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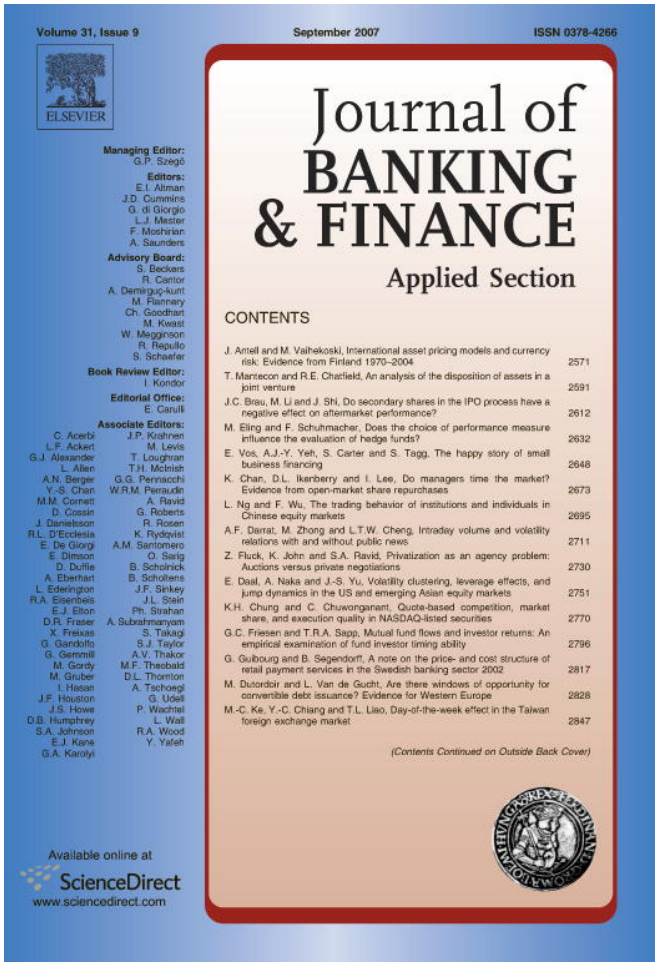

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Japan's banking crisis: An event-study perspective

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Abstract

We calculate abnormal stock returns for Japanese non-financial companies around major events associated with the banking crisis (1995–2000), and find that not all companies were equally sensitive to the malaise of the banking sector: the most affected were small, leveraged, low-tech companies with low credit ratings and low market to book ratios. This is consistent with "credit crunch" theories (companies with limited access to financial markets are sensitive to changes in bank lending) and with claims that innovation is rarely financed by bank debt. We do not find much evidence on the alleged misallocation of loans to support ailing bank clients.
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1. Introduction

Starting in the early 1990s, Japan experienced a deep and prolonged banking crisis, which ended only recently. Estimates of the magnitude of the crisis vary (Hoshi and Kashyap, 2001), but there is no doubt that the problem of non-performing loans in Japan was severe. These loans, combined with strict enforcement of capital adequacy and other banking regulations, had a potentially large impact on the ability of banks to offer credit to

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corporate clients. The characteristics of companies which were particularly sensitive to the banks' restricted lending ability are, however, not perfectly clear: Did good (small?) firms face a credit crunch? Did banks manage to delete their worst clients from their portfolios during the crisis period? Did the sensitivity of companies to events in the banking sector vary by industry or firm characteristics?

Casual observation of industry-specific stock price indexes indicates that, indeed, not all sectors suffered equally during the crisis years (Fig. 1): some industries (e.g., transportation equipment, electronics, or precision instruments), fared much better than others (e.g., real estate, construction and textiles). This raises the possibility that sensitivity to the banking crisis varied across industry and firm attributes. In this paper, we use stock market data to shed more light on this issue, and argue that the banking crisis in Japan affected companies with limited access to bond markets and a heavy debt burden more than other firms. We also find that companies in relatively R&D-intensive industries were not very susceptible to the troubles of the banking sector. Our results are therefore consistent with the macroeconomic literature on the sensitivity of firms with limited access to financial markets to changes in bank lending due to restrictive monetary policy. Our findings are also consistent with the financial economics literature according to which R&D intensive industries are not very dependent on bank finance. By contrast, we find little evidence to support the conjecture that during the second half of the 1990s banks shifted their loan portfolios towards virtually bankrupt "zombies".

Methodologically, we follow the event-study tradition and assemble data on stock price responses of non-financial firms to events related to the banking sector. The events we study include several government measures in relation to the banking crisis, downgrading of banks by the two major international rating agencies (Moody's and S&P), and bank mergers (Japan experienced a consolidation wave in recent years). Around each event, we estimate

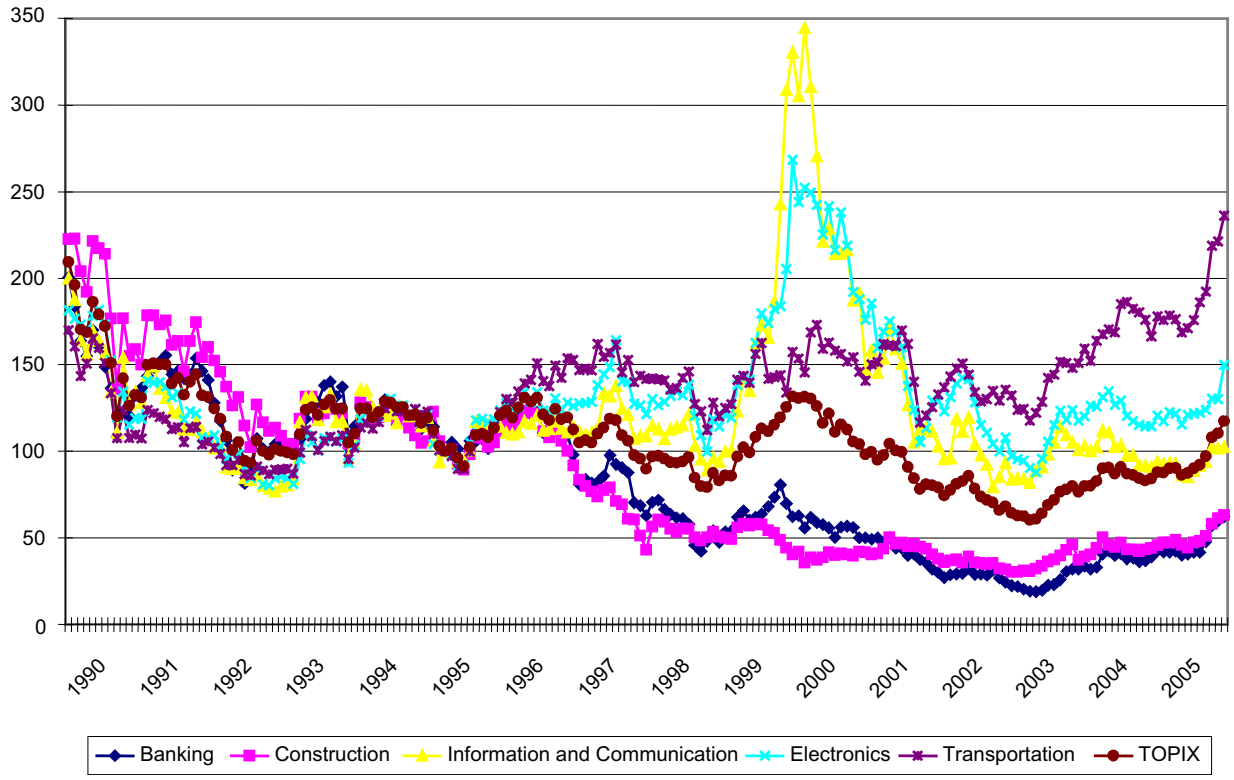

Fig. 1. Co-movement of industry-specific price indexes and bank share prices, 1995–2005 (March 1995 = 100).

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cumulative 11-day and 3-day abnormal returns for a sample of roughly 800 listed non-financial companies. We then relate the abnormal returns to firm characteristics such as size, "quality" (market to book and accounting measures of profitability), leverage, R&D intensity, bond rating, and measures of the strength of bank-firm ties. This enables us to characterize companies which are particularly sensitive to events in the banking sector.

The use of an event-study approach to analyze the impact of government policies, downgrades and mergers raises methodological concerns because these events may be partially anticipated in advance and often evolve over time. We therefore focus on events which generated "surprising" news headlines, and did not coincide with other major news. In doing so, we follow previous studies which applied an event-study approach to the analysis of government policy (e.g., Auerbach and Hassett, 2007), to the analysis of price responses of client companies to the distress of their banks (e.g., Slovin et al., 1993; Yamori and Murakami, 1999; Bae et al., 2002; Brewer et al., 2003; Ongena et al., 2003; and Djankov et al., 2005), and to bank mergers (e.g., Shin et al., 2003; Karceski et al., 2005; and Carow et al., 2006). The present paper contributes to this event-study based literature in two ways. First, following Brewer et al. (2003) and, to some extent, Bae et al. (2002), we focus on the differential response of firms with different characteristics to the events we study and include firm R&D intensity and bond rating which have not been analyzed in this context before. Second, the present paper differs from existing studies of this type in the scope of the analyzed events. Unlike previous studies, we include a large number and variety of positive and negative events related to the banking crisis and to the ability of banks to offer new loans.

The present study is related also to a line of research in financial economics, according to which different types of finance are appropriate for different types of economic activities. One conclusion that emerges from this literature is that R&D activity rarely relies on bank finance (e.g., Allen and Gale, 2000; Carlin and Mayer, 2003). Our finding, that firms in R&D intensive sectors are not very sensitive to bank-related events, is consistent with this argument.

Also of relevance is the finding in the macroeconomic literature on (monetary policy and) "credit crunch" that small firms, as well as other firms with limited access to financial markets, are more sensitive to changes in available bank credit (because of shifts in monetary policy) than are bigger and more reputable firms (e.g., Kashyap et al., 1993). The present paper links the financial economics and macroschools of thought by characterizing firms that are sensitive to changes in bank credit due to a banking crisis, rather than due to monetary policy.

Finally, the paper is, of course, related also to studies of the Japanese banking crisis and its impact on firm behavior. Some of this literature debates the extent to which a credit crunch existed in Japan, especially prior to 1997–1998 (e.g., Hayashi and Prescott, 2002, or Woo, 2003). Our results indicate that some classes of companies were adversely affected by the malaise of the banking system, and, in line with the existing literature, the effect is especially pronounced in 1997–1998. Other studies focus on bank-firm ties as an important determinant of firm performance during the crisis (e.g., Kang and Stulz, 2000, or Klein et al., 2002). Our findings are broadly consistent with these studies, but differ in that, while we find that certain types of bank client firms are sensitive to crisis-related events, within this category, the strength of bank-firm relationships does not seem to matter much. Finally, recent studies of the Japanese banking crisis (e.g., Hoshi and Kashyap, 2004; Peek and Rosengren, 2005; Fukuda et al., 2005) emphasize the tendency of ailing banks to

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support ailing clients (''zombies''); the evidence we provide from stock prices (which may not be the most appropriate tool for testing these theories) indicates that this phenomenon was not very pronounced during our sample period.

The next section describes the data set and empirical approach; the results are presented in Section 3, and Section 4 concludes.

2. Data and empirical approach

2.1. Sample and data sources

Our sample includes about 800 listed firms on the First Section of the Tokyo Stock Exchange (Table 1). These firms are mostly in manufacturing industries and, in addition, in construction, real estate, and retail (sectors which are likely to be sensitive to availability of bank finance). The information we gather on each firm includes daily stock returns (adjusted for dividends), financial statements and market to book ratios.[1] We define ''high R&D firms'' as firms belonging to industries with above-median ratios of R&D expenditures to sales (according to the Ministry of Science and Technology): chemicals, pharmaceuticals, machinery, electronics, transportation equipment, and precision instruments (other measures of R&D intensity are examined in the robustness section). These sectors, which include about half of the sample firms, are less bank-dependent than other sectors, as predicted by Carlin and Mayer (2003).[2] As for bond rating, much of the literature (e.g., Faulkender and Petersen, 2006) has used a dichotomous distinction between rated and unrated companies as a proxy for firm access to non-bank finance. In Japan, many institutional investors cannot supply funds at all to companies with a low rating (lower than BBB), and we therefore replace the traditional dummy variable with a rating scale ranging from one (high) to four (low), using the lowest available credit rating by any of the major rating agencies.[3] In the robustness section, we use also the standard ''unrated company'' dummy variable, as well as rating-specific dummy variables (avoiding the linearity of the rating scale). Finally, following Gibson (1995), we define each firm's main bank as the top lending bank in the Japan Company Handbook; this definition identifies about three-quarters of all firms as having a main bank. Several alternative definitions produce very similar empirical results and are therefore not shown.[4]

[1] Despite the common perception that the First Section of the Tokyo Stock Exchange includes only large firms, our sample is heterogeneous and includes many fairly small companies. Firms in the smallest 1% of the (UFJ merger) sample have sales of less than US$ 130 million; a quarter of the sample firms (over 200 firms) have sales figures smaller than US$ 500 million.

[2] The ratio of liabilities to total assets – leverage – of firms in high-R&D industries is on average 0.225, of which about half are bank loans. By contrast, firms in low-R&D sectors are more leveraged (0.29 on average, a statistically significant difference), of which about two-thirds are bank loans.

[3] One corresponds to a rating of A or higher, two to a rating between A and BBB, three to a rating of BBB or lower, and four to complete absence of rating (not investment grade).

[4] Other main bank definitions we examine include: (a) the top lending bank from the Japan Company Handbook if it is the largest lender over a 5-year period (slightly less than two-thirds of all firms have a main bank according to these criteria). (b) As in (a), and, in addition, the ratio of main bank loans to firm assets exceeds the median (or mean) value of this variable in the sample (3.6% or 5.1%, respectively; using mean bank loans, about one-third of the companies in the sample are classified as main bank clients according to this definition). (c) Instead of, or in addition to, the above requirements, shareholding by the main bank exceeds the median value of this variable in the sample.

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Table 1
Data sources and variable definitions

Variable	Source	Definition	Mean UFJ merger sample	SD UFJ merger sample
Assets	Nikkei NEEDS and JDB Databases	Total assets in (million yen)	269,778	550,926
Tobin's q	Nikkei NEEDS and JDB Databases	Ratio of market value to book value	1.09	1.27
Leverage	Nikkei NEEDS and JDB Databases	Ratio of total liabilities (borrowing and bonds) to assets	0.26	0.20
R&D-intensive industries	Ministry of Science and Technology	Chemicals, pharmaceuticals, machinery, electronics, transportation equipment and precision instruments	0.49	N/A
Bond rating	See text	On a range from 4 (lowest, no rating) to 1 (rated A or higher)	2.95	1.12
Main bank loans, shareholding, etc.	Nikkei NEEDS, JDB Database and Japan Company Handbook	Several definitions used to identify the main bank; see text	Depending on the definition used	N/A

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2.2. Empirical approach

We measure abnormal stock returns by estimating the "market model", where, for each firm, stock returns are regressed on (a constant and) the market returns (the TOPIX index); abnormal returns are actual stock returns minus the model's prediction.[5] Because of the large number and high frequency of events during the period we examine, we use a short period to estimate the market model in the benchmark regressions, with only 40 daily observations between dates −60 and −20 (where date zero is the date of the event). To make sure the short estimation window does not affect our results, we use a 120-day period to estimate the market model in the robustness section. Because of the nature of the events we study, it is often difficult to verify the date in which news might have affected the market, as some events evolved over several trading days. The analysis which follows will therefore focus on cumulative abnormal returns between dates −5 and +5 for each event, a relatively long event-window which might make it difficult to obtain significant results. In the robustness section, we examine a shorter 3-day event window (between dates −1 and +1) as well as raw stock returns (instead of excess returns). The results remain virtually unchanged in all of these specifications.

3. Hypotheses, results and discussion

We report our findings for three event categories. The first consists of government actions designed to address the banking crisis, presumably consisting of good news for banks and their clients. The second consists of cases of downgrading of banks by a major international rating agency (Moody's or S&P); this event category is unambiguously bad for banks (because of increased costs of raising funds), and is expected to adversely affect bank clients as well. The third category consists of three major bank mergers whose impact on client firms is *a priori* ambiguous: on the one hand, a merger may contribute to bank health and therefore improve a bank's ability to offer new loans. Mergers may also make banks "too big to fail" and thus guarantee the continuation of their lending activities. On the other hand, a merger may endanger the relationship between a firm and its main bank. Bank mergers could also lead to a negative effect on the stock prices of client companies simply because the combined bank may be forced to sell some of its equity stake in order not to exceed the legal maximum of 5%.[6]

Our choice of events is based on our reading of the financial press and inevitably involves some subjective judgment. First, we verify that the events we choose do not coincide with other major events on or around the same dates and that news headlines were associated with them. Second, to verify that the selected events are indeed important, we examine movements in the bank stock index around these dates, and find, around many of the events, a substantial difference between changes in bank stock returns and

[5] Many event studies use the Fama-French modification to this model, which includes on the right-hand-side two variables in addition to the market return: the return difference between small and large companies; and the return difference between high and low book-to-market stocks. We do not use this approach because the required data are not readily available for the Japanese market.

[6] If the merged bank's equity stake exceeds the 5% maximum, a temporary approval has to be obtained from the Fair Trade Commission (FTC); the equity stake should be reduced to the legal maximum within 5 years.

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changes in the general stock index (which itself must have been influenced by these events as well).[7]

3.1. Government actions

We examine two types of government actions, capital injections and measures to improve banking supervision:

(i) 5/3/1998: Banks request a government injection of funds.
(ii) 22/6/1998: The Financial Supervisory Agency is established.
(iii) 12/10/1998: The Upper House passes bills to inject funds to the banking industry.
(iv) 5/3/1999: Banks apply for government funds again.
(v) 8/4/1999: The Financial Examination Manual is made public.

With the exception of Event (v), all the events in this category were deemed important and novel enough to warrant major front page headlines in the Japanese financial press.[8] Furthermore, Table 2 suggests that although market participants may have partially expected these government measures, their content and timing were surprising enough to raise bank stock prices by an average of 6%. Regression results, where the dependent variable is cumulative abnormal returns between days −5 and +5 around these events, indicate that government actions in support of the banking sector constituted good news not only for the banks but also for the typical bank-dependent company: small, with low market to book, operating in a low-tech sector, with limited access to bond markets, and highly leveraged. Generally, these results hold for both events involving capital injections (i, iii and iv) and for events consisting of measures to improve banking supervision (ii and v).[9] When measures of main bank ties are added to the regression, we find that firms with high ratios of main bank debt to total assets benefited more than other firms from government measures in support of the banking system.[10]

3.2. Downgrading of banks' credit rating

We now turn to five of the most dramatic downgrading announcements of major Japanese banks by the two leading international rating agencies:

(i) 25/12/1995: Downgrading of Mitsubishi, Sakura, Sumitomo and DKB by S&P.

[7] For example, the bank stock index increased by about 15% around the Mizuho merger discussed below, versus a 3% increase in the TOPIX index. An alternative approach, which we do not follow here, would have been to identify events on the basis of movement in bank stock prices; this approach would have required exercising subjective judgment about the extent to which the probable causes of stock price fluctuations should affect bank lending to client firms.

[8] The last event was reported less prominently, but was considered a surprise among market observers.

[9] Size and market to book are not significant in the capital injections regression. Barth et al. (2006) suggest that increased banking supervision may, under certain circumstances, adversely affect the banking system; apparently, market participants in Japan were not very concerned by this possibility.

[10] Note that the coefficient on main bank loans is larger than the coefficient on leverage when both are included in the regression (although the two are highly collinear). The coefficient on main bank shareholding is statistically insignificant and very close to zero in magnitude.

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Table 2
The effects of government actions to address the banking crisis on cumulative abnormal returns of non-financial firms on days (−5, +5)

	All government actions	All government actions	Improved banking supervision	Injections of capital
Constant	Event-specific	Event-specific	Event-specific	Event-specific
Assets	−0.004*	−0.003	−0.014***	0.002
	(0.002)	(0.002)	(0.003)	(0.003)
Tobin's q	−0.013**	−0.014***	−0.032***	0.001
	(0.005)	(0.004)	(0.006)	(0.006)
Leverage	0.071***	0.042***	0.064***	0.076***
	(0.011)	(0.015)	(0.015)	(0.015)
High-R&D sector dummy	−0.018***	−0.018***	−0.015***	−0.021***
	(0.003)	(0.003)	(0.005)	(0.004)
Bond rating	0.010***	0.008***	0.011***	0.010***
	(0.001)	(0.001)	(0.002)	(0.002)
MB loans to total assets		0.143**		
		(0.063)		
MB shareholding		−0.000		
		(0.001)		
N	4169	4169	1669	2500
R^2	0.08	0.09	0.11	0.05
Average CAR	0.02	0.02	0.04	0.01
Change in bank stock price index (average)	0.06	0.06	0.05	0.06

OLS regressions with event-specific intercepts and robust standard errors. ***, ** and * denote coefficients significant at the 1%, 5%, and 10% levels, respectively. The coefficient on assets is multiplied by 1,000,000.

(ii) 24/1/1996: Downgrading of Sakura and LTCB by Moody's.
(iii) 25/12/1997: Downgrading of Sakura and Sanwa by S&P.
(iv) 30/3/1998: Downgrading of LTCB, Tokyo-Mitsubishi, Asahi and Daiwa by S&P.
(v) 24/12/1998: Downgrading of Daiwa, Sumitomo, DKB, IBJ, Sakura, Sanwa, and Tokai by S&P.[11]

The results, presented in Table 3, indicate that, on average, bank downgrading constituted bad news for listed firms, with an average CAR of −3.3%. In symmetry with our findings on the (positive) stock price response to (positive) government actions, downgrading announcements appear to have been particularly harmful to highly leveraged

[11] Dating downgrading events is difficult because announcements are made in New York and affect the Tokyo market with some delay, especially around holidays and weekends. The dates above refer to dates in which the Tokyo market could have responded to the information (given the long event-window, minor dating changes do not affect the results). In terms of newspaper coverage, downgrading events are typically reported less prominently than government actions, but are discussed in considerable detail in the economics sections of the *Nihon Keizai Shimbon*. We do not examine downgrades involving trust and specialized banks, or downgrades occurring close to other events.

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Table 3
The effects of bank downgrading on cumulative abnormal returns of non-financial firms on days (−5, +5)

	All	All	All	DG-1995	DG-1996	DG-1997	DG-3/98	DG-12/98
Constant	Event-specific	Event-specific	Event-specific	0.010	0.003	0.005	−0.060	0.025
				(0.010)	(0.008)	(0.020)	(0.019)	(0.008)
Assets	0.011***	0.010***	0.011***	0.006***	−0.000	0.019***	0.020***	0.002
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.007)	(0.006)	(0.003)
Tobin's q	0.020***	0.021***	0.019***	−0.002	0.001	0.021**	0.063***	0.003
	(0.003)	(0.003)	(0.003)	(0.006)	(0.005)	(0.009)	(0.012)	(0.004)
Leverage	−0.107***	−0.080***	−0.099***	−0.009	0.009	−0.251***	−0.156***	−0.097***
	(0.009)	(0.014)	(0.010)	(0.015)	(0.013)	(0.028)	(0.025)	(0.014)
High-R&D sector dummy	0.014***	0.014***	0.013***	−0.000	0.012**	0.005	0.033***	0.013***
	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.008)	(0.007)	(0.005)
Bond rating	−0.010***	−0.009***	−0.008***	−0.001	−0.001	−0.016***	−0.024***	−0.009***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.004)	(0.003)	(0.002)
MB involved dummy	0.001	0.000	0.002	−0.008*	−0.013*	0.015	0.006	0.003
	(0.003)	(0.003)	(0.003)	(0.005)	(0.007)	(0.012)	(0.009)	(0.005)
MB loans to total assets		−0.127**						
		(0.051)						
MB shareholding		0.000						
		(0.001)						
Bank loans to total assets			−0.015**					
			(0.004)					
N	4016	4016	4016	790	801	820	829	776
R^2	0.22	0.22	0.22	0.01	0.01	0.17	0.28	0.12
Average CAR	−0.03	−0.03	−0.03	0.00	0.01	−0.06	−0.09	−0.02
Change in bank stock price index[a]	−0.05	−0.05	−0.05	0.05	−0.01	−0.11	−0.10	−0.08

OLS regressions with event-specific intercepts in the pooled regression and robust standard errors throughout. ***, ** and * denote coefficients significant at the 1%, 5%, and 10% levels, respectively. The coefficient on assets is multiplied by 1,000,000.

[a] The figure in the left three columns is an average.

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companies, the coefficient on which is both statistically significant and of substantial magnitude.[12] Also sensitive to downgrading are firms in low R&D industries and low credit ratings. In addition, there is some evidence that small and low market to book firms suffered more from downgrading of their banks. All of these findings are consistent with the characterization of these firms as bank-dependent.[13]

A casual examination of the results in Table 3 suggests that they are not supportive of the view that, as their situation deteriorated, Japanese banks shifted more loans to ailing clients at the expense of more promising firms. Had this been the case, we would have perhaps observed a positive stock price response of low-q firms in low-tech sectors, quite the opposite from what we find. We return to this issue below. Another implication of the results is that the impact of the downgrading announcements of 1997 and early 1998 both on banks and on their clients far exceeded that of the earlier downgrading events.[14]

Surprisingly, the dummy variable "main bank involved" (which takes the value one if a firm's main bank was downgraded) suggests that, after 1997, there was no special impact of downgrading on firms that use the downgraded bank as their main bank. This variable is also insignificant in the pooled regressions.[15] We conjecture that bank-dependent firms suffer more from bank downgrading even if their own main bank is not directly affected because these events are regarded as reflecting the weakness of the financial system as a whole.[16] Despite the insignificance of the "main bank involved" dummy, the coefficient on the ratio of main bank loans to total assets is negative, economically large, and statistically significant, suggesting that firms with high main bank dependence were particularly sensitive to events in the banking sector, regardless of whether or not their own main bank was involved.[17] Main bank shareholding has no impact on stock price responses.

[12] For example, in the pooled sample, firms with leverage two standard deviations above the mean experienced a CAR of −7%, more than twice the sample average.

[13] We interpret high leverage and low credit rating as indicators of bank dependence and limited access to financial markets; an alternative interpretation is that banks, in response to their own downgrading, reduce lending to their riskiest clients. We interpret q as a measure of firm quality, or profitability, which affects access to financial markets; in robustness tests discussed below we find very similar results when using returns to assets (ROA). An interpretation of low q firms as mature companies which can self-finance is inconsistent with the results that these firms are highly sensitive to events in the banking sector.

[14] Average CAR around the 1997 downgrading was −6%. The corresponding figure for the March 1998 downgrading was even more negative, −9%, much higher than for all the other events in this category. The effect of these downgrades on bank stock prices was also particularly pronounced. It is interesting to note that the results here correspond to the results reported by Brewer et al. (2003) for bank failures. They report that small, young, highly leveraged firms with low values of Tobin's q were particularly adversely affected by the bank failure events they examine. Bae et al. (2002), Table 7, also report qualitatively similar results for bank distress in Korea.

[15] In the downgrading events of 1995 and 1996 the coefficient on this variable is negative, perhaps reflecting the diminishing importance of bank-firm relationships towards the end of the decade.

[16] This is corroborated in additional regression specifications which include a measure of the firm's dependence on main bank loans and an interaction of this variable with the main bank's excess returns beyond the TOPIX index (not shown). Despite substantial variation in bank stock excess returns (in response to the downgrading of March 1998, for instance, bank stock prices exhibited negative excess returns ranging from −4% to −20%), we find no impact of the bank's excess returns on the excess returns of client firms.

[17] The coefficient on the ratio of total bank loans to total assets is also negative and statistically significant, although its magnitude is much smaller than that of the coefficient on main bank loans.

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Are these results driven by reverse causality? Bank downgrading could be the result of deteriorating financial conditions of client firms, in which case abnormal stock returns would not reflect a response to changes in the ability of banks to offer new credit. To address this possibility, we estimate the regressions separately for firms whose bank is downgraded and for other firms and find that the coefficients are very similar (not shown). This is inconsistent with the possibility that banks are downgraded in response to financial troubles of their client firms, but is consistent with the interpretation that bank downgrading is regarded by investors as evidence of a systemic crisis. We also estimate the regressions for a restricted sample of firms whose size is below the median – that is, firms whose financial position is not important enough to lead to the downgrading of their lending banks – and find that the results are unchanged (although the coefficient of size becomes less statistically significant). This result is also inconsistent with reverse causality. We conclude that the results reflect the impact of the banks' conditions on their own (and other banks') clients, rather than the other way around.

3.3. Bank mergers

The Japanese financial system experienced a merger wave in 1999 and 2000; we focus here on the three largest and presumably most important mergers:

(i) 20/8/1999: Announcement of the formation of the Mizuho group, consisting of DKB, Fuji and IBJ banks.
(ii) 14/10/1999: Announcement of the formation of the SMBC group, consisting of Sumitomo and Sakura banks.
(iii) 14/3/2000: First announcement of the formation of the UFJ group, consisting of Sanwa, Tokai and Asahi banks.[18]

The results are presented in Table 4: although the average effect of the three bank mergers on client firms was zero, bank mergers constituted good news for firms that can be characterized as bank-dependent. There is a strong positive correlation between leverage and abnormal returns in the pooled sample, as well as in each of the mergers separately.[19] Stock prices of firms in low R&D industries also responded positively (in relatively R&D intensive sectors the average CAR was about 1% lower than in low-tech industries), probably because banks tend to finance more traditional activities, and not so much research

[18] Despite the initial announcement, Asahi bank ended up not joining this group. Note that, although the rating of Japanese banks was much lower during this period than earlier in the decade, none of the merging banks we study was in financial distress at the time of the merger. The UFJ merger (with Sanwa bank at its core) generated the most positive abnormal returns of the three mergers – the average CAR for this event was about 4%, compared with −2% for the other two mergers – perhaps because some of the participating banks were perceived as particularly weak prior to the consolidation, and the news about their survival through the proposed merger constituted a very positive surprise. The increase in the bank stock index was higher around the Mizuho merger (15%) than in this case (about 8%).

[19] According to the coefficient estimates in the pooled regressions, highly leveraged companies (with leverage two standard deviations above the mean) experienced positive returns of about 2%. The results remain unchanged when the ratio of bank debt to total assets is included in the regression.

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Table 4
The effects of bank mergers on cumulative abnormal returns of non-financial firms on days (−5,+5)

	All mergers	All mergers	All mergers	Mizuho	SMBC	UFJ
Constant	Event-specific	Event-specific	Event-specific	−0.036	−0.058	0.018
				(0.011)	(0.012)	(0.013)
Assets	−0.000	−0.000	−0.000	0.004	0.002	−0.008
	(0.003)	(0.003)	(0.003)	(0.005)	(0.006)	(0.007)
Tobin's q	0.003	0.003	0.003	0.014**	0.001	0.001
	(0.003)	(0.003)	(0.003)	(0.006)	(0.006)	(0.003)
Leverage	0.052***	0.046***	0.057***	0.037**	0.068***	0.057***
	(0.011)	(0.012)	(0.016)	(0.015)	(0.017)	(0.024)
High-R&D sector dummy	−0.012***	−0.011***	−0.012***	−0.024***	0.012***	−0.025***
	(0.004)	(0.004)	(0.004)	(0.006)	(0.006)	(0.007)
Bond rating	0.004**	0.002	0.004**	0.000	0.005*	0.006*
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)
MB involved dummy	0.000	0.000	−0.001	0.006	0.002	−0.006
	(0.004)	(0.004)	(0.004)	(0.006)	(0.007)	(0.012)
MB loans to total assets			−0.001			
			(0.001)			
MB shareholding			0.001			
			(0.001)			
Bank loans to total assets		0.010*				
		(0.006)				
N	2606	2606	2606	862	862	882
R^2	0.10	0.10	0.10	0.04	0.03	0.04
Average CAR	0.00	0.00	0.00	−0.02	−0.02	0.04
Change in bank stock price index[a]	0.10	0.10	0.10	0.15	0.08	0.08

OLS regressions with event-specific intercepts in the pooled regression and robust standard errors throughout. ***, ** and * denote coefficients significant at the 1%, 5%, and 10% levels, respectively. The coefficient on assets is multiplied by 1,000,000.

[a] The figure in the left three columns is an average.

and development (this finding holds in two of the three mergers and in the pooled sample). Mergers appear to have been good news for firms with a low credit rating, which we regard as having restricted access to bond markets and high dependence on bank finance, in line with the macroeconomic literature on "credit crunch".[20]

Table 4 suggests also that there is not much of a difference between clients of the merging banks and other companies. This is consistent with our results on downgrading

[20] The maximal possible change in credit rating (from no rating to a rating of A, or better) would lower the 11-day returns by about 1%. Carow et al. (2006) who use a different regression specification to analyze the effect of mega-mergers in the US on stock returns of client firms report a positive effect of firm size, which we do not find here.

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announcements, and in line with the findings of Brewer et al. (2003) on three bank failures. One interpretation is that mergers, much like bank downgrading or failure, are viewed as having an impact on the banking industry as a whole.[21] This is supported by the finding that the strength of bank-firm ties has no effect on excess returns in this case: measures of main bank debt to assets or of main bank shareholding are statistically insignificant when included in the regression. Another interpretation for the absence of any difference between firms whose bank is involved in a merger and other firms may be that mergers involving a firm's main bank may have offsetting positive and negative effects: on the one hand they may improve the ability of banks to offer new loans and on the other hand, bank mergers may destroy relationships, or force an equity sale by the merged bank which can drive down the share prices of client firms.

Before moving to a series of robustness tests, we summarize the implications of our results for the literature on the Japanese main bank system. The overall pattern we observe is consistent with the importance of bank debt for firms with limited access to financial markets. The picture is more nuanced with respect to main bank relationships as opposed to bank debt in general. On the one hand, the effect of main bank loans tends to be similar to – and in the case of government policy even stronger than – the effect of leverage. On the other hand, main bank shareholding and whether or not a firm's main bank is involved in an event do not affect the stock returns of client firms in nearly all of the regressions we estimate. This may be partly due to the fact that the variance of main bank loans is much higher than the variance of main bank shareholding. The diminished importance of bank-firm relationships in the late 1990s may also partially account for the statistical insignificance of some measures of bank-firm ties. Our favorite explanation, however, is that a firm's bank dependence in general is a more important determinant of its stock price response to events in the banking sector than relationships with particular banks.[22]

3.4. Robustness tests

We verify that our findings are robust and hold in the following empirical specifications – Table 5 displays the result for the March 1998 downgrading event – the results for other events and other specifications are also robust:

Alternative measures of stock returns: CAR is measured using a shorter event-window, between days −1 and +1 (rather than between days −5 and +5); The market model in the

[21] This interpretation is consistent also with the following result: As in the case of downgrading, the 11-day excess returns of banks (above the TOPIX index) vary dramatically, from up to 35% for some of the merging banks of August 1999, to a mere 2% for Tokyo Mitsubishi bank which was not involved in the event. Yet we do not find that the excess returns of client firms are correlated with the excess returns of their banks.

[22] We also examine the impact of affiliation with a bank centered group (*keiretsu*). In the context of the events we study, we do not think that, controlling for firm characteristics and main bank ties, group affiliation should strongly affect stock price responses, and indeed, when included in the regressions, a dummy variable for affiliation with one of the Presidents Clubs (which include core group firms, about 13% of the sample) generates inconsistent results, which are typically zero and statistically insignificant, but are positive for a few events and negative in a few others (not shown). Our reading of these results is that group affiliation is not a major determinant of the stock price response to events in the banking sector. This is in some contrast with Shin et al. (2003) who study the Mizuho merger and find, using a different specification, a negative impact of *keiretsu* affiliation on stock price responses.

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Table 5
Robustness tests

	DG-3/98	DG-3/98	DG-3/98	DG-3/98	DG-3/98	DG-3/98	DG-3/98	DG-3/98
	Car $(-1,+1)$	Car $(-5,+5)$ 120-day estimate	Raw returns $(-5,+5)$	Car $(-5,+5)$	Car $(-5,+5)$	Car $(-5,+5)$	Car $(-5,+5)$	Car $(-5,+5)$
Constant	−0.005 (0.009)	−0.060 (0.015)	0.090 (0.016)	−0.046 (0.015)	−0.104 (0.015)	−0.097 (0.019)	−0.057 (0.020)	−0.072 (0.018)
Assets	0.005 (0.003)	0.011** (0.005)	0.010*** (0.005)	0.026*** (0.006)	0.024*** (0.006)	0.023*** (0.006)	0.017*** (0.006)	0.022*** (0.006)
Tobin's q	0.023*** (0.005)	0.058*** (0.011)	0.068*** (0.012)		0.067*** (0.012)	0.066*** (0.013)	0.061*** (0.013)	0.060*** (0.011)
ROA				0.008*** (0.001)				
Leverage	−0.133*** (0.012)	−0.088*** (0.015)	−0.116*** (0.014)	−0.107*** (0.027)	−0.181*** (0.026)	−0.174*** (0.028)	−0.156*** (0.029)	−0.151*** (0.025)
High-R&D sector dummy	0.016*** (0.004)	0.024*** (0.006)	0.021*** (0.005)	0.031*** (0.007)	0.034*** (0.007)	0.034*** (0.007)		
R&D/sales (1994)							0.498*** (0.127)	
Industry R&D/sales								1.028*** (0.171)
Bond rating	−0.011*** (0.002)	−0.015*** (0.003)	−0.015*** (0.003)	−0.023*** (0.003)			−0.024*** (0.004)	−0.024*** (0.003)
Unrated dummy					−0.057*** (0.008)			
Rating = 2						−0.007 (0.011)		

(continued on next page)

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Table 5 (*continued*)

	DG-3/98	DG-3/98	DG-3/98	DG-3/98	DG-3/98	DG-3/98	DG-3/98	DG-3/98
Rating = 3						−0.013		
						(0.015)		
Rating = 4						−0.063***		
						(0.012)		
MB involved dummy	−0.001	0.003	0.003	0.011	0.006	0.006	0.002	0.006
	(0.005)	(0.007)	(0.006)	(0.009)	(0.009)	(0.009)	(0.010)	(0.010)
N	829	829	829	829	829	829	715	829
R^2	0.28	0.26	0.31	0.29	0.28	0.29	0.27	0.30
Average dependent variable	−0.04	−0.05	0.90	−0.09	−0.09	−0. 09	−0.09	−0.09

The table illustrates some of the robustness tests for the March 1998 downgrading event. OLS regressions with robust standard errors throughout. Columns display results (from left to right): 3-day instead of 11-day CAR; estimation of the 11-day CAR using 120 (not 40) days; raw instead of excess 11-day returns; ROA instead of Tobin's *q*; a dummy variable for unrated firms; four dummy variables corresponding to the different ratings; firm level 1994 R&D instead of the high R&D dummy; and industry R&D intensity instead of the high R&D dummy. ***, ** and * denote coefficients significant at the 1%, 5%, and 10% levels, respectively. The coefficient on assets is multiplied by 1,000,000.

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CAR calculation is estimated using days −140 to −20 (a 120-day estimation period) instead of using a shorter 40-day period; Raw stock returns between days −5 and +5 are used instead of abnormal returns.[23]

Alternative measures of firm size, performance, rating and R&D intensity: The natural logarithm of assets is used as a measure of firm size instead of assets (not shown); ROA (return on assets) is used as a measure of firm profitability (or "quality") instead of Tobin's *q*; A dummy variable for unrated companies, or four dummy variables corresponding to the four values on the rating "scale", are used instead of a continuous rating variable ranging between one and four. The results suggest that differences between rated and unrated companies are larger and more statistically significant than differences between high-rated and low-rated companies, in line with the common assumption in the credit crunch literature, suggesting that bond rating should be interpreted as a measure of access to financial markets, rather than as a pure measure of risk. The regression results remain unchanged when incomplete 1994 firm-level R&D intensity (a continuous variable, R&D to sales, not available for all firms) is used instead of a dummy variable for firms belonging to R&D intensive sectors, or when industry-level R&D is used instead of a dummy variable for firms belonging to R&D intensive sectors.

Other robustness tests (not shown): Clustered residuals are allowed in regressions with pooled data across events (e.g. all mergers); The ratio of foreign sales (exports and production abroad) to total sales is included – this variable tends to be positive, suggesting that exporting firms are "better" and therefore less sensitive to events in the banking system, or that these firms are more oriented towards foreign markets and less sensitive to domestic market conditions for which the banking troubles proxy; Finally, we examine the stock price responses of firms in the sample to several events unrelated to developments of the banking sector (e.g. the hospitalization of Prime Minister Obuchi on April 3, 2000). These events do not typically generate stock price responses that are correlated with firm characteristics such as credit rating, R&D intensity, etc. Our findings are therefore not due to measurement problems related to the event study methodology, but rather reflect the sensitivity of firms to events in the banking sector.

3.5. Credit crunch vs. "zombies": Some preliminary tests

It has recently become fashionable to argue that Japanese banks tend to "prop" virtually bankrupt companies, for example by "ever-greening" old loans.[24] According to this

[23] In this specification, a one-stage regression is estimated instead of the market model, followed by the excess return regression. This specification is not subject to some concerns associated with event studies (for example, if an event raises all stock returns by a given percent, this may generate different excess returns for firms with different betas).

[24] Peek and Rosengren (2005), for example, describe the "misallocation of credit in Japan associated with the perverse incentives faced by banks to provide additional credit to the weakest firms... in order to avoid the realization of losses on their own balance sheets" (p. 1144).

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Table 6
Cumulative abnormal returns of "zombie" firms; Dependent variable: cumulative abnormal returns on days $(-5,+5)$

	DG-3/98	DG-3/98	DG-3/98	DG-3/98	DG-3/98	DG-3/98
Constant	−0.060	−0.060	−0.061	−0.061	−0.062	−0.061
	(0.019)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)
Assets	0.022***	0.023***	0.022***	0.023***	0.024***	0.024***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Tobin's q	0.063***	0.063***	0.063***	0.063***	0.064***	0.064***
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
Leverage	−0.158***	−0.155***	−0.158***	−0.146***	−0.149***	−0.149***
	(0.029)	(0.024)	(0.025)	(0.024)	(0.024)	(0.025)
High-R&D sector dummy	0.033***	0.032***	0.030***	0.032***	0.032***	0.032***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Bond rating	−0.024***	−0.024***	−0.023***	−0.024***	−0.024***	−0.024***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
MB involved dummy	0.006	0.005	0.006	0.006	0.006	0.005
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
Z1	−0.009					
	(0.013)					
Z2		−0.098				
		(0.088)				
Z3			−0.079**			
			(0.039)			
Z4				−0.037*		
				(0.022)		
Z5					−0.046	
					(0.040)	
Z6						−0.024
						(0.023)
N	829	829	829	829	829	829
R^2	0.28	0.28	0.29	0.28	0.28	0.28
Average dependent variable	−0.09	−0.09	−0.09	−0.09	−0. 09	−0.09

OLS regressions with robust standard errors throughout. ***, ** and * denote coefficients significant at the 1%, 5%, and 10% levels, respectively. The coefficient on assets is multiplied by 1,000,000. The definitions of "zombies" are as follows: Z1 (91 firms) is from Caballero et al. (2006); Z2 is Z1 restricted to the largest size quartile (8 firms); Z3 is Z1 restricted to the construction and real estate industries (18 firms); Z4 is based on the "Troubled 64" (of which 42 firms are included in our sample); Z5 is based on the "Dirty 30" (of which 22 firms are included in our sample) and Z6 is based on the "List of 51" (of which 42 firms are included in our sample).

view, as their own position deteriorates, banks shift more and more of their loans to their worst clients ("zombies" in the terminology of Caballero et al., 2006). By artificially keeping alive poorly performing companies, banks may avoid their own foreclosure; banks may also tend to "gamble", expecting an eventual bailout by the government. In this

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section, we use several criteria to identify "zombie firms" and measure their stock price response to events in the banking sector (Table 6).[25]

Caballero et al. (2006) propose a definition according to which firms whose actual interest payments are lower than the existing risk-free interest rate on debt of similar maturity are classified as "zombies". When this zombie dummy variable (Z1) is added to the regressions (for example, of the impact of bank downgrading), its coefficient tends to be negative (suggesting a stronger adverse effect on "zombies"), but very far from being statistically significant (other coefficients remain unchanged). Non-parametric tests of the sensitivity of these firms to the banking crisis do not produce very conclusive results either.

One possible explanation for this inconclusive result is that this definition of "zombies" is too rough. Indeed, not all of the firms identified by this definition as "zombies" appear to be particularly weak, and some accounting irregularities may partially account for the difficulty in measuring their true cost of debt. We therefore attempt to identify "zombies" using various combinations of the following criteria: relatively large firms, whose performance (q or ROA) is relatively low, and/or whose leverage increased consistently during their 1990s, instead of, or in combination with, the Caballero et al. (2006) interest rate criterion. None of these exercises identifies a group of firms that clearly consists of losers that are artificially kept alive. It is possible that not all "zombies" have these characteristics; for example, their loans may have decreased if some of them were forgiven, or increased due to "ever-greening;" their accounting performance need not always be extremely low, etc. Alternatively, their "zombie-ness" may have been hidden through accounting tricks. Despite these difficulties, if the Caballero et al. (2006) "zombie" definition is refined to include only firms in the top size quartile (Z2), or only firms in the construction and real estate industries (Z3), a very small group of relatively large companies in these industries is identified as having high CAR values for both positive and negative events in the banking system (not all of these firms exhibit low profit rates or increasing leverage ratios).

After the end of our sample period, in 2002, several "zombie" lists became popular in Japanese press. These include James Fiorillo's "Troubled 64", another list called the "Dirty 30" and a list of 51 allegedly "zombie" firms.[26] "Zombie dummies" based on these lists tend to produce negative coefficients, suggesting that these firms are more adversely affected by the malaise of the banking sector, but most of the coefficients are not statistically significant at conventional levels. Assuming that "zombies" tend to be highly leveraged and low-q firms, the negative "zombie" coefficients combined with the finding that highly leveraged, low-q companies are particularly adversely (positively) affected by negative (positive) shocks to the banking sector, is inconsistent with the conjecture that more loans are allocated to the weakest bank clients as the banks' own financial position deteriorates (if this were the case, one would expect them to have a relatively less negative price response).[27]

[25] Two caveats are in order: First, an event-study methodology may not be the most effective way of testing the prevalence and severity of the "zombie" problem – if banks continue to lend to weak client firms even as their position deteriorates, this may or may not elicit a stock price response. Second, the public discourse in Japan about the possible misallocation of credit did not begin during our sample period; to the extent that investors were not aware of the problem, there will be no special stock price response of this group of companies.

[26] See the magazine *Shincho*, November 2002. Daiei, for example, once the biggest retailer in Japan, appears on all three lists, but in general the correlation between them is only 0.4–0.6.

[27] These results are not driven by reverse causality; they hold also in samples of firms whose bank was not downgraded.

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There are other possible conclusions from these empirical exercises. First, it is possible that, until the late 1990s, the number of "zombies" was not as high. Second, to the extent that they did exist, "zombies" were primarily concentrated in the construction and real estate sectors (which were especially sensitive to events in the banking sector). Third, it is possible that loans to "zombies" were not particularly sensitive to events in the banking sector. Finally, it is also possible that investors were not aware of this problem at the time, so no special stock price response can detected.[28]

Taken together, our favorite interpretation of the results in this section – and we acknowledge that other interpretations are certainly possible – is that the most bank-dependent firms probably belonged "middle Japan" – relatively small firms in relatively low-tech sectors with mediocre performance, perhaps in combination with a some "zombies" and some promising firms (see also Arikawa and Miyajima, 2007).

4. Concluding remarks

Three main conclusions emerge from this study. First, the impact of Japan's banking crisis was far from homogenous: not all companies were equally affected by events in the banking sector. Second, companies which we identify as sensitive to the malaise of the banking sector are the ones characterized by the macroeconomic literature as sensitive to "credit crunches": companies with limited access to bond finance (low or no rating), high levels of leverage (and bank debt) and, to some extent, small and low profit companies. We also find that companies in R&D intensive industries were less affected by the banking crisis than companies in more traditional sectors, in line with the view that bank debt is not a major source of finance for R&D. Finally, we do not find much evidence in stock price responses to suggest that the banking crisis led to a substantial misallocation of credit from good to bad firms. This may indicate that the costs associated with the malaise of the banking sector were more likely to be reflected in borrowing difficulties of some positive-NPV firms, rather than in perverse incentives of ailing banks.

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[28] We also investigate the conjecture that the population of firms which were especially sensitive to events in the banking sector consisted of credit-constrained "highly promising" firms (in the lowest size quartile and in the highest q quartile), but do not find evidence in support of this hypothesis.

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