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JAPAN PREMIUM AND STOCK PRICES: TWO MIRRORS OF JAPANESE BANKING CRISES

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ABSTRACT

This paper investigates how financial troubles among Japanese banks in the second half of the 1990s were viewed by the market. Two indicators, the Japan premium and the stock price index of the banking sector in Tokyo, were examined. Econometric tests were employed to see whether different kinds of investors saw the banking crisis differently, and what kind of news had most impacts on market pricing of Japanese banks. Our findings are as follows. (1) Factors that pushed up the Japan Premium most were the Daiwa Bank incidence in the fall of 1995, failures of large financial institutions in November 1997, and uncertainties in the resolution of banking problem in fall 1998. (2) The bank stock index declined (in relative to the general stock index) most in bank failures, in particular by the Yamaichi Securities failure in November 1997. (3) Individual failures of financial institutions may or may not have impact on other banks' stock prices. (4) The bank stock index and the general stock index historically had co-movements, but the structural changes occurred in the co-movement relationship at around the summer of 1995. (5) News that affected Japan premium and bank stocks are sometimes different. The bank stock price index Granger-causes the Japan premium, but the reverse does not hold. The result is consistent with the view that Japan premium reflects both domestic structural problems and banks' liquidity problem in the euro dollar market, while the bank stock prices reflect the former only.

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1. Introduction

Japanese financial institutions, in particular banks, experienced large shocks in the second half of the 1990s. The deterioration of balance sheets forced some banks to fail or to withdraw from operations abroad. It started with an increase in nonperforming loans due to bursting of asset bubbles in the first half of the 1990s and a difficulty compounded by incomplete disclosure of bank balance sheet conditions and a lack of scheme to deal with near-insolvent banks. Nonperforming loans became an important policy issue from the mid-1990s, but market participants could not have enough information to make accurate judgement on how serious the banks' conditions were. Since 1995, as some banks actually failed and discussion on dealing with failing banks took place, investors have changed their evaluation on the Japanese banking industry in general and individual Japanese banks. In November 1997, two banks—including one of the top 10 banks—and two securities firms—including one of Big Four—have failed. Facing with a widespread fear of financial meltdown, the government decided to strengthen the banking sector. Capital injection—subscription to preferred shares or purchase of subordinated bonds—into major banks using fiscal money took place in March 1998 and, again, in March 1999. The last fiscal injection seems to have put an end to a saga of the 1990s banking crisis in Japan.

How foreign and domestic market participants evaluate the net worth or default risk of Japanese bank is reflected in two different indicators, stock prices of banks in the Tokyo stock exchange and the Japan premium (defined as the difference between the euro-dollar interbank interest rate for Japanese borrowers and that for European/American borrowers).

In order to extract the Japanese banks' reputation among stock market

investors, we constructed the relative stock prices of the banking sector against the rest of the economy. The banking-sector stock price index (Banking-TOPIX) has been publicly available. The bank stock index, BINDEX, reflects profitability, growth potentials, soundness in balance sheets, and other performance indicators of banks, judged by stock market investors. Of course, these banking performance would partly reflect strength of the economy in general. In order to control for the economy-wide factors, the difference between the bank stock index and "other industries stock index." We have constructed the index of general stock prices excluding banking index (TOPIX less the banking sector). The "other industries stock index", NINDEX, is defined as the difference between the TOPIX and the market-value-weight-adjusted bank stock index. Then the difference between NINDEX and BINDEX is called the banking spread in the stock markets, or SP. This indicator shows how investors regard the health of banking sector in relative to the economy-wide business conditions. The spread has started to become large in 1995 and continued to become larger in the second half of the 1990s.

The relationship between NINDEX and BINDEX has changed over time. In the long run, the two indices are cointegrated. However, the cointegration relationship seems to have changed its structure, as the two indices behave differently in the second half of the 1990s. We employ an econometric test developed by Seo (1998) in order to determine when a structural change in the cointegration relationship took place. Although it has been recognized by casual observations that banking stock prices have deviated from the overall stock prices, our formal test to determine the timing of such a change is, to our best knowledge, the first in the literature.

The Japan premium shows fragility, in terms of credit and counterparty risk, of Japanese banks perceived by foreign banks. The premium was added on to the loan

to Japanese banks in the eurodollar interbank market. Since large Japanese banks did not face any premium in the euro-yen or domestic yen-based interbank market, it was rather a puzzle why they were charged premium in the particular market. However, it became a symbol of weakness and vulnerability of Japanese banks. In the second half of the 1990s, whenever bad news about Japanese banks hit international press, the Japan premium seemed to have increased. Japan premium started to have increased in the summer of 1995, and, after some fluctuations, disappeared in April 1999.

After the behavior of the bank stock prices and the Japan premium is described and analyzed separately, the relationship between them is examined. One hypothesis is that these two mirrors of bank soundness are correlated closely. One indicator shows vulnerability, then the other follows. Another hypothesis is that one indicator could influence the other, but not vice versa. In order to test these hypotheses, a vector autoregression is conducted.

It has been observed by many market observers and policy makers that both stock prices of banks and Japan premium reflect market participants' views of Japanese banks in various stages of banking difficulties. However, changes in these variables have not been analyzed systematically. This paper is the first to test the relationship between the Japan premium and the bank stock prices.

The existing literature is briefly described and related to this paper. Peek and Rosengren (2000) regressed Japan premium on various dummy variables to find that changes in credit rating of banks, banking failures, and government announcement on overhauling weak banking system, among others, have contributed to increasing and decreasing Japan premium. They also found that policies not differentiating weak and strong banks contributed to an increase of Japan premium. We extend Peek and

Rosengren in two fronts. First, we included the banking stock prices as one of the explanatory variables of the Japan premium regression. The regression is useful for separating general information that would be reflected in the domestic stock market (risk to solvency) and those information that are specific to the euro-dollar market (liquidity risk in the dollar market). Second, we have identified the Daiwa Bank incident as one of the major news that contributed an increase in Japan premium, while Peek and Rosengren failed to find such an effect. The difference in the two studies depends on constructing a Daiwa incident dummy variable.

Ito and Harada (2000) presented a detailed analysis of event studies on the bank failure news. They showed that prominent failures—starting from the failure of Hyogo Bank (the first listed bank failure) in August 1995—gradually created the perception of systemic risk in the Japanese financial system. The event studies presented in the earlier paper will be summarized in next section

Peek and Rosengren (1997) examined a claim that the large stock prices declines in Tokyo affected the Japanese banks balance sheets and forced the Japanese banks to curtail lending at branches in the United States. Shimizu and Ui (1999) used a game theoretic approach to explain changes in the expectation about bank failures in Japan. Daigo, Yonetani, and Marumo (1998) found that announcements of various measures, such as the changes in accounting method, affected bank stock prices. Brewer, Genay, Hunter, and Kaufman (1997, 2000) analyzed determinants of the Japanese bank stock prices. Their most recent paper shows that bank failures had spillover effects on other bank stock prices.[1]

The paper analyzes the behaviors of bank stock spreads and Japan premium, and their relationship in the 1990s. In anticipation, conclusions can be summarized as

follows: (1) Japan Premium (JP) has sharply jumped up in three occasions, the Daiwa Bank incident in 1995, the major failures of financial institutions in November 1997, and the period of nationalizing two long-term credit banks; (2) Bank stock spreads (SP) increased in response to several financial institutions failures, in particular those in November 1997; (3) In some cases, a bank's failure triggered the decline in banking stock prices in general, or a sign of systemic crisis, but in some other cases, one bank failure goes without notice in the stock market; (4) The bank stock index (BINDEX) and the other stock index (NINDEX) had exhibited a comovement until the mid-1990s; (5) the structural change occurred in the BINDEX and NINDEX cointegration relationship sometime in the summer of 1995; and (6) Although SP and JP in general appears to be influencing each other, the Granger causality tests reveals that SP Granger-causes JP, but not vice versa.

The rest of the paper is organized as follows. Section 2 will describe the data and reviews the results of event studies. Section 3 will analyze the behaviors of BINDEX and NINDEX. Section 4 will investigate determinants of the Japan premium. Section 5 will present a vector autoregression model analyzing a dynamic relationship between Japan premium and the bank stock price spread. Section 6 will conclude the paper.

2. Data and event studies

2.1. Bank stock price index

We would like to describe the movement of bank stock prices in relative to other sectors. The bank stock price index is publicly available, but not the index for all industries except banking. Therefore, we construct the general stock price index

excluding banks by subtracting banking weights from TOPIX. Since TOPIX is the weighted average of 33 different sectoral indices, by removing the banking index from TOPIX, we can construct general index excluding banking as follows:

(2.1) $TOPIX_t = (1-\alpha_t)NINDEX_t + \alpha_t BINDEX_t$

(2.2) $NINDEX_t = \dfrac{TOPIX_t - \alpha_t BINDEX_t}{1-\alpha_t}$

where $\alpha_t = \dfrac{BINDEXMV_t}{TOPIXMV_t}$, and BINDEXMV(t) is current values of banking market capitalization and TOPIXMV is all sector market capitalization.[2] All indices, TOPIX, BINDEX, and NINDEX are adjusted for stock splits. Figure 1 shows the BINDEX and NINDEX from January 4, 1994 to April 30, 1999 with the number of observation being 1,282.

Insert Figure1.

We may observe that deviations between the two indices are minor before August 1995, but after August 1995, the two indices started to diverge. The deviations seem to widen over time.[3]

The bank stock prices relative to other sectors is defined as the bank stock price spread, SP:

(2.3) $SP_t = \ln NINDEX_t - \ln BINDEX_t$

In addition, we will construct a weak banks stock price index. This index will be used to measure the impact of news events, including the failure of banks, on the weak banks. First, take Japanese banks with low credit ratings (Baa2 and Baa3 for long deposit credit ratings in the Moody's Investment Service, *Moody's Global Ratings Guide*), and define the weighted average of these banks' stock prices as the Baa bank stock price index.

2.2. Japan premium

The Japan premium is the premium imposed on Japanese banks' borrowing rate by U.S. and European banks in the eurodollar market. It reflected counterparty risk based on the western banks' belief that Japanese banks had higher risk of default. Since the Japan premium emerged in the eurodollar market, and not in the euroyen market, it also reflects the liquidity problem with the dollars, rather than solvency or liquidity in the yen. In this paper, the Japan premium is defined as the difference between the TIBOR (the Tokyo interbank Offer Rate, or the dollar interbank borrowing rate in Tokyo) and the LIBOR (the London Interbank Offer Rate, or the dollar interbank borrowing rate in London). The TIBOR market participants are mostly Japanese banks. Therefore, the TIBOR reflects Japanese banks' borrowing rate with Japan premium. The LIBOR market has many western banks and only a few Japanese banks.[4] With LIBOR calculation eliminates the extreme values, the Japanese banks' rates are excluded from the LIBOR calculation. Hence, the difference between TIBOR and LIBOR is defined as the Japan premium (JP).[5]

(2.4) $$JP_t = TIBOR_t - LIBOR_{t-1}$$

The relationship between SP and JP can be shown in Figure 2. The bank stock spread data (the difference in the BINDEX and NINDEX, which is normalized as 100 on January 4, 1994) has a trend and is thus considered to have the possibility of nonstationary. However the data can be assumed to be stationary so that the trend is not removed by taking first differences in our estimations but a time trend is used instead. We will discuss this issue in some more detail in subsection 3.3. Note that the bank stock spread seems to be constant or slightly increasing at the end of the sample

period, while the Japan premium has declined dramatically.

Insert Figure 2

2.3. Event study

Ito and Harada (2000) studied how the news of bank failures were received by the stock market in Tokyo. Table 1 shows the 8 cases of financial institution failures. It shows the name of failed bank, the announcement date of the failure, and anticipation (changes in 10, 5, and 3, days prior to the announcement) and reaction (changes in 3, 5, 10 days following the announcement) of various stock price indices (BINDEX, Nikkei 225, the failed bank's (or securities firm's) stock price, Baa3, Baa2, and in some cases, related financial institution's price index).

Insert Table 1

From the table, we can make the following observations. First, for three banks that failed in 1995 and 1996, the failed banks stock prices dropped sharply, as expected, but the other banks' stock prices, even the weak banks' stock prices, did not drop after the announcement of a particular bank failure. Therefore, each of the failures was regarded in the market as an isolated incident. Second, for the three financial institutions that failed in November 1997, Baa2 and Baa3 indices, as well as BINDEX, sharply dropped after the failure announcement. The fall of Baa2 and Baa3 exceeded the fall of BINDEX. These sharp reactions is consistent with the view that systemic risk of banking failures was perceived to have increased by these failures. Third, reactions to the nationalization announcements of the Long-term Credit Bank (LTCB) and Nippon Credit Bank (NCB) were more muted, except some reactions in Baa3 and Baa2 index. In the case of LTCB nationalization announcement, it was anticipated for

a long time through the Diet debate, so that the reaction in BINDEX and Nikkei225 were rather calm, although Baa2 reacted sharply. In the case of NCB nationalization announcement, it was not anticipated in the market. However, the reaction of BINDEX and Nikkei225 were also calmer. Baa3 reacted sharply. The nationalization of LTCB and NCB was carried out under a new mechanism against systemic failure[6]. The market took these failures without increased fears for systemic risk.

In sum, bank failures in 1995 and 1996 did not trigger bank stock price declines of other banks, but those in November 1997 brought down stock prices of other banks, especially those with low credit rating. Systemic risk of the banking system in general was feared. By 1998, the mechanism to deal with bank failures was in place, and nationalization of LTCB and NCB was received without a major impact on other banks' stock prices in general, but some weak banks were affected.

3. Bank stock price movements

3.1. Correlation

From a casual observation of Figure 1, there seem to be three periods in the relationship between the BINDEX and NINDEX. The first period is from January 1994, the first date of our sample, to August 29, 1995, the day before the Hyogo Bank failure. The two indices show comovement. The second period is from August 30, 1995 to December 18, 1996. The deviation of BINDEX and NINDEX seems to widen gradually over this period. The third period is from December 19, 1996 to the end of our sample, April 30, 1999. The two indices in this period maintain the same degree of deviation, or the regaining the comovement in changes.

In order to formally show this casual observation, we calculated the

correlation coefficient of the two indices. For the first period, the correlation coefficient was 0.96 (with samples of 414), for the second period, the correlation coefficient dropped to 0.88 (with samples of 307). The correlation went up again to 0.97 in the third period with samples of 561.

We can interpret this as follows. Before the Hyogo Bank failure, the banking industry was quite a typical industry in the economy. The banking stock movement tracked the rest of the economy quite well. After the Hyogo Bank failure, the bank stocks started to do much worse than the rest of the economy. The Hyogo Bank failure was only the beginning of this deviating trend. By the end of 1996, the deviation between the two indices reached its maximum. From 1997, the deviation seemed to remain stable.

This assessment may appear contradicting the event study conclusion. According to the event analysis the Hyogo Bank failure did not alarm investors about other banks. However, that event seems to be the beginning of the deviation between the BINDEX and NINDEX. Since the event analysis covers only ten days after the event, it does not capture a possible structural change over time. The failures of the large financial institutions in November 1997 are most dramatic and the event analysis shows that it had a large impact on other banking stock prices. It may be natural to expect that November 1997 is the turning point. However, the correlation of the BINDEX and NINDEX increase after November 1997. But, the deviation between the BINDEX and NINDEX had already become large. The stock market must have anticipated low returns in the banking sector, including some failures. After November 1997, not only the banking sector but also the economy in general headed for a contraction (e.g., the GDP growth rate became –2.5%), so that the relative positions of

BINDEX and NINDEX may not have changed. Thus, just the event analysis or the correlation analysis does not give us a definite conclusion. It takes a more formal analysis to determine when the structural change took place.

3.2. Cointegration of BINDEX and NINDEX

In this subsection, the comovement of BINDEX and NINDEX will be formally analyzed using the cointegration technique. First, a unit root test is conducted for BINDEX and NINDEX. Each of the two indices is shown to have a unit root. Then the cointegration relationship between the two indices with an entire sample period is tested. Since the null hypothesis of no cointegration is rejected, it suggests that the two variables are not cointegrated as an entire sample period. This result supports that the long-run relationship between BINDEX and NINDEX cannot be assessed because of a structural change. These test results are shown in Table 2.

Insert Table 2, Unit Root Test and Cointegration Test

We suspect that the relationship may have experienced a structural change, as the preceding section indicates. Our interest is to determine when the structural change took place as well as whether the structural change took place. We apply a technique developed by Seo (1998). The Seo's technique will identify the timing of a structural change, while most of others test the existence of structural break at a pre-determined time[7].

The sample period is from January 4, 1994 to April 30, 1999 with a sample size of 1282. It is assumed that the admissible range of a break point is symmetrically set at [0.15, 0.85].

Consider a two-dimensional time series, BINDEX and NINDEX, generated by

ECM with the 1 lag length what is selected by AIC. The long-run relationship is estimated as follows:

$$(3.1) \qquad \begin{pmatrix} \Delta NINDEX_t \\ \Delta BINDEX_t \end{pmatrix} = \alpha\beta' \begin{pmatrix} NINDEX_{t-2} \\ BINDEX_{t-2} \end{pmatrix} + \Gamma_1 \begin{pmatrix} \Delta NINDEX_{t-1} \\ \Delta BINDEX_{t-1} \end{pmatrix} + \mu + u_t$$

where α is the adjustment vector, β is the cointegrating vector. The tests of a structural change in joint vector $\beta\alpha$ and optimal LM test statistics are defined as follows:

$$(3.2) \qquad Ave\ LM_n^i = \frac{1}{\bar{t} - \underline{t}} \sum_{t=\underline{t}}^{\bar{t}} LM_n^i\left(\left[t/n\right]\right)$$

$$(3.3) \qquad Exp\ LM_n^i = \mathbf{log}\left(\frac{1}{\bar{t} - \underline{t}} \sum_{t=\underline{t}}^{\bar{t}} \mathbf{exp}\left(LM_n^i\left(\left[t/n\right]\right)/2 \right) \right)$$

$$(3.4) \qquad Sup\ LM_n^i = \underset{t\in[\underline{t},\bar{t}]}{Max}\ LM_n^i\left(\left[t/n\right]\right)$$

where τ is assumed to lie in $\tau^* = [\underline{\tau}, \bar{\tau}]$, $\underline{t} = [n\underline{\tau}]$, $\bar{t} = [n\bar{\tau}]$, $i = \beta, \alpha, \beta\alpha$. It is allowed that one time structural change in the cointegrating vector at the break point τ. The break point τ intersects two sub-samples, $t = 1,2,\ldots,[n\tau]$ and $t = [n\tau]+1,\ldots,n$. $[n\tau]$ is the integer operator of $n\tau$.

The test results are shown in Table 3-1 panel B[8]. The plot of LM statistics is in Figure3. From the table, *Sup LM* test rejects the null hypothesis of parameter stability at the 5% size. In figure4, LM statistics show a spike that exceeds 5% critical value of *Sup LM* test around 360. This timing of the spike is approximately in the beginning of July 1995.

Insert Figure 3

Hence, it can be assumed that the relationship between BINDEX and NINDEX that used to have comovements, has been broken at around July 1995. Bank

stock spreads in relative to the general stock prices (SP) increased in response to several financial institutions failures and news of financial troubles, in particular those in November 1997. That is the result from the event study analysis. On the other hand, the result in this section shows that the long run relationship between the two indices has changed earlier than November 1997.

Next, we consider a direct test for structural change with a known break point. As figure4 shows, the sample period is divided in two sub-samples: the first half is from January 1994 to June 31, 1995, the latter half is from July 1, 1995 to April 30, 1999.

Consider the following DOLS, dynamic OLS estimation. The long run relationship between two indices is defined as:

(3.5) $$NINDEX_t = \mu + \gamma BINDEX_t + z_t$$

which is called SOLS, static OLS. By including not just the current change but also past and futures changes of the regressor, the OLS estimator of the cointegrating vector γ on this regression is referred to as the DOLS. The estimator is distinguished from the SOLS estimator based on the cointegrating regression without changes.

When the lag length is picked as 2 for required regularity conditions[9], the DOLS regression is as follows:

(3.6) $$\begin{aligned} NINDEX_t = \mu + \gamma BINDEX_t + \beta_0 \Delta BINDEX_t + \beta_1 \Delta BINDEX_{t+1} + \beta_2 \Delta BINDEX_{t+2} \\ + \beta_{-1} \Delta BINDEX_{t-1} + \beta_{-2} \Delta BINDEX_{t-2} + z_t \end{aligned}$$

where cointegrating vector γ is simply the SOLS estimator of γ. The shortcoming of SOLS is that the bias of the SOLS estimator can be large and that the asymptotic distribution of t value depends on nuisance parameters. The rescaled t and Wald statistics based on DOLS have the asymptotic normal and chi-squared distributions. Therefore, the estimator is asymptotically equivalent to other efficient estimators.

Table3-2 reports the parameter estimates by SOLS and DOLS for two

sub-samples. The estimates of γ based on the first half of the sample and the latter half very different so that the estimates are not stable over the sample. This finding suggests that the relationship of BINDEX and NINDEX has been broken around the end of June 1995.

The possibility could be easily tested by the Chow test of structural change, that is

$$\begin{aligned} NINDEX_t &= \mu + \gamma BINDEX_t + \delta_0 D_t + \delta_1 BINDEX_t D_t \\ &+ \beta_0 \Delta BINDEX_t + \beta_1 \Delta BINDEX_{t+1} + \beta_2 \Delta BINDEX_{t+2} + \beta_{-1} \Delta BINDEX_{t-1} \\ &+ \beta_{-2} \Delta BINDEX_{t-2} + z_t \end{aligned} \tag{3.7}$$

where D_t is a dummy variable whose value is 1 after June 30, 1995 and 0 otherwise. The Wald statistic for the null hypothesis that $\delta_0 = 0, \delta_1 = 0$ is asymptotically $\chi^2(2)$. The DOLS estimate of (3.7) is shown in Table3-3. Our test can reject the stability of parameters at the 1% size. The 1% significant Wald statistics support the view that the structural change occurred in the BINDEX and NINDEX cointegration relationship at the end of June 1995.

Insert Table 3

3.3. Changes in SP

In this subsection, we will investigate what kinds of news have caused the deviation between BINDEX and NINDEX. We will take several dummy variables to explain the changes in SP (the log difference between the two indices).

The list of dummy variables and expected signs are summarized as follows:

D1: the day after the announcement of major bankruptcies (+);

D2: the news on public funds for recapitalization of funds (-);

D3: seven days following the failures of financial institutions (+);

D4: from the start of the Diet discussions on LTCB to the announcement of nationalization (?);

D5: downgrading of any Japanese financial institutions (+);

D6: Any day that had news on the Daiwa incident during one month following its announcement (September 26, 1995) (+); and

D7: Any day that had news on punishment by the US regulators on the Daiwa Bank operations in the United States from the announcement to the U.S. decision to have the Daiwa withdraw from the United States (February 2, 1996). (+)

For D1 and D5, we use a two-day event window that includes the day of the announcement as well as the day after the announcement, in order to account for the fact that market participants may not have time to react for the announcement in the evening. For D1, D2, and D7, the Nihon Keizai Shinbun, newspaper, CD-ROM on news articles database, was consulted.

The following model is estimated for the above dummy variables:

$$(3.8) \qquad SP_t = \beta_0 + \beta_1 SP_{t-1} + \beta_2 JP_{t-1} + \beta_3 T + \sum_{i=1}^{7} \alpha_i D_i + \varepsilon_t$$

where SP_t is the bank stock price spread, $(\ln NINDEX_t - \ln BINDEX_t)$ on day t, JP_{t-1} is the Japan premium, $(TIBOR_{t-1} - LIBOR_{t-2})$, on day t-1, β_0 is the intercept coefficient, T is the time dummy variable and $\sum_{i=1}^{7} D_i$ is dummy variables explained above. Equation (3.8) is estimated by OLS since SP_t is shown to be a stationary variable (the unit root test is shown in Table 2).

Table 4 presents the results from estimating equation (3.8) over the period between January 4, 1994, and April 30, 1999. The news on the failures of financial institutions (D3) is shown to have significant impact on SP. As expected, failures have made market participants to believe that the health of financial institutions was worse than previously expected. While not statistically significant, the Diet discussion (D4) on the LTCB and a new framework for dealing with failing banks, as it dragged on, made SP to increase instead to decrease. The effect of downgrading (D5) did not have statistically significant effects, even though the sign was right, either because the Japanese investors who dominate the Tokyo stock market ignored the Moody's rating or because the downgrading was well anticipated in the pricing.

Insert Table 4.

4. Determinants of Japan premium

To determine what kinds of news have caused the increase in Japan Premium, especially whether the response of Japan Premium was based on the domestic news or other news from abroad, the following model is estimated:

$$JP_t = \beta_0 + \beta_1 JP_{t-1} + \beta_2 SP_{t-1} + \beta_3 T + \sum_{i=1}^{7} \alpha_i D_i + \varepsilon_t \qquad (4.1)$$

where JP_t is the Japan premium, $(TIBOR_t - LIBOR_{t-1})$, on day t, SP_{t-1} is the bank stock price spread, $(\ln NINDEX_{t-1} - \ln BINDEX_{t-1})$ on day t-1, β_0 is the intercept coefficient, T is the time dummy variable and $\sum_{i=1}^{7} D_i$ is the dummy variables listed in the previous subsection. The lagged endogenous variables SP_{t-1} and JP_{t-1} are ensured to be predetermined. There is no simultaneity problem in the model because of the time difference as is described in Table 8. Therefore, it can be investigated whether

SP made JP to increase. JP_t is also shown to be a stationary variable (the test result is in Table 2). Equation (4.1) is estimated by generalized method of moments (GMM) because the standard errors of the OLS regression based on the equation had serially correlated[10].

Table 5 presents the results from estimating equation (4.1) over the same period in the previous subsection. The lagged SP has a significant impact on JP. This evidence supports the idea that a decline in the bank stock index in relative to the general stock index has a significant impact on increasing the Japan premium. In other words, the evaluation of the Japanese banking industry which is determined in the domestic market has affected the level of the Japan premium.

The news on the Daiwa bank incident (D6) had a significant positive impact on the rise of JP, which is consistent with investors being uncertain about the transparency of Japanese banking information and about the effectiveness of the supervision system in Japan. Therefore the announcement on the incident increased in JP. Our result is different from that of Peek and Rosengren (2000), who used a one-day event window for Daiwa bank incident and didn't obtain any significant effect on the Japan premium. Rating downgrading news (D5) has a statistically significant effect on JP. Downgrading Japanese financial institutions as expected raised the Japan premium. Foreign banks increased a premium in response to more default risk of Japanese banks as indicated in the rating change. The news on Diet discussion about LTCB for temporarily nationalization (D4) did have a significant impact on the premium, probably because the negotiation took a longer-than-expected period and foreign banks (investors) were skeptical about effectiveness of the Japanese safety net. The Diet discussion ended with a new measure introducing effective measures to force

banks to quickly re-capitalize. However the long discussion reflected skepticism among investors and increased the Japan premium.

Insert Table 5.

The regression results presented above and in the preceding subsection show that the news about vulnerability and stabilization of Japanese financial systems have tended to widen the spread between the bank stock index and the general stock index. Although the banking spread in the stock markets, SP, has been affected by domestic news, the news that affected the Japan premium are sometimes different. The Japan premium tended to increase in response to the news that made international financial press, such as Daiwa bank incident in N.Y. and downgrading of Japanese financial institutions by foreign rating agencies. A dynamic causal relationship between SP and JP is also analyzed by the same results since the two equations, equation (3.8) and equation (4.1), are in the same form.

The lagged endogenous variable SP_{t-1} in the JP equation (in Table 5) is statistically significant, and based on simple t test, the bank stock index is said to Granger-cause the Japan premium. However, the lagged endogenous variable JP_{t-1} is not significant in the SP equation (in Table 4). Thus, the decline of the bank stock index in relative to the general stock index affects on the increase in Japan premium, but not vice versa. In this analysis, the t test is equivalent to the F test in VAR with one lag. In general, the number of lags in VAR system may be larger than one. We have examined the VAR system with two lags. But, the result was very similar to the one presented here.

5. VAR with 2 lags

In this subsection we present the results of F statistics and impulse response functions by VAR system with two lags. The two variables, SP and JP, are contemporaneous intra-day variables, so that they can be treated by a regular time series model. A vector autoregressive model will be used to test Granger causality. The VAR model can be written in the following form with 2 lags of the variables:

$$(5.1) \qquad \begin{bmatrix} JP_t \\ SP_t \end{bmatrix} = \begin{bmatrix} v_1 \\ v_2 \end{bmatrix} + \sum_{i=1}^{2} \begin{bmatrix} \pi_{11,i} & \pi_{12,i} \\ \pi_{21,i} & \pi_{22,\mathrm{i}} \end{bmatrix} \begin{bmatrix} JP_{t-i} \\ SP_{t-i} \end{bmatrix} + \begin{bmatrix} v_{1t} \\ v_{2t} \end{bmatrix}$$

where $\begin{bmatrix} \pi_{11,i} & \pi_{12,i} \\ \pi_{21,i} & \pi_{22,i} \end{bmatrix}$ is a matrix of VAR coefficients, and $\begin{bmatrix} v_{1t} \\ v_{2t} \end{bmatrix}$ is a vector of white noise process shocks to the model. In the model, SP is said to Granger-cause JP if lagged values of SP have explanatory power in a regression of JP.

Only F statistics in the above VAR for the sample period of January 1994 to April 1999 are shown in Table 6. The “SP lags” in the JP equation is the F statistics, which is significant, the bank stock index is said to Granger-cause the Japan premium. However, the “JP lags” is not significant in the SP equation. The causal relationship is not changed.

Figures4.1, 4.2, 4.3 and 4.4 display impulse response functions, with periods measured on the horizontal axis, and impulse shock on the vertical axis. The response of SP (JP) to an impulse in the other variable, JP (SP) in the system is investigated. We trace out the effect of one standard deviation exogenous shock to SP (JP) on JP (SP)[11]. Impulse response of JP to JP itself (figure5.1) is strong and persistent. Impulse response of SP to SP itself (figure5.4) is also strong and persistent. On the other hand, impulse response of JP to SP (figure5.2) is slightly increasing and persistent. An unexpected increase in the Japan Premium tends to lower Japanese banks’ stock prices in relative to other stock prices. Impulse response of SP to JP (figure5.3) is negative but

nearly zero which is consistent with a result that JP doesn't Granger-cause SP.

The bank spread in the stock market and the Japan premium both have contained important information to understand Japanese financial systems. They explain fragility of the financial systems. The joint analyses of the two indicators show that announcements which increased the bank stock spread, especially those after July 1995, also increased the Japan premium over time.

Insert Table 6.

Insert Figure4.

6. Concluding remarks

This paper investigates how financial weakness among Japanese banks were viewed by the market participants in Japan and abroad. Two indicators, the Japan premium (premium that Japanese banks had to pay over western banks when they borrow dollars in the interbank market) and the stock price index of the banking sector in Tokyo, were examined. How foreign and domestic market participants evaluate the net worth and default risk of Japanese bank is reflected in the two indicators, respectively. The relationship between the banking index and the index of general stock prices excluding banking index has changed is examined.

The Japan Premium that started to have increased in the summer of 1995 disappeared in April 1999 as western banks have increased credit lines with Japanese banks.The decline in the Japan Premium most likely reflects slow improvement of Japanese banks' credit ratings by two capital injection, and improved new regulatory system. The other indicator, the bank stock spread remains high even after JP has disappeared. Therefore it seems that Japanese financial crisis (high default risk) has

ended in April 1999,but profitability of Japanese banks (in relative to other sectors in the Japanese economy) remains low.

We presented how the news of bank failures were received by the stock market and found that bank failures in November 1997 brought down stock prices of other banks. Systemic risk of the banking sector was feared in that period. Stock prices of banks with low credit rating were especially hard hit. News on bank failure increased the spread between the bank stock index and the general stock index.

We also examined what kinds of news have caused the Japan premium and the deviation of two stock indices. Changes in the spread were influenced by the domestic news about vulnerability and stabilization of Japanese financial systems. However, changes in Japan premium were influenced by domestic news as well as news from abroad.

In order to formally show the deviation of bank and general stock indices, we calculated the correlation coefficient of those indices. The correlation coefficient smaller in the period when the deviation seems to widen gradually, so that we became inferred to find that structural relationship between the two indices have changed over time. We employed an econometric test that a structural break occurred at the end of June 1995.

News that affected Japan premium and the deviation of two stock indices were not identical. Based on the OLS regression, news on the failures of financial institutions were shown to have significant impacts on the spread of the two stock indices. In the same way, we found that the lagged spread of two indices had a significant impact on the Japan premium. Therefore it is true that the evaluation of the Japanese banking industry which is determined in the domestic market has

affected the level of the Japan premium. News of the Daiwa bank incident and news of bank downgrading were also shown to have significant impact on the Japan premium.

A causal relationship between the two indicators have been analyzed by VAR. The bank stock spread and the Japan premium both have contained important information with regard to financial system in Japan. The joint analysis has shown that announcements which have impact on the bank stock index increased the spread, then increased the Japan premium.

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Endnote

[1] Brewer, Genay, Hunter, and Kaufman (2000) came to our attention after we wrote the first draft of this paper.

[2] Monthly market valuations are taken from Statistics Monthly of the Tokyo Stock Exchange. The monthly figures are adjusted for daily figures by price index changes, assuming that the number of issued stocks do not change within that month. Any problem with this assumption is corrected within the month.

[3] One might ask whether divergence may be any way related to a regular business cycle of a recession or a recovery or a cyclical movement of general stock prices, rather than a peculiarity of the time. Hence, we will check whether movements of the two indices in the second half of the 1990s are in any way typical or atypical in the long run trend. Comparing monthly index of TOPIX and BINDEX from 1985 to 1999, one can confirm that the relationship has been stable between the two indices until the mid-1990s, over the business cycles and stock price cycles.

[4] The LIBOR is calculated by the British Bankers' Association as the average of the dollar interbank offer rate. From the beginning of our sample period until January 1999, there were three Japanese banks, including the Bank of Tokyo Mitsubishi, in the 16 banks that are samples for the LIBOR. Since highest four and lowest four banks were eliminated from the average calculation of the LIBOR, it can be safely assumed that the LIBOR is not influenced by the Japan premium. After January 1999, only the Bank of Tokyo Mitsubishi is included in the LIBOR calculation samples, hence there is no contamination of Japan premium in the LIBOR.

[5] Alternatively, the Japan premium can be measured as the borrowing rates of Japanese banks in London vs. the borrowing rates of western banks in London. However, we do not have access to the data of individual banks' borrowing costs. Therefore, we took the TIBOR minus LIBOR. In essence, our approach produces a premium very similar to that one by the alternative approach.

[6] Earlier in 1998, a new law was passed to make it possible for the authorities to nationalize a very weak bank.

[7] Perron (1989) was the first to develop a test of structural changes in the nonstationary series. Andrews (1993) showed a test for a case where the timing of structural change is unknown. Quintos (1997) showed a similar test in the Error Correction Model. Seo has extended Andrews and Quintos and made the calculation easier.

[8] Empirical work in this section is done in Gauss, our program is based on the one which is given by Byeongseon Seo.

[9] Lag length is made to increase with the sample size T at a rate slower than $T^{1/3}$. The required conditions are in Saikkonen(1991).

[10] The OLS standard errors of equation (4.1) showed serial correlation by White's test. The OLS variance of the same equation revealed heteroskedasticity-correlated standard errors by Breusch-Godfrey test. Since the orthogonality condition between the

error term and regressors is rejected, we apply GMM to the equation. For the weighting matrix, initial values are obtained by 3SLS and the procedure by Newey-West(1987) weighting scheme is used with assuming 5 period autocorrelation.

[11] If the variables have different scales it is useful to consider innovations of one standard deviation rather than unit shocks.

Table1:Reactions of bank stock prices to bank failure announcement.

Failed Financial Institutions (Reason of Failure)	Default Date		BINDEX	NKAVE	Failed Institution	Baa3	Baa2	Yamaichi Securities	Daiwa Securities
Hyogo Bank Failure(Announce of giving up rebuilding)	1995/8/30	10days before	3.84	0.13	-4.43	3.88	4.05		
		5days before	-0.10	-2.22	3.94	0.95	-1.90		
		3days before	-0.77	-2.01	3.94	0.48	-0.95		
		3days later	-1.48	-2.03	-39.41	-4.74	-2.31		
		5days later	-2.76	-2.74	-59.61	-5.85	-8.01		
		10days later	1.88	2.74	-59.11	-2.57	3.06		
Taiheiyo Bank Failure (Agreement of rebuilding plan)	1996/3/29	10days before	-4.38	-6.89	-0.69	-1.77	-6.81		
		5days before	-1.69	-2.99	-1.03	-2.81	-3.07		
		3days before	-0.80	-1.41	2.41	-1.71	-0.41		
		3days later	-1.62	-0.48	-44.67	-2.57	-3.91		
		5days later	-1.06	0.68	-65.29	-1.94	-2.34		
		10days later	-0.22	0.50	-69.16	-1.19	-2.19		
Hanwa Bank	1996/11/21	10days before	0.44	-2.02	5.98	0.40	0.28		
		5days before	0.25	-0.77	8.37	-1.09	0.28		
		3days before	-0.74	-1.89	5.98	-0.29	-0.98		
		3days later	0.09	0.97	-39.84	-3.16	-0.01		
		5days later	-0.65	-0.87	-60.96	-4.32	-2.34		
		10days later	-3.63	-1.31	-61.75	-2.47	-5.93		
Sanyo Securities Firm Apply for Corporation Reorganization	1997/11/3	10days before	10.51	4.83	-12.00	1.84	9.11	26.01	11.29
		5days before	2.90	3.35	-18.67	2.96	1.54	28.25	-0.30
		3days before	2.64	2.30	-13.33	4.57	0.53	3.59	4.90
		3days later	-4.48	0.20	-64.00	-7.31	-8.50	-21.52	-7.28
		5days later	-12.18	-4.64	-65.33	-7.62	-17.85	4.04	-27.34
		10days later	-12.94	-8.20	-64.00	-16.18	-31.81	-21.52	-25.71
Hokkaido Takushoku Bank Failuere	1997/11/17	10days before	12.81	8.36	16.67	23.59	35.48		
		5days before	0.85	3.73	7.69	7.13	14.98		
		3days before	1.79	2.14	5.13	4.28	13.09		
		3days later	-6.70	-2.54	-41.03	-3.24	-17.12		
		5days later	-7.70	-5.22	-41.03	-10.19	-29.24		
		10days later	-0.85	1.12	-42.31	-11.53	-24.68		
Yamaichi Securities Firm Failure	1997/11/22	10days before	-12.12	-6.53	35.03	4.54	15.63	3.88	
		5days before	-1.42	-2.79	3.82	1.59	8.54	1.55	
		3days before	-7.03	-5.60	-23.57	-8.50	2.32	-3.57	
		3days later	3.10	4.69	-32.48	-18.60	-22.15	-20.93	
		5days later	10.34	7.26	-31.85	0.81	10.84	-12.56	
		10days later	3.04	1.68	-32.48	-5.81	3.33	-24.96	
Long-Term Credit Bank of Japan Nationalization	1998/9/11	10days before	7.11	5.39	-3.70	0.85	2.44		
		5days before	1.68	4.48	0.00	-0.75	-4.27		
		3days before	2.89	1.78	0.00	3.42	10.37		
		3days later	-1.50	-2.65	-29.63	-4.23	-6.10		
		5days later	-4.60	-4.53	-31.48	-7.90	-9.76		
		10days later	-6.88	-2.92	-44.44	-6.77	-17.07		
Nippon Credit Bank Nationalization	1998/12/12	10days before	-1.45	-3.21	-9.20	-0.30	-6.14		
		5days before	0.01	2.14	8.05	1.94	1.56		
		3days before	2.06	3.54	9.20	1.96	-0.43		
		3days later	-3.45	-0.10	0.00	-9.12	-2.04		
		5days later	-2.12	0.56	0.00	-9.69	-4.11		
		10days later	-7.31	-2.70	0.00	-12.75	14.64		

Figure1:Three Indices (BINDEX(right scale), TOPIX and NINDEX(left scale))

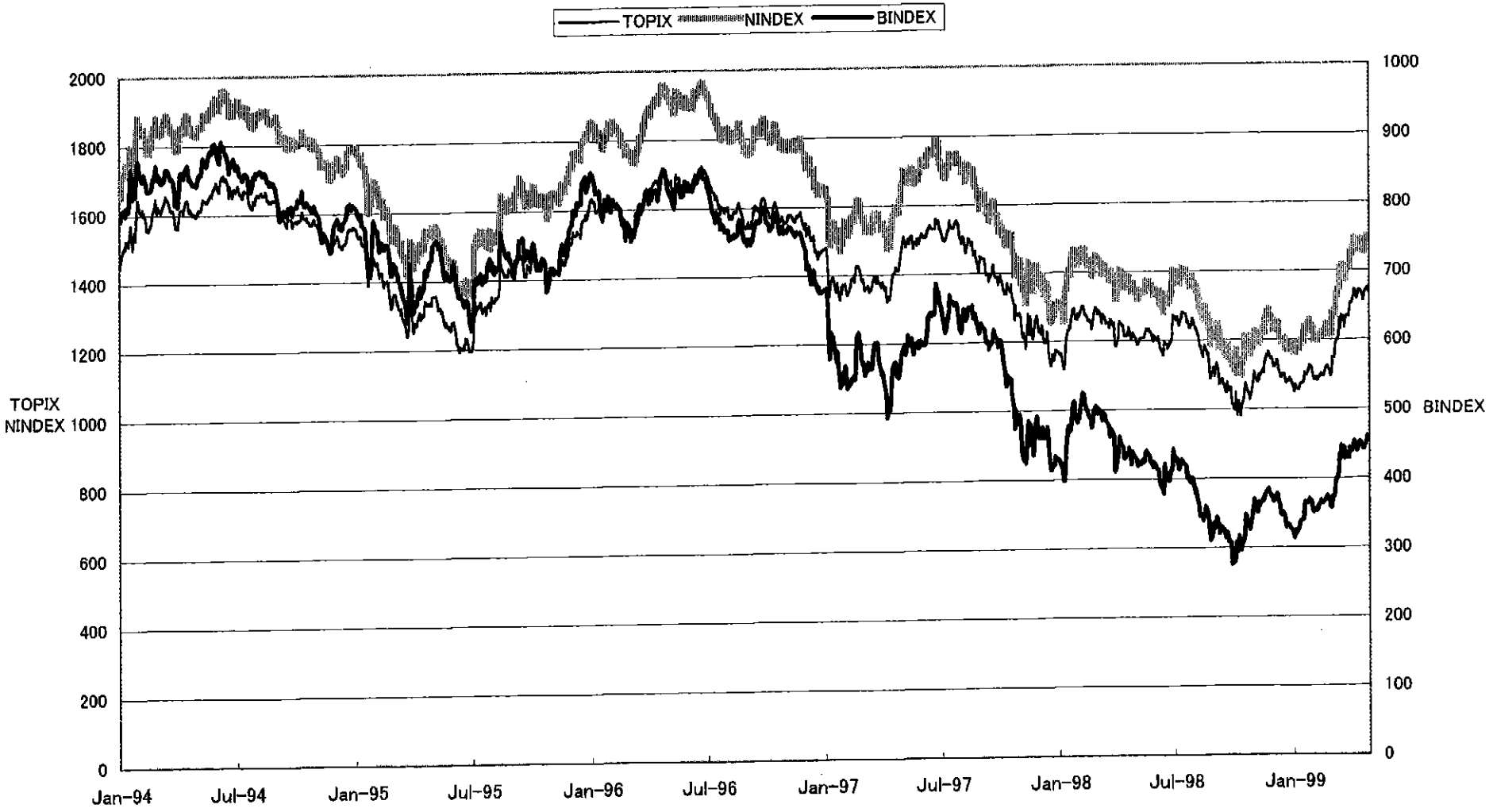


Figure2: Japan Premium(in basis points, left scale,thin line) and Bank Stock Spread(the difference in the BINDEX and NINDEX, right scale, bold line. Both are normalized as 100 on January 4, 1994)

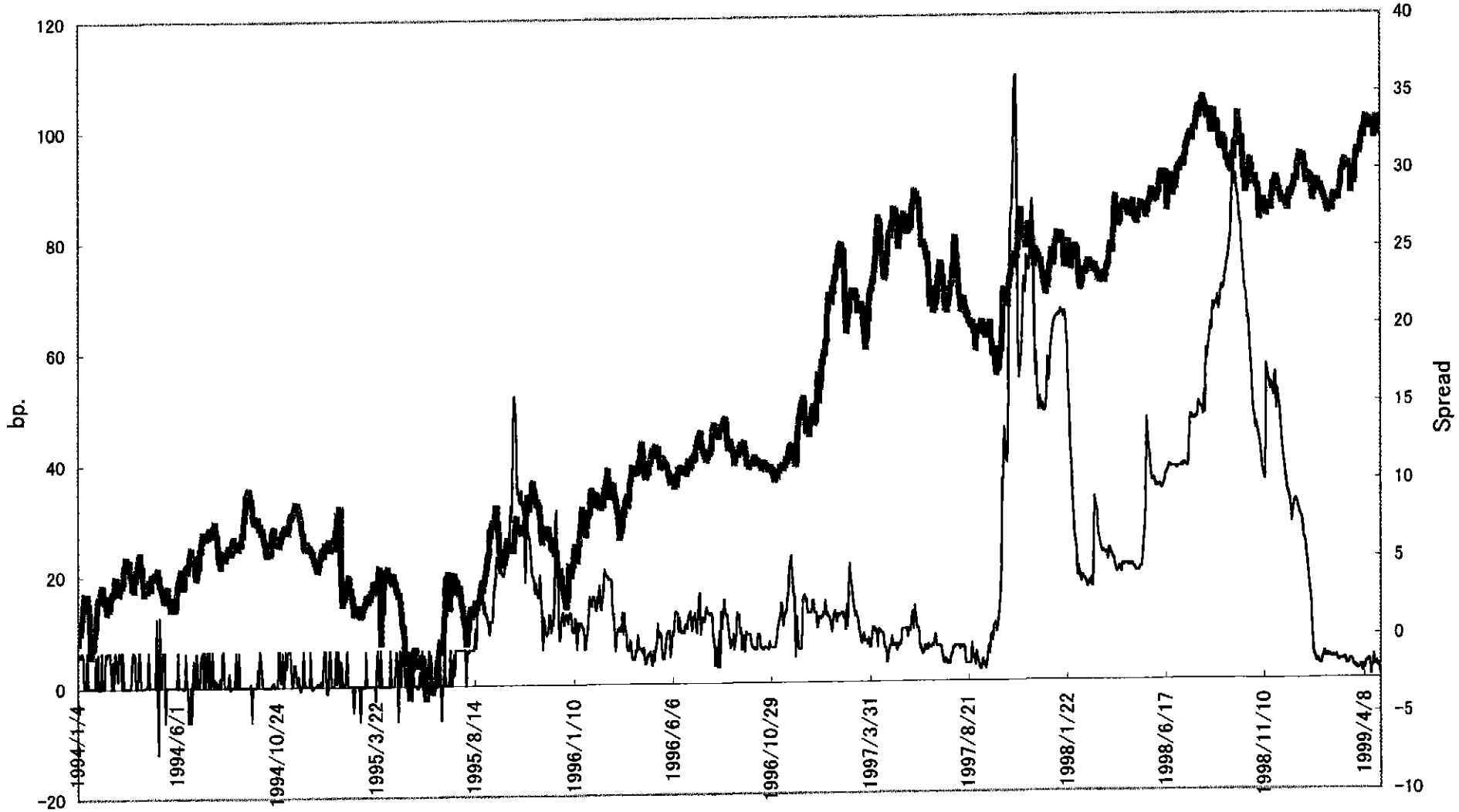


Figure **3.** Stability Test of the Stock Index: 1994/1/4–1999/4/30

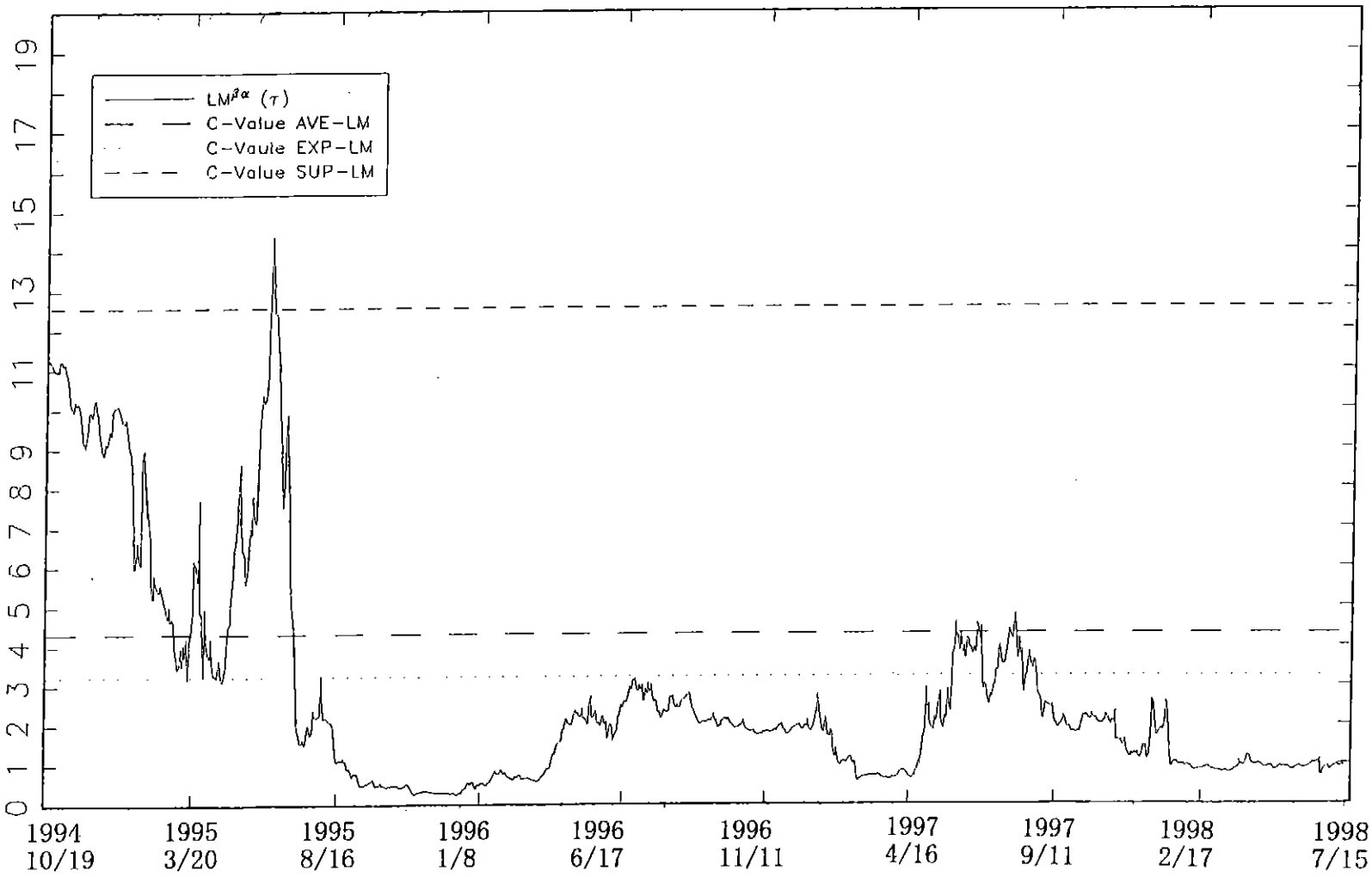


Fig.4-1 Response of JP to JP

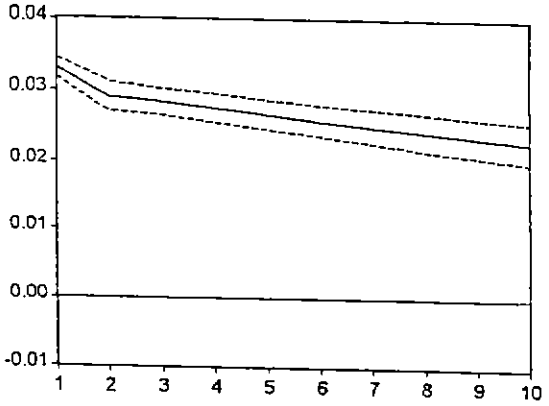


Fig.4-2 Response of JP to SP

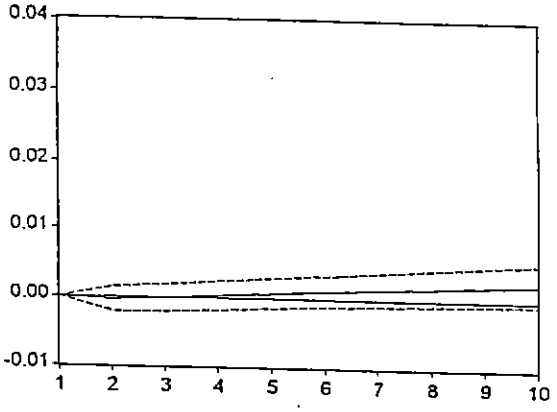


Fig.4-3 Response of SP to JP

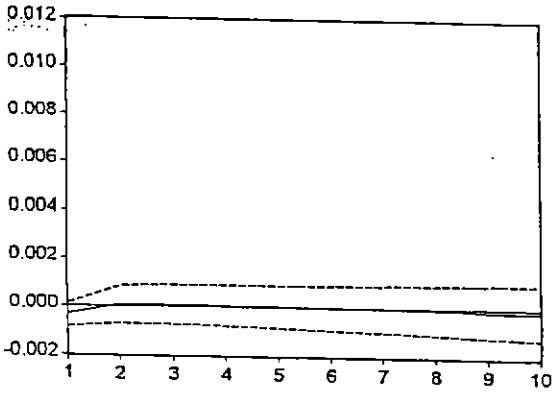


Fig.4-4 Response of SP to SP

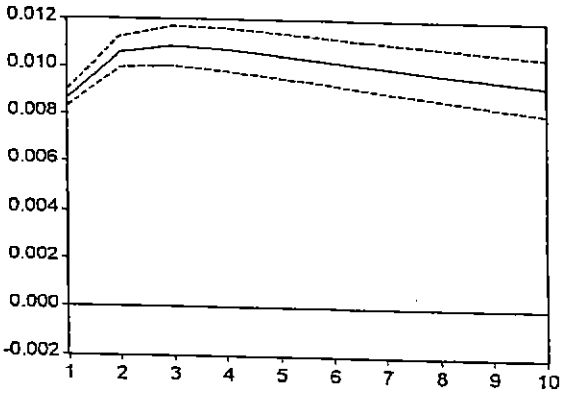


Table2 Unit Root Test and Cointegration Test

Panel A: a model with intercept and a trend				
Variable	lag	AIC	SIC	ADF statistics
NINDEX	1	5.765	5.770	-2.287
BINDEX	1	4.593	4.597	-2.747
SP	1	4.253	4.257	-3.076
JP	1	3.023	3.027	-3.750**
Panel B: a model with intercept				
NINDEX	1	5.768	5.772	-1.462
BINDEX	1	4.598	4.602	-1.028
SP	1	4.254	4.258	-3.014**
JP	1	3.026	3.031	3.158**
Panel C: augmented Dickey-Fuller test based on residual				
	1	4.254	4.258	-2.960

For panelA, the 5% and 10% critical values are -3.41 and -3.12 respectively by Hamilton(1994)Table B.6, Case4.
For panelB, the 5% and 10% critical values are -2.86 and -2.57 respectively by Hamilton(1994)Table B.6, Case2.
For panelC, the 5% and 10% critical values are -3.80 and -3.52 respectively by Hamilton(1994)Table B.9, Case3.
SP is the spread, log(NINDEX)-log(BINDEX), JP is the Japan Premium, (TIBOR-L IBOR).
Asterisks ** denote the significance at 5% level.

Table3-1 Results of Error Correction Model

PanelA: adjustment and vector		
Variable	α (adjustment vector)	β (cointegration vector)
NINDEX	-0.011	1
s.e.	(0.006)	
BINDEX	-0.004	-1.065
s.e.	(5.453)	(0.227)
PanelB: tests for parameter stability, joint vector β α		
	LMstatistics	5%Critical value
AveLM$_{\beta\alpha}$	2.763	4.320
ExpLM$_{\beta\alpha}$	3.099	3.240
SupLM$_{\beta\alpha}$	14.376*	12.550

Asterisk * denote the significance at 5% level.

Table3-2 SOLS and DOLS in two subsamples

γ	94/1/4-95/6/30	95/7/1-99/4/30
SOLS	2.354	1.279
DOLS	2.388**	1.278**
rescaled s.e.	-0.035	-0.012

Asterisk ** denote the significance at 1% level.

Table3-3 Test for Structural Change

	γ	δ 0	δ 1	Wald statistics
DOLS	2.363**	950.01**	-1.085**	8.349*
rescaled s.e.	-0.048	39.24	-0.049	

Asterisks *, ** denote, respectively, the significance at 5% and 1% levels.

The 5% and 1% critical values of χ^2 are 5.99 and 9.21 respectively.

Table4 OLS Estimation of the SP

Const	Time	JP_{t-1}	SP_{t-1}	D1	D2	D3	D4	D5	D6	D7	DW-h	R2
0.013**	0.00001**	0.984**	−0.001	0.0004	0.0001	0.0025**	0.0007	0.0007	0.0010	0.0021	8.85	0.997
(0.0042)	(0.000003)	(0.0056)	(0.0018)	(0.0016)	(0.0009)	(0.0012)	(0.0019)	(0.0019)	(0.0021)	(0.0023)		

Asterisks ** denote significance at 1% levels.
Parenthesis is standard error.

Table5 GMM Estimation of the JP

Const	Time	SP_{t-1}	JP_{t-1}	D1	D2	D3	D4	D5	D6	D7	R2
−0.052***	−0.00002	0.939***	0.070***	0.012	0.002	0.017**	0.015**	0.031**	0.015*	0.003	0.949
(0.0162)	(0.00002)	(0.009)	(0.029)	(0.072)	(0.005)	(00073)	(0.0074)	(0.013)	(0.0081)	(0.0073)	

SP_{t-1}, JP_{t-1} denote ($logTOPIX_{t-1}$−$logBINDEX_{t-1}$) and (($TIBOR_{t-1}$)−($LIBOR_{t-2}$)) respectively.

Asterisks *, **,*** denote, respectively, the significance at 10%, 5% and 1% levels.

Parenthesis is standard error.

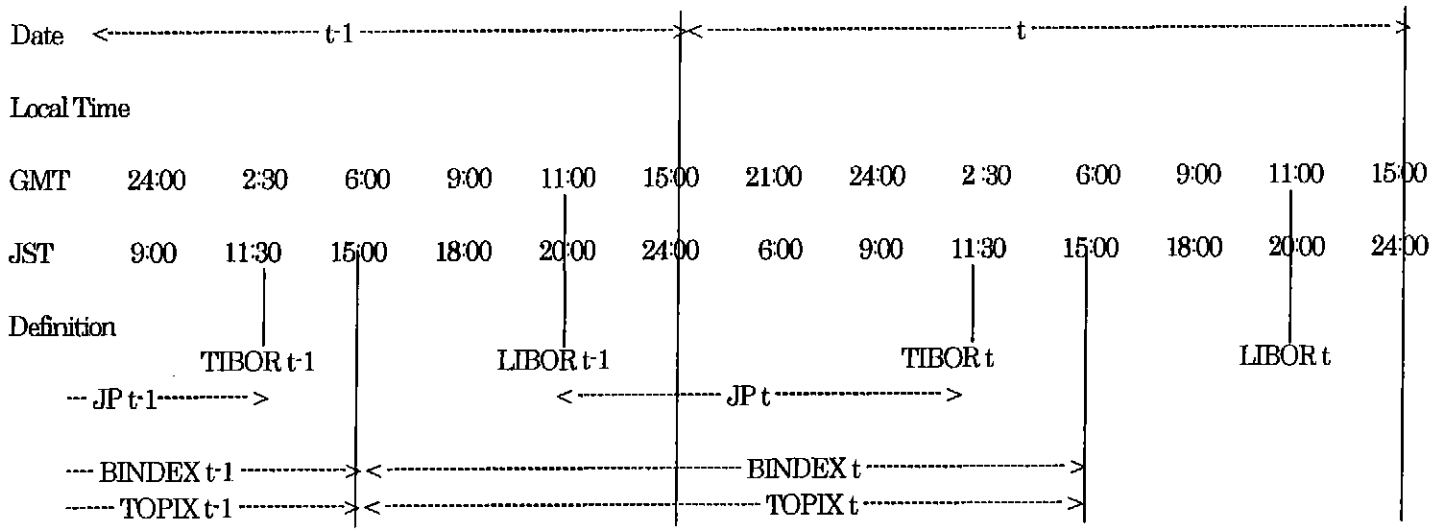
Variance matrix in the GMM based on 3SLS for the initial value is estimated by Newly−West method, assuming 5 auto−correlation lags.

Table6 Fstatistics in VAR with 2 lags 1994/1/4-1999/4/30

	JP	SP
JP lags	5802.15**	0.213
SP lags	6.312**	19922.36**

The critical values are 3.00 and 4.61 respectively at the 5% and 1% levels by $F(2,\infty)$.
Asterisks ** denote the significance at 1% levels.

Appendix Time table



Notation:
GMT = Greenwich Mean time
JST = Japan Standard Time
TIBOR = Tokyo Inter-bank Offered Rate
LIBOR = London Inter-bank Offered Rate
JP = Japan Premium
BINDEX = Bank stock Index

Timing:
At JST 11:30 A.M. TIBOR is decided on the interest rate for 3-month yen deposits offered to banks in the Tokyo interbank market on the last trading day of the contract.
At GMT 11:00 A.M. LIBOR is determined on sixteen BBA designated banks provide quotes which reflect their perception of the rate at which U.S. dollar deposits are generally available to the marketplace.
Tokyo Stock Exchange opens at 9:00 A.M., trades until 11:00 A.M., and then breaks for lunch until 1:00 P.M. The afternoon session continues until 3:00 P.M. and the indices are decided on the closed stock price.