Financial Turbulence and the Japanese Main Bank Relationship

Mark M. Spiegel
Federal Reserve Bank of San Francisco
and
Nobuyoshi Yamori[1]
Nagoya University

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Abstract

The Japanese "main bank" relationship, under which a bank holds equity in a firm and plays a leading role in its decision-making and financing, may leave a firm dependent on its main bank for financing due its information advantage over other potential lenders. While alternative sources of finance may mitigate this dependency, it may resurface during episodes of financial turbulence.

We examine the sensitivity of returns on portfolios of Japanese firm equity to the returns of their main banks using a three-factor arbitrage-pricing model. We find no significant dependence on main bank returns when coefficient values are constrained to remain constant over the entire sample. However, the data strongly suggest a structural break subsequent to the last quarter of 1997, a turbulent period for Japanese financial markets. When a structural break is introduced, main bank sensitivity increases after the break, usually to significantly positive levels.

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1. Introduction

There is a large literature discussing the nature of the Japanese "main bank" system, under which most Japanese firms maintain a close relationship with a single commercial bank. The characteristics of this relationship are that a firm's main bank is usually a principal shareholder of the firm, and its primary lender. In addition, the firm's main bank usually plays an important role in monitoring the firm and assisting it during periods of crisis.[2]

Because of these close ties, the main bank is likely to have superior information about the firm than other potential lenders [Sheard (1994)]. For example, the main bank can obtain information concerning a firm's financial position by observing the flows of funds into and out of the firm's settlement account in its main bank [Aoki, et al (1994)].

The net impact on the firm of this information asymmetry is uncertain. On one hand, there is some evidence that this information advantage can ease a firm's liquidity constraints [e.g. Hoshi, Kashyap and Scharfstein (1991)]. On the other hand, Weinstein and Yafeh (1998) find that entities with strong main bank relationships pay higher net interest rates.[3] Nevertheless, this evidence is insufficient to conclude that entities are worse off under main bank relationships. If a main bank relationship enhances firm liquidity during periods of firm distress or low aggregate liquidity levels, the relationship may be interpreted as the main bank insuring its client firms. In this context, the higher overall average rates can be interpreted as insurance premia.

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[2] See Aoki, et al (1994) for an introduction to the Japanese main bank system.
[3] The evidence concerning the impact of the strength of relationship banking in the United States tends to go in the other direction. Measuring relationship banking strength by the duration of a bank-borrower relationship, Peterson and Rajan (1994) found no significant relationship between between relationship strength and lending terms, while Berger and Udell (1995) find a negative relationship.

However, dependency on an individual bank may have adverse consequences if that bank becomes reluctant or unable to extend credit. Because of its information advantages, main banks are believed to carry the primary monitoring duties towards their entities, while other potential lenders typically follow the main bank's lead in assessing the creditworthiness of a potential borrower [Aoki (1994)]. Consequently, firms known to have a close relationship with a single main bank will have difficulty raising funds from other sources. Other potential lenders will hold some positive probability that the firm is unable to obtain funds from its main bank because the main bank possesses adverse information about the firm.

There is some evidence that such a channel operated in Japan. Gibson (1995) found that investment decisions of firms with financially distressed main banks were more sensitive to firm liquidity conditions. Kang and Stulz (2000) demonstrate that firms which were more dependent on bank financing experienced lower returns in the first three years of the 1990's, a period of credit contraction for Japan. Yamori and Murakami (1999) demonstrate that the failure of the Hokkaido Takushoku Bank led to larger abnormal stock returns for firms with closer relationships to the bank.

However, there has been speculation that financial liberalization has diminished the dependence of firms on their main banks. Since the mid-1970's firms have enjoyed greater flexibility in their financing decisions, particularly due to their heightened ability to issue bonds directly [Aoki (1994)]. As such, they are less reliant on main bank borrowing. Weinstein and Yafeh (1998) find that differences identified in capitalization between main bank client firms and non-client firms disappears in the 1980s.

In this paper, we examine whether firms are still dependent on their main banks. We examine the sensitivity of equity values of an equally-weighted portfolio of main bank client firms to changes in the equity values of their main bank. We look at a three-factor model of bank asset returns in which, in addition to interest rates and the return on the market portfolio, the client firms are sensitive to the returns on their main bank.

Our hypothesis is that the importance of a main bank relationship is likely to change over time. Holding firm financial health constant, a firm may be less dependent on its main bank for funding when credit is plentiful. When banks are reluctant to lend in general, however, a firm that is unable to obtain funds from its main bank may find even worse prospects from other potential lenders. As such, firms with main bank relationships may be even more sensitive to the condition of their main bank during periods of financial turmoil. Moreover, investigations that constrain the coefficients to be constant over time may lead to false inferences.

The main bank relationship is also likely to be affected by changes in average levels of financial fragility among firms. Main banks usually organize financial rescue packages when firms face financial difficulties. Moreover, main banks usually bear more than a proportional share of the losses in these rescue packages. As a result, if a firm's main bank is weak, the probability of its rescue in the event of financial turmoil is reduced. For example, in the recent Sogo failure, IBJ offered to bear large losses to encourage other banks to agree on the rescue plan. In contrast, the weakness of Fuji Bank may have played a role in the failure of Yamaichi Securities.

The financial strength of the main bank is also likely to be relevant. Firms may be sensitive to their main bank's returns because changes in the underlying position of their main bank may affect its lending practices. This effect should be stronger the weaker is the main bank, as financially stronger banks are better placed to weather bad news without aggressively changing their lending strategy.

We first examine the three-factor model constraining coefficients to be constant for the duration of the sample period. Our results suggest that the returns to firms over the 1990s are negatively correlated with the returns on their main banks. These results suggest that the relationship between firms and their main banks are “zero-sum,” i.e. that good news for firms’ creditors represented bad news for their client banks.

However, we then explicitly introduce the possibility of a structural break in our specification, associated with the banking crisis that hit Japan with the rash of bank failures in the middle of our sample. Our hypothesis is that the insurance role of the main bank relationship would be observable during episodes of financial turbulence when credit was scarce. We first consider three historical events as potential break dates, and then use Andrews’ (1993) method for testing for structural change when the break date is unknown.

The first historical break date we consider is the failure of Cosmo Credit Corporation on July 31, 1995. Commercial banks bore a large share of the burden of the Cosmo Credit Cooperative’s failure, as well as those of Kizu Credit Corporation and Hyogo Bank in August. Peek and Rosengren (1998) note that the “Japan Premium,” under which Japanese banks faced additional costs of funds relative to European and United States banks, began shortly after these failures were revealed.[4]

The second historical break date we consider is the failure of the Hanwa Bank on November 21, 1996. The failure of Hanwa Bank, a second regional bank, represented a regulatory watershed because the Ministry of Finance did not attempt to find a rescuing bank, as had been the prevailing practice under the Japanese convoy system.[5] The Deposit Insurance Corporation instead assumed Hanwa's liabilities and closed the bank.

The third historical break date considered is the failure of Yamaichi Securities on November 25, 1997. Yamaichi's failure was significant not only because it was the first failure by one of the "big four" securities companies, but also because it disclosed that Yamaichi was hiding 200 billion yen in losses. This increased suspicion about the quality of assets in Japan's financial system. The failure of Hokkaido Takushoku, Japan's first "city bank" failure, also took place in November of 1997.

While all of these dates seem like plausible candidates for a structural break in the main bank relationship, the truth is that we are quite uncertain about the date of the structural change. Andrews (1993) provides a method of dealing with the problem of unknown change point when one is willing to limit the potential change points to a subset of the sample. We proceed by searching for a structural break for the period starting in mid-July of 1995 and ending at the end of 1997. The methodology used, which is described in more detail below, entails conducting an F-test for every possible break date in the sub-sample and then choosing the date with the maximum F value as the candidate date for a structural break. The confidence intervals for the F-test are then explicitly designed to account for manner in which the candidate break date was chosen.

Our results suggest evidence of a structural break in the sensitivity of portfolio equity values for all of the main bank portfolios we study using both historical break dates and the Andrews method. The coefficient on main bank equity after the structural

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[4] See Cargill, Hutchison and Ito (1997), for details on these financial institution failures.
[5] See Spiegel (2000) for details on the Japanese convoy system.

break, the period in the sample that we would consider more volatile, is consistently higher than that before the structural break, again regardless of the method used to time the structural break. In addition, all of the entity portfolios except the Sanwa Bank and Sumitomo Bank portfolios are shown to be positively dependent on main bank equity values at statistically significant levels after the break. The relative lack of significance of the Sumitomo and Sanwa banks is not surprising, given that these are the main banks in the sample with the greatest financial strength. Finally, using the Andrews method, all of the main bank portfolios in our sample suggest the fourth quarter of 1997 as the date of the structural break.

These results are shown to be robust to a number of sensitivity tests. First, because main banks are exposed to their client firms to some degree, both as equity holders and in their role as principal firm creditors, the issue of simultaneity arises in our specifications. To address this issue, we instrument for main bank returns using the returns of other banks in the system as our instruments. The intuition behind this specification is that main bank returns will be dependent on the returns of other banks because of news relevant to Japanese banks. As these other banks are not, by definition, as exposed to the main bank's client firms as their main bank, their returns are valid as instruments.

Our instrumental variable results are quite similar to those obtained using ordinary least squares estimation. As before, we find evidence of a structural break in the sensitivity of portfolio equity values for all of the main bank portfolios. In addition, the coefficient on main bank equity after the structural break is again consistently higher than that before the structural break.

However, there are a few differences. We now find that the dependence of the Dai-ichi Kangyo portfolio on its main bank's returns is also insignificant after the break. After Sumitomo and Sanwa Bank, Dai-Ichi Kangyo is in the next strongest category, so its relative lack of robustness is in keeping with the notion that sensitivity to main bank returns should be greatest for the weakest banks in the sample. The remaining majority of main bank portfolios are positive and significant as before.

Second, the instrumental variables results are not as uniform in their timing of the structural break. While three of the main bank portfolios again find the structural break in the fourth quarter of 1997, other banks' results suggest the beginning of 1997, or some time in 1996, as the date of the structural break.

We also examine the robustness of our results to the introduction of a Japanese banking index to our specification. It is possible that the estimated sensitivity of the firms to their main bank returns may simply reflect sensitivity to news about Japan's banking system, rather than news specific to its main bank. To test for this possibility, we examine the robustness of our results to the inclusion of this additional factor using both ordinary least squares and instrumental variables estimation methods.

The results for this alternative specification also support our basic hypotheses. All of the specifications, regardless of the method used to identify the break date, show evidence of a structural break in the data. Moreover, a majority of main banks studied still demonstrate a positive dependence on the returns of their main bank after the break as well as an increase in their main bank coefficient. Again, the financially weaker banks in the sample display the greatest robustness.

The remainder of this paper is divided into four sections. Section 2 describes the data set and introduces the methodology used in the paper. Section 3 describes the basic estimation results. Section 4 discusses the robustness of our results to instrumental variables estimation and to the inclusion of a bank index factor. Section 5 concludes.

2. Methodology

2.1 Data

We identify main bank relationships by choosing firms whose largest shareholder is one of a group of Japanese "city banks," or the Industrial Bank of Japan. City banks and Long-Term Credit Banks have long been the primary financial intermediaries associated with main bank activity in Japan.

Although there were 13 city banks and 3 long-term credit banks in 1988, we dropped banks that experienced large mergers or experienced bankruptcy during our sample period. Banks excluded due to merger include Mitsui Bank and Taiyo Kobe Bank, which were merged into Sakura Bank in 1990, Kyowa Bank and Saitama Bank, which were merged into Asahi Bank in 1991, and Mitsubishi Bank and Bank of Tokyo, which were merged into Bank of Tokyo-Mitsubishi in 1996. Banks excluded due to failure include Hokkaido Takushoku Bank, which failed in November 1997, Long-Term Credit Bank of Japan which was nationalized in October 1998, and Nippon Credit, which was nationalized in December 1998.

The main banks used in our study are then Sumitomo, Sanwa, Dai-ichi Kangyo, Fuji, Tokai, Daiwa, and the Industrial Bank of Japan (IBJ). Using data from *Japanese*

Companies Quarterly, Summer 1999, we chose firms whose largest shareholder was one of the above main banks.

Other methods for identifying main banks have been used in the literature. For example, Gibson (1995) used questionnaire data from Toyo-Keizai Shinposya to identify the identity of a firm's main bank. Firms were asked to list the banks that they use. Main banks are identified as banks which are listed first, as the convention is that firms list first the bank with which they maintain the closest relationship.

A difficulty with this methodology is that it exaggerates the prevalence of main-bank relationships, because all firms have main bank relationships by definition. In contrast, our identification methodology may under-identify the number of main bank relationships, because banks are restricted to hold no more than 5% equity shares in firms due to the anti-trust regulation. Nevertheless, for firms categorized by both methods, Gibson (1995) found that the identification of firm main banks was not sensitive to the methodology chosen. Firms were identified as having the same main banks under both methods 95% of the time.[6]

Our final sample consists of 82 entities that are affiliated with seven main banks. The summary statistics for the sample are shown in Table 1. While main banks are identified on the basis of end-of-sample equity shares, it can be seen that the share of

[6] Gibson also considered the method of identifying a firm as a client of a main bank if an employee of the bank sits on the firm's board of directors. This method also matched the one used in our study 95 percent of the time. Horiuchi, et al (1988) treat a company as a client of a particular main bank when it is listed by the Economic Research Association (Keizai Chosa Kyogikai) as part of that bank's financial group.

financing the firms receive from their main banks are relatively stable over the sample, indicating stability in the main bank relationship.

Bank financial strength is also identified using Moody's rating for long-term deposits in 1998. It can be seen that the strongest main banks in the sample are Sanwa and Sumitomo Banks, earning an A1 and A2 rating respectively. Dai-Ichi Kangyo and IBJ are the next strongest banks, earning an A3 rating. The remaining banks in the sample, Fuji, Tokai and Daiwa receive weaker ratings.

Our sample consists of daily data from 1/4/88 to 12/30/98, or 2741 observations per firm.[7] We dropped firms that were thinly traded, defined as having four consecutive trading days of no trading. Individual days with no recorded trade are recorded as having no price movements on that day.

2.2 Empirical specification

We consider the following three-factor arbitrage-pricing model

$$\widetilde{R}_t = c_j + \beta_i i_t + \beta_m R_{m,t} + \beta_{mb} R_{mb,t} + \varepsilon_t \quad (1)$$

where $\widetilde{R}_t$ represents the return on the equity of a portfolio of entities, defined as the log difference in equity values, c_j is a constant term, i_t represents the interest rate, measured by the overnight call rate, $R_{m,t}$ represents the return on the market portfolio, $R_{mb,t}$ represents the return on the entity's main bank, and ε_t represents an i.i.d. disturbance term.

[7] One observation is used to calculate daily returns.

Under the null hypothesis of no structural change, c, β_i, β_m, and β_{mb} will be equal across the subgroups identified below. Alternatively, given a structural break at some interior date t^*, we allow $c = c$ if $t \le t^*$, where t^*, $c = c'$ otherwise; $\beta_k = \beta_k$ if $t \le t^*$, $\beta_k = \beta_k'$ otherwise $(k = i, m, mb)$.

We therefore proceed by first estimating equation (1) over the entire sample by ordinary least squares. We then split the sample according to the structural break date t^* and estimate the two sub-samples separately.

3. Results

3.1 No structural Break

Estimation results with no structural break for portfolios of entities sharing the same main bank are reported in Table 2. The results appear to confirm the contention that a firm's interests are not necessarily in line with those of its main bank. The estimated coefficient on main bank returns is negative and significant at the five-percent level for all of the main bank groups studied except Daiwa and Fuji Bank, which are insignificant.

In contrast, the coefficient estimate on the market beta is positive and significant at the five-percent level. Interestingly, the coefficient estimate of the market beta is above one for all main bank portfolios in the study. This suggests that main bank relationships are most prevalent among high market beta firms. The interest rate variable is insignificant for all of the main bank portfolios in the study except IBJ, which is positive and significant at a five percent confidence level.

Finding a negative coefficient on the returns to the main bank is not necessarily inconsistent with the notion that the main bank provides liquidity services to its entities. The market is also pricing news concerning the division of the rents associated with main bank activity between the main bank and its client firm. Holding these rents constant, good news for the main bank may represent bad news for its client firms. This can explain the overall negative coefficient found for most of the main bank portfolios for the entire sample.

However, in times of financial distress, we would expect the coefficient on the main bank return to become more positive. During turbulent periods, the firms who enjoy main bank affiliation will be more dependent on their main bank for financing. Positive news for the main bank may then reflect positively on both the main bank's ability and willingness to extend funds to its client firms. We next turn to the investigation of such a relationship among Japanese banks in the turbulent latter portion of the 1990s.

3.2 Historical Break Dates

To investigate the change in sensitivity of firm equity values to main bank returns during turbulent periods, we divide the sample in two. We first use historical events as dates in which to divide the sample. The three historical break dates considered are the Cosmo Credit Corporation failure, which occurred on July 31, 1995, the Hanwa bank failure, which occurred on November 21, 1996, and the Yamaichi Securities failure, which occurred on November 25, 1997.

The results are shown in Table 3. β_{mb} represents the estimated coefficient on main bank returns prior to the structural break, while β'_{mb} represents the estimated coefficient on main bank returns after the structural break.

The F-test results show strong evidence of a structural break in the factors determining main bank equity values for all main bank portfolios and all historical break dates. The F-tests reported use the standard confidence intervals, which maintains the assumption that the posited break dates are not subject to pre-testing bias. We deal with issues associated with pre-testing explicitly below.

In addition, all of the main banks studied also show a significant increase in the main bank coefficient after the structural break for the first two break dates. For the Yamaichi Securities failure, all the main banks except Sumitomo Bank and Sanwa Bank are again significant at a five percent level, although those two just miss entering at a ten percent confidence level. This result is significant because it suggests that the structural breaks identified by the F-test results reflect changes in the sensitivity of the firms to returns on their main banks, rather than, for example, only reflecting changes in the firms' market betas.[8]

For all of the main banks studied, the sign of the main bank coefficients are negative and significant prior to the break date for all historical break dates. However, the coefficient estimates after the break date vary slightly across the main bank portfolios. Four of the main bank portfolios, Tokai, IBJ, Daiwa, and Fuji are positive and significant

[8] The fact that Sumitomo and Sanwa Bank show a significant structural break but no significant increase in the main bank coefficient suggests that the structural break for those banks was primarily attributable to changes in their market betas.

after the break, while three of the main banks, Sumitomo, Sanwa and Dai-ichi Kangyo, are usually insignificant.[9]

Note that the main bank portfolios that fail to show a significant positive dependence on the returns of their main banks are the strongest banks in the sample financially.[10] As we discussed above, one would expect the sensitivity of firms to their main banks to be greatest when their main banks are in a weak financial condition. When banks are weak financially, a given change in bank equity values should have a greater impact on bank lending practices. This notion is confirmed by the result that the main bank coefficients for all of the weaker main banks in the sample enter positively and significantly after the structural break.

3.3 Unknown Break Dates

While the historical break dates posited above are all plausible, the fact that it is impossible to prefer one over the other implies that the break date must be treated as unknown. Moreover, the dates chosen are subject to "pre-testing" bias, because it is impossible to select break dates without prior information about the underlying data. Andrews (1993) has developed a method to deal with this problem by explicitly adjusting the confidence interval estimates of the F-tests for structural breaks for the manner in which the break date is chosen.

To choose the break date, we first identify a subgroup of admissible dates. Andrews (1993) demonstrates that restricting the search to a sub-sample of the data is required, as allowing every date to be a potential break date would preclude convergence

[9] The main bank coefficient for the Dai-ichi Kangyo portfolio is positive and significant at the 5 percent level when the Yamaichi Securities failure date is treated as the structural break date.

in the estimation process. We choose the two-and-one-half year time-period that contains all three of the historical events entertained in the previous section. We define the set of potential break dates as all dates between July 3, 1995 and December 30, 1997. Since the window incorporates most of the major events in Japanese financial markets over the course of the sample, it appears likely that any breaks in the data would occur within this period. This period represents approximately one-fourth of the time series in the sample. As Andrews demonstrates, increasing the size of this window would reduce the power of our test.

We then break the sample in two for every potential break date within the window. We estimate equation (1) for each sample and run a standard Chow test using the F-statistic generated by comparing the results of the two sub-samples with those of the unbroken sample in section 3.1. Standard errors are then obtained from Andrews (1993). This methodology gives us an F-statistic for the possibility of a structural break for each portfolio of main banks for each potential break date that has been adjusted for pre-testing bias.

The F-statistics for each of the main bank portfolios are plotted for each potential break date in Figure 1, with the date with highest F-statistic value indicated. The striking feature of our results is that each of the portfolios suggests a similar period for the structural break, near the end of 1997. Four of the seven time series, Tokai, IBJ, Sanwa, and Dai-ichi Kangyo, peak in December of 1997, while the other three time series peak earlier. Fuji peaks in September of 1997, while Daiwa and Sumitomo peak in October and November of that year respectively.

[10] IBJ actually has the same credit rating as Dai-Ichi Kangyo.

The identification of this period as the timing of a structural break in the main bank relationship is consistent with the notion that the main bank relationship would be more important during turbulent financial episodes. Japan experienced a rash of significant failures in its financial sector during this period, beginning with that of Kyoto Kyoei bank in October. Problems escalated in November, with the first city bank failure, that of Hokkaido Takushoku, and the failure of two large Japanese securities companies, Sanyo and Yamaichi Securities.[11] Peek and Rosengren (1998) also identify November of 1997 as the month in which positive spreads emerged on interbank loan rates for Japanese banks, the so-called "Japan Premium."

The results for the main bank portfolios using this "maximum F-value" method are shown in Table 4. The results are quite similar to those using posited historical break dates above. All of the coefficient values prior to the break dates are negative and significant at a five percent confidence level. Subsequent to the break date, all main bank portfolios except Sumitomo and Sanwa enter positive and significant at the five-percent confidence level. All of the measured differences between the estimated main bank coefficients with the exception of Sumitomo Bank are also positive and significant at a five percent confidence level. Again, Sumitomo and Sanwa are the strongest banks in our sample and the results for those main banks would be expected to be weakest.

4. Robustness tests

4.1 Instrumental variables estimation

Because a firm's main bank is likely to be exposed to its client firms, both as a lender and as an equity holder, there is a possibility of simultaneity bias in the estimation

[11] See Spiegel and Yamori (2000) for details on failures during this period.

of equation (1). To accommodate this possibility, we evaluate the robustness of our above results to instrumental variables estimation, using the returns on the other main banks in our portfolio as the instruments. In each case all of the other six main banks are used as instruments for the main bank series being studied. The intuition behind this specification is that main bank returns will be dependent on the returns of other banks because of news relevant to Japanese banks. As these other banks are not, by definition, as exposed to the main bank's client firms as their main bank, their returns are valid as instruments.

The results for instrumental variables estimation using the maximum F-value method for timing the structural break date are shown in Table 5.[12] It can be seen that the results are quite similar to those obtained using ordinary least squares estimation. As before, we find evidence of a structural break in the sensitivity of portfolio equity values for all of the main bank portfolios at a five percent confidence level. In addition, we find that the coefficient on main bank equity after the structural break is significantly higher than that before the structural break for all main banks in the sample. We also find that all main bank coefficients prior to the structural break are negative and significant at a five percent confidence level.

We now find that the dependence of the Dai-ichi Kangyo portfolio on its main bank's returns is insignificant after the break, in addition to the Sanwa Bank and Sumitomo Bank portfolio results we found above. The remaining majority of main banks are positive and significant as before. However, Dai-Ichi Kangyo is the next strongest

[12] We also ran instrumental variable estimates for the posited historical break dates above. Our results were again similar to those found using ordinary least squares and are available upon request.

bank financially after Sanwa and Sumitomo, so the qualitative results concerning bank financial strength are quite similar to those found using ordinary least squares estimates.

The most striking distinction is that the instrumental variable results are not as uniform in their timing of the structural break. While three of the main bank portfolios find the structural break in the fourth quarter of 1997 in accordance with the ordinary least squares results, the results for the other main bank portfolios time the structural break as occurring in the beginning of 1997, or some time in 1996. These results shed doubt on the uniformity in the timing of the structural break suggested by the ordinary least squares estimates. However, it should be remembered that the differences in the sub-samples identified by these different break dates are not that large relative to the ten-year estimation period.

4.2 Inclusion of a banking index

It is possible that the estimated sensitivity of the firms to their main bank returns may simply reflect sensitivity to news about Japan's banking system, rather than news specific to its main bank. Individual bank returns are likely to reflect the fortunes of the banking industry as a whole. As a result, finding a positive dependence of firm portfolio returns on the returns of their main bank may simply imply dependence on the banking industry, rather than a renewed dependence on their main bank. To test for this possibility, we examine the robustness of our results concerning the main bank coefficient to the inclusion of an index of bank industry returns using both ordinary least squares and instrumental variables estimation methods.

The results with the banking index included are shown in Table 6. Structural break dates were identified using the maximum F-value technique, and standard errors are adjusted according to the Andrews (1993) method.[13] It can be seen that the bank index coefficient is uniformly negative and statistically significant prior to the structural break, but varies widely across main bank portfolios after the structural break.

As before, almost all of the main bank portfolios show evidence of a structural break at statistically significant levels. The lone exception here is Daiwa Bank, which fails to pass the F-test for a structural break using ordinary least squares estimation, but does pass at a 5 percent confidence level using the instrumental variables technique.

The majority of the main bank portfolios studied again show a statistically significant increase in the main bank coefficient regardless of the estimation method used. These include Tokai, IBJ, Daiwa, and Fuji. However, the Sumitomo and Sanwa Bank portfolios actually change sign and show a statistically significant decrease in their main bank coefficient after the structural break, again regardless of the estimation method used. The estimated change in the main bank coefficient of the Dai-ichi Kangyo portfolio is positive, but insignficant.

Again, the three banks which fail to show a statistically significant increase in the bank index coefficient are the three strongest main banks in the sample, Sumitomo, Sanwa, and Dai-ichi Kangyo.[14] Moreover, the four strongest banks, including the three above and IBJ, all fail to show a positive and statistically significant main bank coefficient after the structural break, while the coefficient estimates for the three weaker banks in the sample, Tokai, Daiwa and Fuji are positive and statistically significant. This

[13] We again also estimated the specification in Table 6 using the historical break dates. These results were very similar and are available from the authors upon request.

relative weakness in the performance of the stronger main bank portfolios mirrors the relative weakness in the strongest banks in the base regression above. As before, the stronger banks in the sample would be expected to display weaker results because their lending behavior would be expected to be less sensitive to shocks to their equity values.

It is also interesting to compare the relative size of the main bank coefficients to those on the bank index returns.[15] Because bank index returns also change over the structural breaks, we compare pre and post break main bank coefficients with pre and post-break bank index betas.

These results are also shown in Table 6. Prior to the estimated structural break dates, we find that main bank sensitivity exceeds sensitivity to the bank index returns for all main bank portfolios in the sample under ordinary least squares, although differences are insignificant under instrumental variables estimation for Tokai, Daiwa, and Sumitomo Bank. Subsequent to the structural breaks, we again find disparities that reflect bank financial strength. Main bank sensitivity is significantly less than bank index sensitivity for the two strongest main bank portfolios, Sumitomo and Sanwa Bank, while the other banks in the sample tend to display greater sensitivity to their main banks, although not always at statistically significant levels.

5. Conclusion

This paper provides evidence that Japanese entities are still sensitive to their main banks during episodes of financial turbulence. While the entity portfolios failed to demonstrate sensitivity to the returns of their main banks when coefficients were

[14] IBJ actually has the same rating as Dai-ichi Kangyo, but a lower rating than Sumitomo or Sanwa.
[15] Since the bank index retruns are also expressed in percentages, there are no unit issues here.

constrained to remain constant over the entire sample, allowing for a structural break reveals that these portfolios were sensitive to returns of their main banks during the turbulent late 1990s. These results were particularly robust for the weaker banks in our sample, but all banks in the sample demonstrated evidence of a structural break over the sample period.

In addition, the estimated timing of the structural break in the main bank relationship using the maximum F-statistic method under ordinary least squares was quite uniform across the seven main banks studied. Using the maximum F-statistic method and ordinary least squares estimation, all of the seven main banks identified the fourth quarter of 1997 as the period containing the structural break. This was a very turbulent period for the Japanese banking system, with the first failure of a Japanese city bank, Hokkaido Takushoku, as well as the failure of Sanyo and Yamaichi Securities. The estimated timing of the structural break was less uniform when using instrumental variables, but the qualitative differences between the two sample periods remained relatively robust.

These results suggest that the problems associated with the information advantage enjoyed by an entity's main bank are most likely to arise in environments in which liquidity is poor. Moreover, they suggest that the main bank system of finance still pursued in Japan may provide an additional argument for a "credit channel" in business cycles.

There were a number of banks whose increase in main bank sensitivity was not found to be robust to the inclusion of an index for the banking industry as a whole. However, robustness was systematically related to main bank financial strength. In particular, the two strongest main banks in the sample, Sumitomo and Sanwa, actually demonstrated a statistically significant decrease in main bank sensitivity after the estimated structural break.

While the decrease in the value of the main bank coefficient for the two strongest banks was surprising, the fact that robustness paralleled bank weakness was not. Our hypothesis maintained that firms would be sensitive to the returns of their main banks during turbulent financial episodes because adverse news for their main bank could have bad implications for that bank's lending capacity. This would be less of a concern for the strongest banks in the system, as they should be better able to weather adverse news without marked reductions in lending activity.

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Table 1
Summary Statistics[1]

Main Bank	Moody's Credit Rating	Number of Entities	Average % of Equity 1999	Average % Of Equity 1994	Average % of Equity 1989
Tokai Bank	Baa1	5	4.880	4.800	4.520
IBJ	A3	7	4.700	4.729	4.829
Daiwa Bank	Baa3	7	4.986	4.933	4.833
Sumitomo	A2	12	4.567	4.642	4.508
Sanwa	A1	15	4.633	4.600	4.657
Dai-ichi Kangyo	A3	20	4.675	4.650	4.528
Fuji Bank	Baa1	16	4.800	4.600	4.506

[1] Credit ratings based on Moody's for long-term deposits in 1998. Number of entities refers to number of entities in sample which list bank as their main bank. Equity exposure obtained from Japanese Companies Quarterly (1999).

Table 2
Estimation Results:
No Structural Break[1]

Mainbank	C	$i_{r,t}$	$R_{m,t}$	$R_{mb,t}$	Obs	R^2
Tokai	-0.00007	0.00009	1.0594**	-0.0241**	2741	0.5163
	(0.0003)	(0.00009)	(0.0239)	(0.0121)		
IBJ	-0.0005	0.0002**	1.2997**	-0.0488**	2741	0.6396
	(0.00030)	(0.00008)	(0.0249)	(0.0120)		
Daiwa	0.0001	-0.00001	1.0473**	0.0151**	2741	0.6019
	(0.0003)	(0.00007)	(0.0189)	(0.0078)		
Sumitomo	-0.0002	0.00006	1.0147**	-0.0450**	2741	0.7149
	(0.0002)	(0.00005)	(0.0164)	(0.0086)		
Sanwa	-0.0002	0.0001	1.1334**	-0.0341**	2741	0.6504
	(0.0002)	(0.00007)	(0.0208)	(0.0106)		
Dai-ichi Kangyo	-0.00004	0.00006	1.1331**	-0.0361**	2741	0.7930
	(0.0002)	(0.00005)	(0.0148)	(0.0072)		
Fuji	-0.0001	0.00008	1.0444**	-0.0061	2741	0.7180
	(0.0002)	(0.00005)	(0.0172)	(0.0079)		

[1] Estimated by ordinary least squares. ** indicates significance at a 5% confidence level.
* indicates significance at a 10% confidence level.

Table 3
Estimation Results:
Historical Break Dates[1]

Failure Event	Tokai	IBJ	Daiwa	Sumitomo	Sanwa	Dai-ichi	Fuji
Cosmo Credit							
(7/31/95)							
β_{mb}	-0.085**	-0.115**	-0.042**	-0.082**	-0.064**	-0.083**	-0.077**
	(0.014)	(0.013)	(0.012)	(0.010)	(0.012)	(0.009)	(0.011)
β'_{mb}	0.088**	0.051**	0.050**	-0.014	0.007	0.019	0.065**
	(0.024)	(0.024)	(0.011)	(0.017)	(0.022)	(0.013)	(0.013)
$\beta'_{mb} - \beta_{mb}$	0.173**	0.166**	0.092**	0.068**	0.071**	0.102**	0.142**
	(0.028)	(0.028)	(0.017)	(0.020)	(0.025)	(0.016)	(0.017)
F-Value	11.569**	14.013**	8.264**	12.3**	3.117**	14.739**	20.75**
II. Hanwa Bank							
(11/21/96)							
β_{mb}	-0.079**	-0.111**	-0.036**	-0.077**	-0.068**	-0.079**	-0.078**
	(0.013)	(0.013)	(0.011)	(0.009)	(0.011)	(0.008)	(0.010)
β'_{mb}	0.12**	0.051*	0.052**	-0.021	0.012	0.022	0.067**
	(0.034)	(0.031)	(0.014)	(0.023)	(0.028)	(0.017)	(0.015)
$\beta'_{mb} - \beta_{mb}$	0.199**	0.162**	0.088**	0.056**	0.08**	0.101**	0.145**
	(0.036)	(0.033)	(0.018)	(0.024)	(0.030)	(0.019)	(0.019)
F-Value	13.799**	17.176**	8.741**	15.578**	7.463**	16.651**	22.247**

[1] Estimated by ordinary least squares. Break dates treated as known. β_{mb} represents estimated coefficient on main bank returns prior to structural break, while β'_{mb} represents coefficient subsequent to structural break. F-value represents results of structural break Chow test. ** indicates significance at a 5% confidence level. * indicates significance at a 10% confidence level.

Table 3
Estimation Results:
Historical Break Dates[1]
(continued)

III. Yamaichi Securities

(11/25/97)							
β_{mb}	-0.070**	-0.102**	-0.027**	-0.066**	-0.057**	-0.073**	-0.064**
	(0.012)	(0.012)	(0.010)	(0.009)	(0.010)	(0.008)	(0.009)
β'_{mb}	0.183**	0.101**	0.067**	-0.012	0.006	0.060**	0.091**
	(0.048)	(0.044)	(0.018)	(0.035)	(0.044)	(0.024)	(0.021)
$\beta'_{mb} - \beta_{mb}$	0.253**	0.203**	0.094**	0.054	0.063	0.133**	0.155**
	(0.049)	(0.046)	(0.021)	(0.036)	(0.045)	(0.025)	(0.023)
F-Value	16.029**	22.569**	10.14**	18.112**	8.677**	20.995**	23.060**

[1] Estimated by ordinary least squares. Break dates treated as known. B_2 represents estimated coefficient on main bank returns prior to structural break, while B'_2 represents coefficient subsequent to structural break. F-value represents results of structural break Chow test. ** indicates significance at a 5% confidence level. * indicates significance at a 10% confidence level.

Table 4
Estimation Results:
Break Dates Chosen from Maximum F-Values [1]

	Estimated Break Dates	β_{mb}	β'_{mb}	$\beta'_{mb} - \beta_{mb}$	F-Value
Tokai	12/24/97	-0.071**	0.224**	0.296**	20.739**
		(0.012)	(0.048)	(0.049)	
IBJ	12/05/97	-0.104**	0.117**	0.221**	24.837**
		(0.0121)	(0.045)	(0.047)	
Daiwa	10/13/97	-0.038**	0.067**	0.106**	12.211*
		(0.010)	(0.017)	(0.020)	
Sumitomo	11/21/97	-0.066**	-0.016	0.050	19.796**
		(0.010)	(0.034)	(0.035)	
Sanwa	12/17/97	-0.064**	0.035	0.099**	11.677*
		(0.011)	(0.045)	(0.046)	
Dai-ichi Kangyo	12/17/97	-0.075**	0.070**	0.145**	23.414**
		(0.008)	(0.025)	(0.026)	
Fuji	9/25/97	-0.071**	0.081**	0.152**	24.377**
		(0.009)	(0.020)	(0.022)	

[1] Estimated by ordinary least squares. Break dates chosen by maximum F-value method. B_2 represents estimated coefficient on main bank returns prior to structural break, while B'_2 represents coefficient subsequent to structural break. Standard errors adjusted for pre-testing bias. F-value represents results of structural break Chow test. ** indicates significance at a 5% confidence level. * indicates significance at a 10% confidence level.

Table 5
Instrumental Variables
Break Dates Chosen from Maximum F-Values[1]

	Estimated Break Dates	β_{mb}	β'_{mb}	$\beta'_{mb} - \beta_{mb}$	F-Value
Tokai	11/17/97	-0.281**	0.196**	0.477**	21.911**
		(0.026)	(0.080)	(0.084)	
IBJ	12/08/97	-0.200**	0.180**	0.379**	30.457**
		(0.020)	(0.067)	(0.070)	
Daiwa	9/25/96	-0.290**	0.120**	0.411**	22.380**
		(0.035)	(0.029)	(0.045)	
Sumitomo	1/10/97	-0.187**	0.036	0.2230**	39.271**
		(0.014)	(0.033)	(0.0358)	
Sanwa	4/12/96	-0.247**	0.054	0.301**	24.948**
		(0.020)	(0.034)	(0.040)	
Dai-ichi Kangyo	7/15/96	-0.197**	-0.019	0.177**	29.226**
		(0.013)	(0.024)	(0.027)	
Fuji	12/16/97	-0.142**	0.126**	0.268**	28.738**
		(0.014)	(0.033)	(0.036)	

[1] See text for list of instruments. Break dates chosen by maximum F-value method. B_2 represents estimated coefficient on main bank returns prior to structural break, while B'_2 represents coefficient subsequent to structural break. Standard errors adjusted for pre-testing bias. F-value represents results of structural break Chow test. ** indicates significance at a 5% confidence level. * indicates significance at a 10% confidence level.

Table 6
Estimation Results with Bank Index Added
Break Dates Chosen from Maximum F-Values[1]

	Tokai	IBJ	Daiwa	Sumitomo	Sanwa	Dai-ichi	Fuji
I Ordinary Least Squares							
Break Date	12/24/97	12/5/97	10/14/97	11/21/97	10/28/97	7/15/96	9/13/96
β_{mb}	-0.021	-0.038**	-0.019*	-0.003	0.019	0.015	0.007
	(0.013)	(0.015)	(0.011)	(0.011)	(0.013)	(0.010)	(0.013)
β'_{mb}	0.229**	0.080	0.064**	-0.152**	-0.138**	0.049**	0.072**
	(0.059)	(0.056)	(0.018)	(0.042)	(0.047)	(0.020)	(0.019)
$\beta'_{mb} - \beta_{mb}$	0.250**	0.117**	0.083**	-0.150**	-0.155**	0.035	0.065**
	(0.060)	(0.058)	(0.021)	(0.044)	(0.049)	(0.023)	(0.024)
$\beta_{mb} - \beta_{bi}$	0.259**	0.224**	0.180**	0.208**	0.319**	0.367**	0.307**
	(0.037)	(0.038)	(0.031)	(0.026)	(0.032)	(0.027)	(0.034)
$\beta'_{mb} - \beta'_{bi}$	0.248*	-0.066	0.015	-0.606**	-0.640**	0.159**	0.091
	(0.149)	(0.145)	(0.091)	(0.099)	(0.119)	(0.050)	(0.057)
F-Value	21.032**	26.947**	12.950	44.422**	32.663**	28.313**	22.6174**

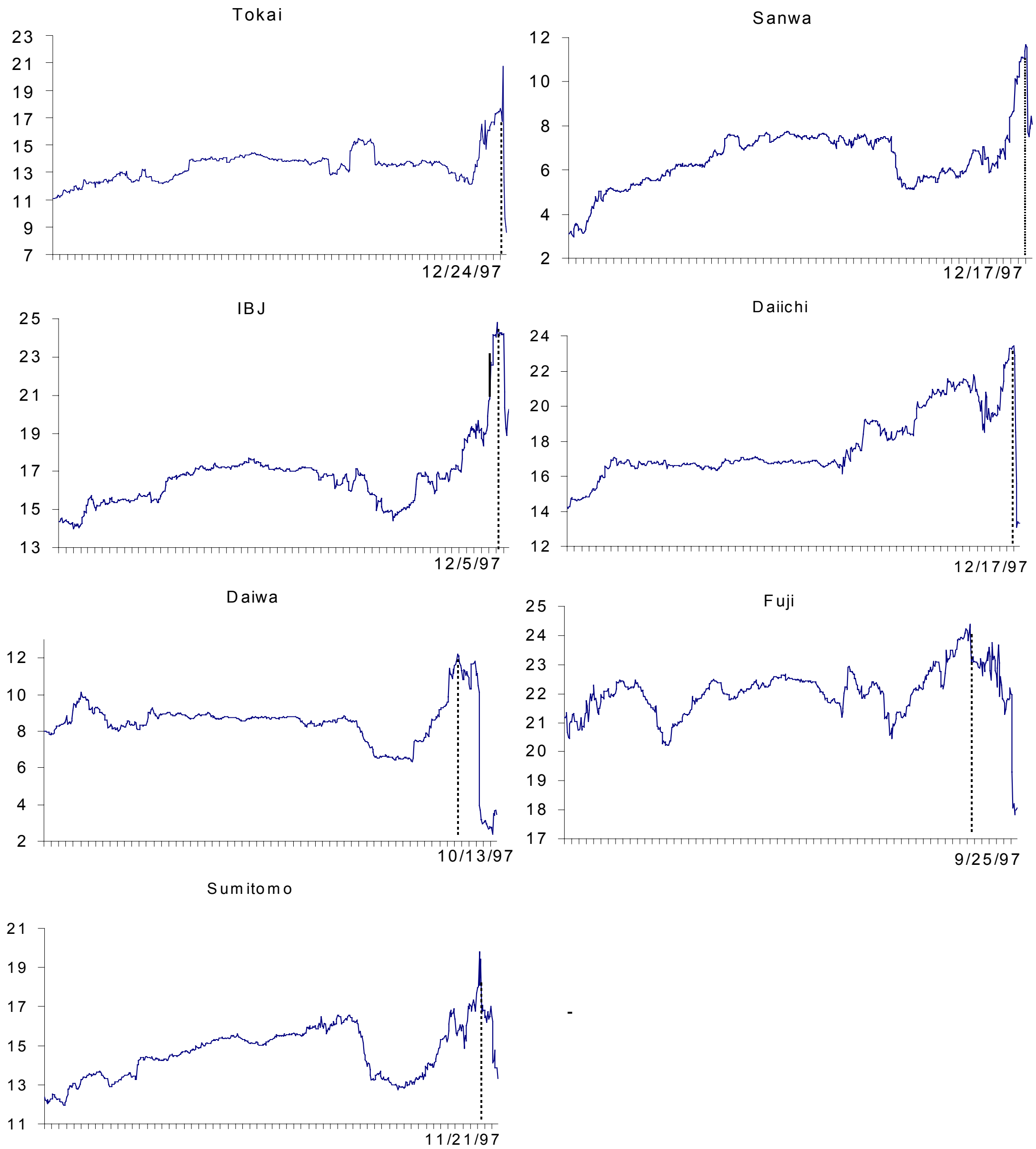
[1] Estimated by ordinary least squares. Break dates chosen by maximum F-value method. β_{mb} represents estimated coefficient on main bank returns prior to structural break, while β'_{mb} represents coefficient subsequent to structural break. β_{bi} represents estimated coefficient on bank index returns prior to structural break, while β'_{bi} represents the bank index coefficient estimate subsequent to structural break. Standard errors adjusted for pre-testing bias. F-value represents results of structural break Chow test. ** indicates significance at a 5% confidence level. * indicates significance at a 10% confidence level.

Table 6
Estimation Results with Bank Index Added
Break Dates Chosen from Maximum F-Values[1]
(continued)

II Instrumental Variables							
Break Date	11/17/97	5/14/96	9/25/96	11/21/97	10/28/97	7/15/96	12/16/97
β_{mb}	-0.145**	-0.046	-0.169**	-0.064**	-0.041	-0.023	-0.044
	(0.057)	(0.045)	(0.075)	(0.028)	(0.039)	(0.026)	(0.030)
β'_{mb}	0.278*	0.201**	0.164**	-0.234**	-0.320**	0.018	0.097
	(0.168)	(0.093)	(0.041)	(0.075)	(0.077)	(0.053)	(0.064)
$\beta'_{mb} - \beta_{mb}$	0.423**	0.247**	0.334**	-0.170**	-0.279**	0.041	0.147**
	(0.177)	(0.103)	(0.085)	(0.080)	(0.086)	(0.059)	(0.071)
$\beta_{mb} - \beta_{bi}$	0.033	0.306**	-0.045	0.070	0.185**	0.277**	0.120**
	(0.087)	(0.080)	(0.101)	(0.050)	(0.065)	(0.047)	(0.053)
$\beta'_{mb} - \beta'_{bi}$	0.407	0.362**	0.288**	-0.767**	-1.066**	0.080	0.026
	(0.289)	(0.164)	(0.090)	(0.137)	(0.155)	(0.096)	(0.148)
F-Value	16.790**	25.141**	15.598**	45.025**	37.120**	27.314**	23.443**

[1]Estimated by instrumental variables. Break dates chosen by maximum F-value method. β_{mb} represents estimated coefficient on main bank returns prior to structural break, while β'_{mb} represents coefficient subsequent to structural break. β_{bi} represents estimated coefficient on bank index returns prior to structural break, while β'_{bi} represents the bank index coefficient estimate subsequent to structural break. Standard errors adjusted for pre-testing bias. F-value represents results of structural break Chow test. ** indicates significance at a 5% confidence level. * indicates significance at a10% confidence level.

Figure 1
F-values over event window[1]



[1] Estimated by ordinary least squares. Sample window from 7/3/95 through 12/30/97. Graphs plot F-values obtained given sample separated at date *t*. Date shown corresponds to maximum F-value for sample.