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The Segmentation of Loan Interest Rates by Regional Financial Institutions: A Panel Cointegration Analysis

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Whether there are segmentations of loan interest rates in Japanese regional financial markets is an important issue. The main purpose of this work is to show the answer to the question. We analyzed the data of the loan interest rates of regional financial institutions during FY 1992 and FY 2007 by the methods of panel cointegration tests. As a result, we found cointegration relationships between spreads of loan interest rates by the regional financial institutions and logarithmic values of nominal gross prefectural products. Furthermore, we estimated the error correction model to see what factors caused the errors.

Field of Research: Regional Banking

JEL Classification: G21; G23

1. Introduction

Loan interest rates of regional financial institutions are affected by many kinds of factors such as economic conditions, credit risks of borrowers, risk tolerance of financial institutions, competition intensities of loan markets, regional business cycles, changes of policy interest rates, duration of loans, and so on and so forth.

The purpose of this work is to examine whether there are the segmentations of loan interest rates in regional financial markets of Japan in the long run since the collapse of bubble economy by panel cointegration analyses. If there are segmentations of them, they are supposed to be mainly affected by the regional economic conditions against “Law of One Price”. As a matter of fact, not only the regional economic

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conditions, but the above-mentioned factors also have some effects on the loans interest rates like noises. Therefore, for the purpose above, we adopted cointegration approach which enables us to see whether a long-term equilibrium between them exists or not. If we can find existence of a stationary linear combination of nonstationary random variables, there are supposed to be a cointegration relationship where a long-term equilibrium makes them converge after some time lags. It means that there are segmentations by region in the long run.

Kano and Tsutsui (2003) shows that the loan markets for shinkin banks, which is one of business categories of regional financial institutions in Japan, are segmented, even though those of regional banks are not.[*1] This means that the loan interest rates of shinkin banks in smaller areas, which have regulatory limitations on business area, tend to be diversified against “Law of One Price”. The question is whether these kinds of diversifications are made by long-term convergences with some time lags or not. In this work, we are concerned with cointegration analysis for the long periods since the collapse of the bubble economy in Japan.

However, cointegration analysis needs setting up rather long periods to analyze. The period we set up is from FY 1992 when the bubble economy in Japan had just burst until FY 2007 when the economy had been booming for the longest period after the war time even under persistent deflation. But it is too short as sample periods for cointegration analysis. Besides, the data on the loan assets of financial institutions are limited to low frequency ones; only annual and biannual data are available in Japan. Therefore we use the method of panel cointegration analysis which is effective to find long-term equilibrium among variables. They enable us to analyze the relationships by inclusion many cross-sectional variation and compensating for the insufficient degrees of freedom.

Furthermore, from the late 1990s until the early first decade of this century, it is often pointed out that Japanese financial system were in dysfunctional state. In those days, some Japanese financial institutions went bankrupt and others were forced to be merged into or consolidated by the other healthier financial institutions to avoid their bankruptcies. And the nonperforming loan (NPL) ratios of most financial institutions which remained at high levels prevent them from increasing their loan amount, especially to small and medium-sized enterprises (SMEs).

Our research is unique in that we assume the existence of some factors that prevented the convergence of loan interest rates by regional financial institutions with

the respective nominal gross prefectural products and found them by our empirical analysis of an error-correction model (ECM) for the loan interest rate of regional financial institutions during the difficult time in Japan.

This work is organized as follows. Section 2 presents the overview of relevant literature. Section 3 presents descriptions of our sample and the variables. Section 4 presents the results of our empirical analyses, or unit root test and panel cointegration test of the data. Section 5 concludes.

Table 1.1: The business categories of financial institutions in Japan and the definition of regional financial institutions

Business categories				Definition and characteristics	The number of banks at the end of FY1992	The number of banks at the end of FY2007
		Commercial Banks	City Banks	Banks whose head offices or central branches are located in major cities and have presences nationwide.Especially the present top 3 banks are called Megabanks. These banks are also the cores of three gigantic financial groups.	11	6
Regional Financial Institutions in this work	Regional Financial Institutions		Regional Banks	Banks which are members of Regional Banks Association of Japan. Most of them are the largest banks in the prefectures where their head offices are located.	64	64
			Second-tier Regional Banks	Banks which are members of The Second Association of Regional Banks. Compared with Regional Banks, most of them are smaller.	71	45
		cooperative financial institutions	Shinkin Banks	A type of cooperative financial institution serving SME, local residents and local community. Anyone who lives, works, or has an office in the region served by the bank can become a member. However, companies with over 300 employees are prohibited from membership.	435	281
			Credit Unions, JA banks, Labor credit association… etc			

2. Literature Review

Numerous attempts have been made by researchers to apply panel cointegration analysis widely to a variety of study objects. Additionally Nagahata et al (2004) estimated long-run equilibrium relationships of land prices using a panel cointegration analysis and estimate an ECM for them and the ECM finds that deviations from the long-run equilibrium and non-performing loans have an effect on the fluctuation of real land prices.

Furthermore Nakamura and Saita (2007) found the cointegration relationships between the discounted present values of lands calculated based on the

macro-economic indicators and land price indicators. The ECM Nakamura and Saita (2007) estimated showed that not only the changes in the discounted present values of lands, but also the changes in the demographic factor have an effect on the fluctuation of real land prices.

It is generally pointed out that increases of NPL ratio have harmful effects on the sound lending activities of Banks. For example, Sekine et al (2003) pointed out that in the 1990s, many banks including some regional financial institutions did not write off the NPLs aggressively enough by their forbearance policy. The lending under the policy is also called with a touch of exaggeration “Zombie Lending” in Caballero, Hoshi and Kashyap (2008). Such ways of lending gave especially Japanese major banks and some regional financial institutions an incentive to reduce loans to sound companies rather than reducing loans to bad companies.

As for a thesis on the causality between land prices and bank loans, Kiyotaki and Moore (1995) is famous for its theoretical dynamic models including the mechanism where rises in land prices cause the increases of collateral values. Land price falling have been another harmful effect on the sound lending activities of banks. Ogawa and Kitasaka (2000) showed that there were credit crunches for mainly SMEs which had depended on land collateral loans much as means of funding in the periods after the collapse of bubble economy. According to Ogawa and Kitasaka (2000), this is because the decline in asset prices caused not only restricted firms’ investment behavior throughout the 1990s, but also magnified agency costs of banks by causing deterioration in their balance sheets and net worth.

As mentioned in section 1, Kano and Tsutsui (2003) showed interesting empirical results. Estimating risk adjusted loan interest rates of regional financial institutions, they tested the difference in interest rates across prefectures by the method of multiple comparison. Although it is a precious and important research on whether there are segmentations of regional loan markets or not, it used only cross-section data in FY 1997 not to include any analyses in time-series.

And relationship lending is regarded as an effective solution against such problems for regional financial institutions to keep their sound lending even in the worse economic situation. As Petersen and Rajan (1995) pointed out, relationship lending makes their SME and regional lending feasible because soft information generated during the relationship produces rents for the bank later in the relationship and permits the early losses to be offset. The function is known as intertemporal smoothing of relationship

lending.

3. Data, Variables and Hypothesis

In this work we assume that there is a cointegration relationship between spreads of loan interest rates and logarithmic values of nominal prefectural economic products in Japan for long periods since the collapse of bubble economy. We use the two kinds of proxy variables. One is "$SPREAD_{i,t}$" which is the spread between loan interest rates of regional financial institutions and risk free rates. And the other is "$Log(NGPP)_{j,t}$" which is the proxy of the logarithmic value of nominal gross prefectural products. The index i of "$SPREAD_{i,t}$" indicates each individual of regional financial institutions while the index j of "$Log(NGPP)_{j,t}$" indicates each individual of 47 prefectures in Japan. Additionally index t of both variables indicates each individual of the periods of fiscal years.

We expect that the panel cointegration approach adopted in this work should contribute in strengthening the acknowledged low power of individual cointegration tests in small sample. Indeed, the sample period from FY1992 until FY 2007 —16 annual observations are included— may seem rather short for undertaking the cointegration analysis. However it would be a good choice to exploit the panel dimension of our data. We employ two kinds of established panel unit root tests —Im, Peterson and Shin (IPS) test and Augmented Dickey Fuller (ADF) test— and four kinds of new panel cointegration tests Westerlund (2007) developed whose simulation results suggest that the tests have good small-sample properties with small size distortions and high power relative to other popular tests. Hence, we hope that the gains from testing in panel will compensate the low power of the residual-based tests in small sample.

We made the model of reduced forms to describe the relationship between them. Firstly, regional loan demand and supply functions could be specified as follows;
Loan demand function

$$L_{i,t}^{d} = \alpha_0 + \alpha_1 loanrate_{i,t} + \alpha_2 \ln\left(NGPP\right)_{j,t} + \mu_{i,t}^{d} \quad (1)$$

Loan supply function

$$L_{i,t}^{s} = \beta_0 + \beta_1 loanrate_{i,t} + \beta_2 rf_{i,t} + \mu_{i,t}^{s} \quad (2)$$

where r_f is the risk free interest rate such as average yields of Japanese government

bonds and $L^d_{i,t}$ and $L^s_{i,t}$ are the loan amount of demand and supply. We could introduce the reduced form of those functions as follows

$$r_{i,t} - rf_{i,t} = spread_{i,t} = \gamma_0 + \gamma_1 \ln(NGPP)_{j,t} + \mu_{i,t} \quad (3)$$

During this period many regional financial institutions had disappeared by mergers and bankruptcies in Japan. We cut out the data of disappeared regional financial institutions because we need use balanced panel data for the unit-root tests and the panel cointegration tests. The number of regional financial institutions in FY 2007 is 388 diminished from 592 in FY 1992.

“Regional Financial Institution” we call in this work consists of three kinds of business categories: regional banks, second-tier regional banks and shinkin banks as table 1-1 shows. The sources for all of these data are Ginko Zaimu Shohyo Bunseki (*Analysis of Financial Statements of All Banks*) by the Japanese Bankers Association and Zenkoku Shinyo Kinko Zaimu Shohyo (*Financial Statements of Shinkin Banks in Japan*) by Financial Book Consultants, Ltd. And the variables “Log(NGPP)$_{j,t}$” are data from System of Prefectural Account which are estimated figures of aggregated economic activities by prefecture in reference to System of National Accounts (SNA). Cabinet Office, Government of Japan aggregate System of Prefectural Account of 47 prefectures and release “Annual Report on Prefectural Accounts”. We show the empirical results of several kinds of tests to analyze the long-term relationships between the data in section 4 as follows.

4. The Empirical Result

4.1 Unit Root Test

First of all we test for the presence of a unit root to verify whether the variables are non-stationary or not. Recently several kinds of unit root test for panel data being introduced in the previous literatures, we adopted two kinds of test: Im, Pesaran and Shin (IPS) test and Augmented Dickey Fuller (ADF) test. Both of them are established tools in panel data analysis. Refer to Im, Pesaran and Shin (2003), and Maddala and Wu (1999) respectively.

Those tests consider the following basic ADF specification:

$$\Delta y_{i,t} = \alpha y_{i,t-1} + \sum_{j=1}^{p_i} \gamma_{ij} \Delta y_{i,t-j} + \beta_0 + \beta_1 t + \beta_2 x_{i,t} + \varepsilon_{i,t} \quad (4)$$

where β_0 is a constant, β_1t is a time trend, p_i is the appropriate lag order, $x_{i,t}$ is the explanatory variables and $\Delta y_{i,t}$ is the explained variable. The null hypothesis of both IPS and ADF test is that $H_0 : \alpha_i = 0, \text{for all i}$ against the alternative hypothesis $H_1 : \alpha_i < 0,$ for at least one i. Table 4-1 shows the results of the panel unit root tests. The lag length employed in those unit root tests are selected by the Akaike Information Criterion. Judging from the result, both of "$SPREAD_{i,t}$" and "$Log(NGPP)_{j,t}$" are I(1).

As Table 4-1 shows, the both kinds of null hypotheses of the existence of unit root for the first differences of those variables are strongly rejected at 1 percent significance levels while those for the floors of them are not rejected in both tests. In addition, the same results of unit root tests for the residuals of the equation (3) are reported in Table 4-2. These results also show us that the residuals are also I(1).

4.2 Panel Cointegration Test

In this work we apply the panel cointegration tests developed by Westerlund (2007). [*2] In this test, we suppose a data generating process in the form as follows:

$$\Delta y_{i,t} = \phi_i * ECT_{i,t-1} + \sum_{j=1}^{p_i} \gamma_{ij} \Delta y_{i,t-j} + \sum_{j=-q_i}^{p_i} \beta_{ij} \Delta x_{i,t-j} + \delta_i' d_t + \varepsilon_{i,t} \quad (5)$$

where d_t contains the deterministic components, for which there are three cases as follows. In the first case, $d_t = (1, t)'$ so $\Delta y_{i,t}$ is generated with both a constant and a time trend; in the second case, $d_t = 1$ so $\Delta y_{i,t}$ is generated with a constant; and in the third case, $d_t = 0$ so (5) has no deterministic terms. In this work we set $d_t = 1$ so that the data generating model include a constant without a time trend.

The parameter ϕ measures the speed which the system returns to its equilibrium after a sudden shock. We require the parameter ϕ to be negative to have a cointegration relationship among the variables. If the parameter ϕ is equal to zero, there is no cointegration.

Westerlund (2007) developed four new panel cointegration tests that are based on

structural dynamics and do not impose any common-factor restriction. The idea is to test the null hypothesis as $H_0 : \phi_i = 0$ for all i, by inferring whether the error-correction term in the panel error-correction model as shown above is equal to zero. The four kinds of tests can be divided into two groups by the difference of the alternative hypotheses. The two tests called group-mean tests are designed to test the alternative hypothesis that at least one unit is cointegrated as $H_1^G : \phi_i < 0$ for at least one i, while the other two called panel tests are designed to test the alternative hypothesis that the panel is cointegrated as a whole as $H_1^P : \phi_i = \phi < 0$ for all i.

The two kinds of group-mean tests can be calculated by:

$$G_{\mathrm{T}} = \frac{1}{N}\sum_{i=1}^{N}\frac{\hat{\phi}_i}{SE\left(\hat{\phi}_i\right)} \quad (6)$$

$$G_{\alpha} = \frac{1}{N}\sum_{i=1}^{N}\frac{T\hat{\phi}_i}{\hat{\phi}_i} \quad (7)$$

The two kinds of panel tests can be calculated by:

$$P_{\mathrm{T}} = \frac{\hat{\phi}}{SE\left(\hat{\phi}\right)} \quad (8)$$

$$P_{\alpha} = T\hat{\phi} \quad (9)$$

And in this work we need to take consideration of the cross-sectional dependence because their loan interest rates and loans outstanding have affection respectively one another to some extent as preceding studies pointed. To avoid this problem we introduced bootstrap into the test to get the robust critical values for the test statistics. The number of replication for the bootstrap is 400, and the both number of lags and leads are set 1 simply.

Table 4-3 shows the results of these panel cointegration tests using three kinds of Kernel windows. As for the test of the statistic values of G_{T} and P_{T}, the null hypotheses are rejected (using a 5% significance level) in most cases, while they are

not rejected in all the tests of the statistic values of G_α and P_α. Judging from the results, it is reasonable to suppose that "$SPREAD_{i,t}$" and "$\log(NGPP)_{j,t}$" are cointegrated even though null hypotheses are not perfectly rejected.

Now we can introduce an error correction model. It is as follows:

$$\Delta SPREAD_{i,t} = \beta_0 - \phi * ECT_{i,t-1} + \beta \Delta \log(\mathrm{NGPP})_{\mathrm{j,t}} + \lambda \Delta z_t + \varepsilon_t \quad (10)$$

where, ECT_{t-1} stands for Error Correction Term. This means that relational expression $\Delta SPREAD_{i,t} = \beta_0 + \beta \Delta \log(NGPP)_{\mathrm{j,t}} + \lambda \Delta z_t$ is effective in the long run, while $ECT_{i,t-1}$ occurs to correct the deviation from the long-term equilibrium, which is the difference between actual spread and its long-term equilibrium value, that is $(SPREAD - SPREAD*)_{i,t-1}$

ΔZ_t are the explanatory variables based on short-run dynamics as we stated. These variables widen the gap between the equilibrium and the non-equilibrium. As mentioned above, considering the characteristics of regional financial institutions as risk-averters, the variables which have much effect on the competition in the regional loan markets and the loan demands and regional economic situation are plausible as proxy variables for ΔZ_t.

4.3 Estimation of Error Correction Model

In this subsection, we estimate ECM based upon the long-run equilibrium of the relationships between variables. Again, let us show the ECM as the equation (10). It is as follows:

$$\Delta SPREAD_{i,t} = \beta_0 - \phi * ECT_{i,t-1} + \beta \Delta \log(\mathrm{NGPP})_{\mathrm{j,t}} + \lambda \Delta z + \varepsilon_{i,t} \quad (10)$$

where i = 1……N is the number of regional financial institutions, j = 1……N is the number prefectures and t= 1……T is the number of periods.

We consider the following four variables as suitable ones for ΔZ of the ECM.

1. $NPL_{i,t-1}$: One period lagged variable of NPL ratio

$NPL_{i,t-1}$ is one period lagged variable of $NPL_{i,t}$ and considered to have much effect on

the activity of regional financial institutions in the short run. The data of risk management loans of individual Shinkin banks are not available before FY 1998. Therefore we adopted an alternate solution for missing data of individual shinkin banks as follows;

① At first we calculated average NPL ratios of regional commercial banks (regional banks and second-tier regional banks) in 47 Japanese prefectures from FY1992 until FY2007.

② We substitute the NPL ratios of them by prefecture for the NPL ratios of individual shinkin banks sorted by prefecture as well from FY 1992 until FY 1997.

2.$\Delta ACLP_{j,t}$: Change rates of the average commercial land prices by prefecture

The variable $\Delta ACLP_{j,t}$ is the yearly change rate of the average commercial land price index. The fluctuations of land prices are thought to have much effect on the activities of regional financial Institutions.

3. $SMEDI_{j,t}$: SMEs' business confidence DI

The SMEs' business confidence DI of Japan has been released by SMRJ[*3] every quarter since 1980. At first we transformed the quarterly DI into yearly DIs by calculating the average values on a fiscal year basis. The regional DI have been released since FY 1994 and those in FY 1992 and FY 1993 are not acquirable. As a workaround we substituted the DI of the whole country for them.

All regional DI are negative and the mean of them is -21.694 as table 4-10 shows. SMEs' business confidences had been exacerbated from FY1992 to FY2007 as a general trend.

4. $HHI_{j,t-1}$: one period lagged variable of the Herfindahl-Hirschman Index calculated by loans outstanding of regional financial institutions by prefecture

Table 4-4 is the descriptive statistics of ECM and Figure 4-1 illustrates the fluctuations of the variables of ECM. In estimation of ECM, we used Random Coefficient Model to allow for heterogeneity in parameters. The result of ECM is posted in Table 4-5. In test of parameter constancy of the model, null hypothesis that there is homogeneity of parameters was rejected. All estimated coefficients except for $HHI_{j,t-1}$ are significant and have expected signs.

The coefficient of $ECT_{i,t-1}$ is -0.6352, negative and more than -1. This shows that the

sign of $ECT_{i,t-1}$, to correct the deviations from the long-run equilibriums, are matching theoretically.

The coefficient of $\Delta Log(NGPP)_{j,t}$ is +0.0152, significantly positive. In previous section we found cointegration relationship between the spread and logarithmic values of gross prefectural product. It is certain that when regional economies expand (recess), the risk premium that regional financial institutions take increase (decrease) during the periods with some time lag from FY 1992 to FY 2007.

The coefficient of $NPL_{i,t-1}$ is +0.0071, positive, although its significance is at a little more than 1%. This means that NPL ratios are rather good index for the degree of risk-taking judging from only the sign condition. It is natural that the more NPLs financial institutions hold, the more risk premium they also take. However, as the significance level of $NPL_{i,t-1}$ at a little more than 10% shows, we cannot say that the ratios prevented the spread of regional financial institutions from their convergence with the logarithmic values of gross prefectural product as a whole. It is fair to say that this is because NPL ratios of most regional financial institutions increased more and more rapidly than they had expected and the NPL disclosure principles had been so frequently made more strict ones that the credibility of the NPL ratios released in early 90s are especially low.

The coefficient of $\Delta ACLP_{j,t}$ is -0.0025, significantly negative, although its p-value is rather high, 0.056. Firstly, it means that when land prices are falling as we have seen in ‘90s in Japan, the spreads tend to be widened. Furthermore, from the viewpoint of ECM, the falling land prices prevented the convergence between the spread and the logarithmic values of gross prefectural product. As Ogawa and Kitasaka (2000) pointed out, the falling land prices decreased loan demands of SMEs and caused deterioration in regional financial institutions’ balance sheets. It is obvious that the falling for a long time made Japanese financial system into which regional financial institutions were incorporated less functional.

The coefficient of $SMEDI_{j,t}$ is -0.0005, significantly negative. Firstly, this means that while the business confidence index of SMEs get worse, regional financial institutions take risks. Furthermore, from the viewpoint of ECM, the deterioration of them prevented the convergence between the spread and the logarithmic values of gross prefectural product. It seems reasonable to suppose that the loan demands of SMEs declines when business confidence is deteriorated.

The coefficient of $HHI_{j,t-1}$ is 0.01262, not significant and positive. This means that we can say neither that the intensities of competitions for loans in prefectures have any

effect significantly on the spread nor that they prevent the convergence between the spread and the logarithmic values of gross prefectural product.

Table 4.1: Results of unit root tests of variables and our judgment

	$SPREAD_{i,t}$		$\log(NGPP)_{j,t}$	
Im, Pesaran and Shin test (IPS test)				
Level	-0.39		-2.04	
1st difference	-39.70	***	-29.45	***
ADF test- Fisher Chi-square				
Level	672.58		728.85	
1st difference	2,713.97	***	2,189.04	***
Judgment	I(1)		I(1)	

"***", "**" and "*" denote statistical significance at the 1%, 5% and 10% levels, respectively
Null and alternative hypotyeses of thosetests are as follow:
H_0:each series contains a unit root, H_1:some of the individual series contains a unit root
In any test, the base model for the residual include both their constant terms and time trends

Table 4.2: Results of unit root tests of residuals and our judgment

	explainted variable:$SPREAD_{i,t}$	
Im, Pesaran and Shin test (IPS test)		
Level	-0.31	
1st difference	-44.79	***
ADF test - Fisher Chi-square		
Level	668.83	
1st difference	2,722.27	***
Judgment	I(1)	

"***", "**" and "*" denote statistical significance at the 1%, 5% and 10% levels, respectively
In any test, the base model for the residual include both their constant terms and time trends

Table 4.3: Results of cointegration tests and our judgment

Variables: $SPREAD_{i,t}$ and $\log(NGPP)_{j,t}$

Kernel window	Statistics	Value	Z-value	p-value	robust p-value	
1	Gt	-2.355	-12.662	0.000	0.053	*
	Ga	-4.172	10.749	1.000	0.315	
	Pt	-39.41	-10.959	0.000	0.035	**
	Pa	-4.38	-0.665	0.253	0.150	
2	Gt	-2.355	-12.662	0.000	0.053	*
	Ga	-3.78	12.166	1.000	0.398	
	Pt	-36.841	-8.374	0.000	0.048	**
	Pa	-3.522	3.142	0.999	0.358	
3	Gt	-2.355	-12.662	0.000	0.048	**
	Ga	-3.448	13.368	1.000	0.438	
	Pt	-35.813	-7.341	0.000	0.040	**
	Pa	-3.516	3.17	0.999	0.255	

"***", "**" and "*" denote statistical significance at the 1%, 5% and 10% levels, respectively
In any test, the base model for the residual include their constant terms without their time trends
The lag length employed in those unit root tests are selected by the Akaike Information Criterion

Table 4.4: Descriptive statistics for ECM

	obserbations	Mean	Maximum	Minimum	Std. Dev.
$\triangle SPREAD_{i,t}$ (%)	5,820	-0.0082%	5.227%	-4.544%	0.5244
ECT_{t-1}	5,432	0.018	0.042	-0.012	0.011
$\Delta log(NGPP)_{j,t}$	5,820	0.004	0.185	-0.151	0.024
$NPL_{i,t-1}$(%)	5,820	5.61%	27.20%	0.04%	0.044
$\Delta ACLP_{j,t}$(%)	6,208	-9.052%	28.080%	-54.207%	0.097
$SMEDI_{j,t}$	6,208	-20.694	-10.575	-31.850	4.874
$HHI_{j,t-1}$	5,820	0.333	0.776	0.041	0.168

Figure 4.1: Graphs of mean value of variables of ECM

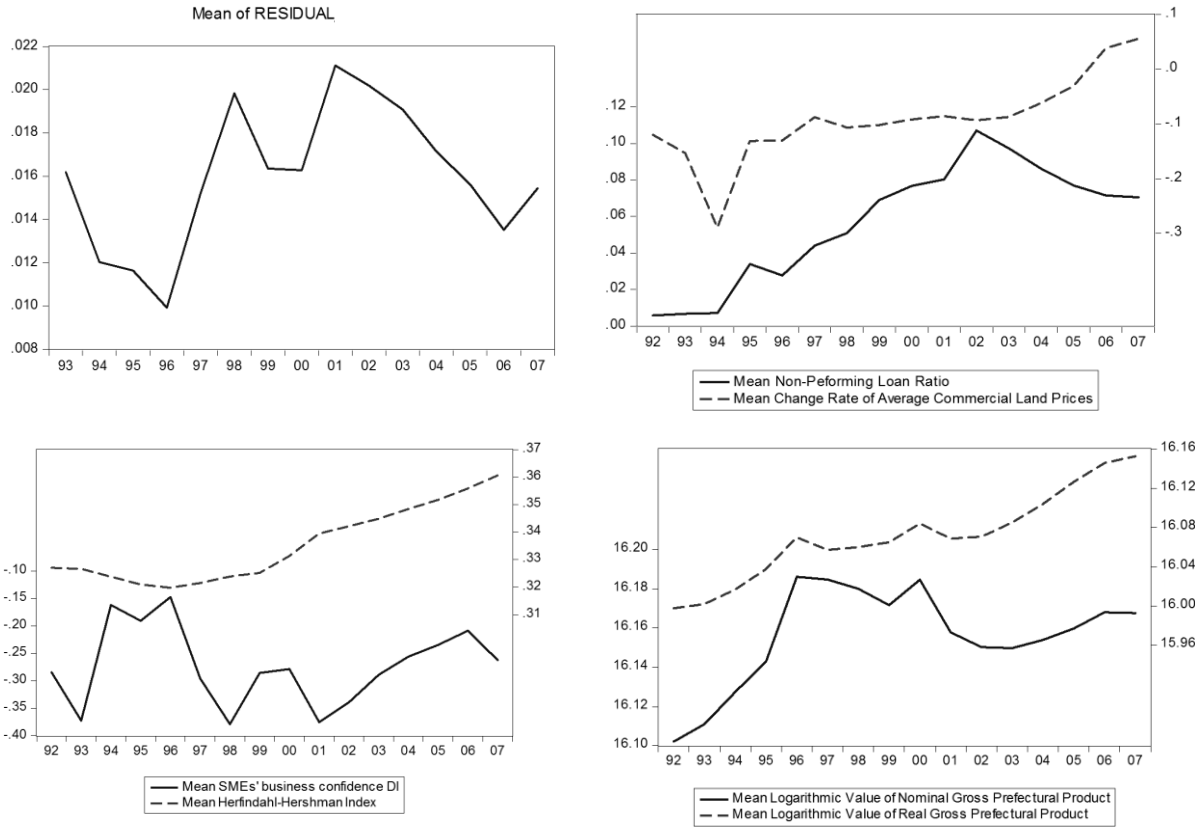

Table 4.5 Result of ECM

	explained variable $\Delta SPREAD_{i,t}$		
Explanatory variables			
ECT_{t-1}	-0.6352	(0.0000)	***
$\Delta log(NGPP)$ j,t	0.0152	(0.0010)	***
$NPL_{i,t-1}$	0.0071	(0.1030)	
$\Delta ACLP_{j,t}$	-0.0025	(0.0560)	*
$SMEDI_{j,t}$	-0.0005	(0.0000)	***
$HHI_{j,t-1}$	0.0126	(0.4020)	
constant term	-0.0076	(0.0170)	**
Observations	5,432		
wald test χ^2	2,338.71	***	
Test of parameter constancy χ^2	5,013.45	***	

Notes:
1. Estimated as a Random Coefficients Model. See Swamy(1970).
2. Figures in parentheses are p-value.. "***", "**" and "*" denote statistical significance at the 1%, 5% and 10% levels, respectively
3. Test of parameter constancy is a test for parameter homogeneity. The null hypothesis corresponds to homogeneous parameters across regional financial institutions, which follows the χ^2 distribution with K(n-1) degrees of freedom. K is the number of explanatoryvariables and n is the number of samples.

5. Conclusion

In this work, to begin with, we first examined whether there are cointegration relationship between "$SPREAD_{i,t}$" and "$log(NGPP)_{j,t}$" or not. The former variables are loans interest rates of Japanese regional financial institutions minus the average subscription yields of Japanese government bonds in the same fiscal years, and the latter variables are logarithmic values of nominal gross prefectural products from FY 1992 till FY2007. After all we found the cointegration relationship between them. It means that it is appropriate to say that as a whole there are segmentations in Japanese regional loan markets against "Law of One Price". In the long run, their loan interest rates converged with their regional economic situation with some time lags.

Then we estimate ECM including four explanatory variables based on short-run dynamics. And we found that both the increase of NPL ratio of regional financial

institutions and the falls of land prices and SMEs' business confidence DIs tend to break long-term equilibriums between "$SPREAD_{i,t}$" and "$Log(NGPP)_{j,t}$", meanwhile Herfindahl-Hirschman index don't have significant affection.
In Japan since the collapse of the bubble economies, some regional financial institutions had disappeared by mergers and bankruptcies. Increases of their nonperforming loans, shrinking of their assets and decreases of the demands for their loans have prevented them from lending to SMEs and the local companies. Some became too risk-avert to take risks to increase their loans and such lending attitudes suffocated regional economies where they act at home.

However, as a whole, Japanese regional financial institutions had managed to adjust their loan interest rates to their local economic situations and business conditions of SMEs. It seems reasonable to suppose that that is because they have put the way of relationship lending into practice to enhance their community based banking activities for a long time. In spite of the difficult times, in the long run and as a whole, they had strengthened their functions of relationship banking to get over. As Petersen and Rajan (1995) suggested, relationship lending is an advantageous way for regional financial institutions for regional and SME lending even in difficult times. It is fair to say that the time lags of the convergences result from the inter-temporal smoothing which is one of functions of relationship lending. It is important for activation of the whole economy in Japan to enhance function of relationship lending more.

Endnotes

1. Refer to Table 1-1 about the business categories of regional financial institutions of Japan and the definition of the word "regional financial institutions" in this work.

2. The Stata module called "XTWEST" which we used was developed for the panel cointegration tests based on Westerlund (2007). This module may be downloaded and be installed from within Stata. The routine is described in Persyn and Westerlund (2008). D'Alessandro (2010) also uses this module.

3. SMRJ is an independent administrative institution governed by Ministry of Economy, Trade and Industry. About 19,000 SMEs are polled quarterly for the DI. These polls have been continued since 1980. On top of business confidence DI, they manage and release financing DI, sales DI, current profit DI and the other seven kinds of DIs. As segments of data, the DI of the whole country is divided into those of 8 regions and is divided into those of 5 industries.

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