0.0021
	Weighted Average	0.5191	0.3727	0.1083		0.0701
Chugoku	Tottori	0.6311	0.2966	0.0722	4.7169	0.0210
	Shimane	0.6143	0.3025	0.0831	4.1900	0.0149
	Okayama	0.2795	0.5306	0.1899	2.3577	0.1374
	Hiroshima	0.5076	0.4067	0.0857	4.6215	0.0020
	Yamaguchi	0.4886	0.4307	0.0807	3.4271	0.0063
	Weighted Average	0.5297	0.3766	0.0937		0.0363
Shikoku	Tokushima	0.1922	0.6043	0.2035	2.1881	0.1684
	Kagawa	0.4855	0.3695	0.1450	3.5549	0.0016
	Ehime	0.5005	0.4008	0.0987	4.8854	0.0061
	Kochi	0.5757	0.2955	0.1288	3.8011	0.0252
	Weighted Average	0.4699	0.3962	0.1339		0.0504
Kyushu	Fukuoka	0.6560	0.2570	0.0871	3.9236	0.0126
	Saga	0.4607	0.4383	0.1010	3.8850	0.0315
	Nagasaki	0.4915	0.3784	0.1301	3.6500	0.0193
	Kumamoto	0.6039	0.3189	0.0771	4.3047	0.0014
	Oita	0.5827	0.3448	0.0725	4.5885	0.0022
	Miyazaki	0.6365	0.2788	0.0848	3.4301	0.0063
	Kagoshima	0.6471	0.2712	0.0817	3.8810	0.0089
	Weighted Average	0.5829	0.3274	0.0897		0.0117

Table 5. Informational Contents of Prefecture Regressions (1976–1996)

Region	Prefecture	Share of Information			Total Bits of Information	Information Inequality with Respect to Region
		Returns	Agri. Depn.*	Farm Size		
Hokkaido	Hokkaido	0.0851	0.5231	0.3918	0.0765	—
Tohoku	Aomori	0.2428	0.3630	0.3942	0.1524	0.0531
	Iwate	0.3453	0.4124	0.2423	0.1296	0.0042
	Miyagi	0.4124	0.5342	0.0534	0.0548	0.1360
	Akita	0.3424	0.4703	0.1872	0.3731	0.0105
	Yamagata	0.0587	0.1483	0.7931	0.1132	0.6664
	Fukushima	0.3343	0.5474	0.1183	0.4008	0.0527
	Weighted Average	0.3046	0.4491	0.2463		0.1538
Kanto-Tosan	Ibaraki	0.2438	0.5649	0.1914	0.6976	0.0575
	Tochigi	0.6608	0.2366	0.1026	0.7872	0.1380
	Gunma	0.2944	0.6535	0.0522	0.1063	0.0910
	Saitama	0.2592	0.5346	0.2062	0.5764	0.0496
	Chiba	0.4222	0.4667	0.1111	0.9047	0.0039
	Tokyo	0.4490	0.5121	0.0389	0.1541	0.0576
	Kanagawa	0.6756	0.2888	0.0356	0.3678	0.1670
	Yamanashi	0.3118	0.5011	0.1871	0.5427	0.0206
	Nagano	0.2367	0.5696	0.1937	0.4107	0.0630
	Weighted Average	0.4040	0.4555	0.1406		0.0720
Hokuriku	Niigata	0.2942	0.5132	0.1926	0.2997	0.0112
	Toyama	0.4016	0.3715	0.2269	0.5676	0.0319
	Ishikawa	0.4135	0.5198	0.0667	0.6158	0.0371
	Fukui	0.2880	0.5532	0.1588	0.5475	0.0119
	Weighted Average	0.3587	0.4864	0.1549		0.0230
Tokai	Gifu	0.3375	0.4584	0.2041	0.5122	0.0341
	Shizuoka	0.2162	0.6726	0.1112	0.2928	0.0197
	Aichi	0.2721	0.6244	0.1035	0.2663	0.0056
	Mie	0.3030	0.6394	0.0576	0.3321	0.0295
	Weighted Average	0.2916	0.5774	0.1310		0.0222
Kinki	Shiga	0.2439	0.4129	0.3431	0.5263	0.0248
	Kyoto	0.0587	0.3732	0.5681	0.1061	0.3066
	Osaka	0.1972	0.1373	0.6655	0.0858	0.4181
	Hyogo	0.3780	0.5191	0.1029	1.1068	0.0668
	Nara	0.0961	0.2329	0.6710	0.1390	0.4099
	Wakayama	0.3149	0.6414	0.0437	0.1177	0.1596
	Weighted Average	0.2980	0.4569	0.2451		0.2310
Chugoku	Tottori	0.2934	0.5050	0.2016	0.6183	0.0068
	Shimane	0.3762	0.4888	0.1349	0.3847	0.0054
	Okayama	0.3053	0.5491	0.1456	0.7167	0.0042
	Hiroshima	0.3505	0.5460	0.1035	0.4062	0.0146
	Yamaguchi	0.4106	0.3456	0.2437	0.2855	0.0535
	Weighted Average	0.3336	0.5036	0.1628		0.0169
Shikoku	Tokushima	0.3516	0.5522	0.0962	0.1658	0.0158
	Kagawa	0.3449	0.4924	0.1627	0.5208	0.0005
	Ehime	0.3903	0.4157	0.1940	1.1067	0.0128
	Kochi	0.2745	0.6820	0.0435	0.3785	0.0980
	Weighted Average	0.3563	0.4909	0.1528		0.0318
Kyushu	Fukuoka	0.2150	0.5079	0.2771	0.1234	0.0274
	Saga	0.3113	0.5513	0.1374	0.2011	0.0138
	Nagasaki	0.3533	0.5803	0.0664	0.2148	0.0684
	Kumamoto	0.3053	0.4863	0.2084	0.3856	0.0146
	Oita	0.2617	0.5005	0.2378	0.1742	0.0127
	Miyazaki	0.1599	0.7156	0.1245	0.3293	0.0450
	Kagoshima	0.1516	0.5931	0.2553	0.2819	0.0353
	Weighted Average	0.2477	0.5705	0.1817		0.0310

* Agri. Depn. = the degree of agricultural dependence = agricultural income/farm family income.

their expectation to transfer farmland uses. Therefore, most cases of the enlargement of farm sizes were by lease and seldom by purchase. Consequently, farm sizes did not have a significant effect on farmland prices. Recalling the regression results in Table 2, most of the coefficients of agricultural dependence were negative and this means that the prefectures with a smaller degree of agricultural dependence (or higher degree of commercialization and industrialization) would have more volatile farmland prices. That is, when the agricultural sector transfers more farmland to commercial or industrial usage, there will be greater fluctuations in the rents and farmland prices.

5.3 Analysis of Information Inequality Across Regressors

Farmland pricing factors provide different information contents in different prefectures, even in the same region. Therefore, the Information Inequality Analysis is suggested. The analysis is composed of the Information Inequality across Regressors (IIAR) Analysis and the Inequality of Information in Regressions (IIIR) Analysis. The former uses the equation (8) to calculate an index to indicate the dispersion of the distribution of bits of information across regressors.

$$IIAR_i(p, q) = \sum_{j=1}^N P_j \ln(p_j/q_j) \quad (8)$$

where $IIAR_i$ is the Information Inequality across Regressors for prefecture i , p_j is the probability of information bits provided by the j -th independent variable under the posterior distribution of information bits, q_j is the distribution under the prior distribution and is defined as the average distribution for the region where prefecture i is located, N is the number of independent variables and equal to 3 here. IIAR is made up of prefecture information shares relative to the regional average information shares. A smaller value of IIAR means that the information distribution of farmland pricing factors is closer to the regional pattern. In the case of Akita Prefecture, its returns, interest rates, and inflation provided 0.4468, 0.4547, and 0.0985 of p_j values; 0.5558, 0.3432, and 0.1010 of q_j values. Plugging the numbers into the equation (8) yields the IIAR for Akita Prefecture as 0.0279.

The IIARs for various prefectures during 1962–1975 are presented in the last column of Table 4. For example, the IIARs for Aomori and Iwate Prefectures are 0.0140 and 0.0414, respectively. Aomori Prefecture had a more similar distribution of bits of information to the regional average than Iwate Prefecture. From Table 4, we know that Fukushima Prefecture is the prefecture with the smallest dispersion (or information inequality) such that the farmland-pricing model for Fukushima Prefecture was the most representative for the models in the Tohoku region. The other results can be explained in the same way. If we want to compare the dispersion of information bits distributions among regions, we should look at the weighted averages in the last column of Table 4, where the IIAR arithmetic average across the prefectures in a region is shown. For example, the average IIAR for the Tohoku region was 0.0171. The comparison of regional average IIAR indicated that the Kinki and Shikoku regions were the regions with the greater dispersion in bits of information while the Kyushu and Tohoku regions were regions with smaller dispersion. In other words, prefectures in Kyushu and Tohoku had more homogeneity in the informational distributions of pricing factors. Finally, there was only one regression model in Hokkaido, so it had no IIAR.

5.4 The Inequality of Information in Regressions

The above “IIAR” compared the dispersion in bits of information across independent variables among the prefectures in a region, and compared the average inequalities among regions. From another perspective, the inequality of information in regressions (IIIR) is used to measure the dispersion in total bits of information across prefectures in a region. In other words, the former analyzes the regressor informational content (in Tables 4 and 5) in the “horizontal” direction, while the latter analyzes the inequality in the information bits provided by every prefecture model in the “vertical” direction. The formula for the inequality of information in regressions is:

$$IIIR_i = \sum_{j=1}^N W_j \ln \left(N_N \sqrt{\prod_{j=1}^N W_j} \right) \quad (9)$$

Table 6. Information Inequalities of Regions

Region	Inequality of Information in Regressions (IIIR)		Average Information Inequality Across Regressors (IIAR)	
	1962–1975	1976–1996	1962–1975	1976–1996
Hokkaido	—	—	—	—
Tohoku	0.0151	0.2282	0.0171	0.1538
Kanto-Tosan	0.1141	0.1911	0.0194	0.0720
Hokuriku	0.0182	0.0367	0.0414	0.0230
Tokai	0.0112	0.0333	0.0317	0.0222
Kinki	0.2116	0.5002	0.0701	0.2310
Chugoku	0.0306	0.0555	0.0363	0.0169
Shikoku	0.0398	0.2191	0.0504	0.0318
Kyushu	0.0041	0.0639	0.0117	0.0310

where $IIIR_i$ is the inequality of information in regressions for region i ; w_j =(total bits of information of prefecture j in region i)/(sum of total bits of information for all prefectures in region i); N is the number of prefectures in region i . The IIIRs for various regions are presented in columns 2 and 3 of Table 6 and the average IIARs are in columns 4 and 5. The latter is from the weighted averages for various regions in the last column of Tables 4 and 5. A greater inequality in information in regressions (IIIR) means that the region has a greater dispersion of total bits of information such that the farmland-pricing model is not appropriate for aggregate regional data analysis, even if the individual prefecture model is appropriate. Table 6 shows that the IIIRs for the Kinki and Kanto-Tosan regions were large, while the IIIRs for the Kyushu, Tokai, Tohoku, and Hokuriku regions were quite small. Therefore, the farmland-pricing model was more appropriate for the latter regions. In the Kyushu region, its IIIR was 0.0041 and the average IIAR was 0.0117 for the period 1962–1975. Compared with other regions in the same period, both indexes were smaller, which means that the total bits of information for each prefecture were very close and the distributions of information across the regressors were also similar.

The results for 1976–1996 are presented in columns 3 and 5 of Table 6. From the perspective of IIIR, the numbers were larger for Kinki and Tohoku while smaller for Tokai and Hokuriku. This means that models with net agricultural returns, agricultural

dependence, and farm sizes were more appropriate for Tokai and Hokuriku than for Kinki and Tohoku. From the perspective of IIAR, Kinki and Tohoku had a higher level of average inequality while Chugoku and Tokai had a lower level. This means that the information bits distributions of net agricultural returns, agricultural dependence, and farm sizes were of a greater variance in Kinki and Tohoku and of a less variance in Chugoku and Tokai.

6. Conclusion

This paper uses the approach of information bits to analyze the factors influencing farmland prices. According to the empirical analysis, net agricultural returns were the most important factor in most prefectures and the interest rate ranked as second in the period 1962–1975. The average information inequality across regressors (IIAR) shows that the bits information distribution among regressors in Kinki and Shikoku were of a greater variance while those in Kyushu and Tohoku were of a less variance. The analysis of information inequality in regressions (IIIR) for various regions shows that Kinki and Kanto-Tosan had a higher variance in prefectures' distributions of information bits while the distributions in Kyushu or Tokai were much similar. Therefore, capitalization models were more appropriate for the latter regions.

Since the actual prices have diverged from the theoretical prices after 1975, the regression function of farmland prices was remodeled as explained by

variables of net agricultural returns, agricultural dependence, and farm sizes. The regression results show that agricultural dependency was the most important variable. From the perspective of inequality of information in regressions (IIIR), the models with net agricultural returns, agricultural dependence, and farm sizes were more appropriate for Tokai and Hokuriku than for Kinki and Tohoku. Finally, the analysis of average information inequality across regressors (IIAR) shows that the information bits distributions of net agricultural returns, agricultural dependence, and farm sizes were of a greater variance in Kinki and Tohoku and of a less variance in Chugoku and Tokai.

References

- [1] Alston, J.M., "An Analysis of Growth of U.S. Farmland Prices," *American Journal of Agricultural Economics*, vol. 68 (February 1986), pp. 1-9.
- [2] Adelaja, A.O., T. Miller and M. Taslim, "Land Values, Market Forces, and Declining Dairy Herd Size: Evidence from an Urban-Influenced Region," *Agricultural and Resource Economics Review*, vol. 27 (April 1998), pp. 63-71.
- [3] Anderson, T.W., *An Introduction to Multivariate Statistical Analysis*, (2nd ed, John Wiley & Sons, New York, 1984).
- [4] Burt, O.R., "Econometric Modeling of the Capitalization Formula for Farmland Prices," *American Journal of Agricultural Economics*, vol. 68 (February 1986), pp. 10-26.
- [5] Campbell, J.Y. and R.J. Shiller, "Cointegration Tests and Present Value Models," *Journal of Political Economics*, vol. 95 (October 1987), pp. 1062-1088.
- [6] Chavas, J. and A. Thomas, "A Dynamic Analysis of Land Prices," *American Journal of Agricultural Economics*, vol. 81 (November 1999), pp. 772-784.
- [7] Chow, G.C., "Rational Versus Adaptive Expectations in Present Value Models," *Review of Economics and Statistics*, vol. 71 (August 1989), pp. 376-385.
- [8] Falk, B. and B. Lee, "Fads Versus Fundamentals in Farmland Prices," *American Journal of Agricultural Economics*, vol. 80 (November 1998), pp. 696-707.
- [9] Featherstone, A.M. and T.G. Baker, "An Examination of Farm Sector Real Estate Dynamics," *American Journal of Agricultural Economics*, vol. 69 (August 1987), pp. 532-546.
- [10] Hardie, I., P. Park, P. Gottlieb and D. Wear, "Responsiveness of Rural and Urban Land Uses to Land Rent Determinants in the U.S. South," *Land Economics*, vol. 76 (November 2000), pp. 659-673.
- [11] Kanoh, S. and H. Murase, "On Land Price Formation: Bubble versus Option," *Japanese Economic Review*, vol. 50, no. 2 (June 1999), pp. 212-226.
- [12] Moss, C.B., "Returns, Interest Rates, and Inflation: How They Explain Changes in Farmland Values," *American Journal of Agricultural Economics*, vol. 79 (November 1997), pp. 1311-1318.
- [13] Phipps, T.T., "Land Prices and Farm-Based Returns," *American Journal of Agricultural Economics*, vol. 66 (November 1984), pp. 422-429.
- [14] Robinson, L.J., L.A. Lins and R. VenKataraman, "Cash Rents and Land Values in U.S. Agriculture," *American Journal of Agricultural Economics*, vol. 67 (November 1985), pp. 794-805.
- [15] Shannon, C.E., "A Mathematical Theory of Communication," *Bell System Technical Journal*, vol. 27 (July 1948), pp. 379-423 and 623-656.

(受理日：2004年3月17日)