Board of Governors of the Federal Reserve System

International Finance Discussion Papers

Number 549

May 1996

MORE EVIDENCE ON THE LINK BETWEEN BANK HEALTH AND INVESTMENT IN JAPAN

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ABSTRACT

Among stock-market-listed Japanese firms in 1994-95, the financial health of the firm's main bank did not significantly affect its investment behavior, after controlling for stock market valuation and cash flow. However, among the subset of bank-dependent firms, investment was lower by over 50 percent at firms that have one of the lowest-rated banks as their main bank. Because low-rated banks are smaller and deal with fewer firms, and because bank-dependent firms themselves tend to be smaller than non-bank-dependent firms, the aggregate effect on business investment in 1994-95 that I identify is tiny. These results contrast with Gibson (1995), a similar study which, using data for 1991-92, found a small effect of poor bank health on investment for all stock-market-listed Japanese firms and no difference between bank-dependent and non-bank-dependent firms.

More Evidence on the Link between Bank Health and Investment in Japan

Michael S. Gibson[1]

Introduction

Previous research by Gibson (1995) has found that, in 1991-92, the problems in the banking sector in Japan had a small negative effect on business investment in Japan. For those firms that dealt with the weakest banks, investment was lower by 30 percent, compared to firms that dealt with the highest-rated banks. Because the weakest banks were small and dealt with few firms, the aggregate effect on the Japanese economy was small. This paper updates this research, using a different data set over the 1994-95 fiscal year.

Economists have argued that bank credit has few close substitutes, implying that a disruption in the provision of bank credit can affect the real economy. If long-term relationships between banks and firms are important, a disruption at a single bank can affect the firms that deal with that bank, at least temporarily. I look at the investment behavior of a cross-section of Japanese firms, to see if poor health at a firm's main bank is associated with lower investment after controlling for other variables that affect investment. The two control variables I include are Tobin's Q and cash flow. Gibson (1995) performed a similar test, and the theory and prior evidence on the effects of bank health on investment are described there in more detail.

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Empirical Results

The equation to be estimated is

$$\left(\frac{I}{K}\right)_i = \alpha Q_i + \beta\left(\frac{CF}{K}\right)_i + \gamma BANK_i + \epsilon_i \qquad \textbf{(1)}$$

where $(I/K)_i$ is the ratio of gross investment to the replacement value of the capital stock of firm i; Q_i is the ratio of the market value of the firm's capital stock to its replacement cost measured at the beginning of the fiscal year; $(CF/K)_i$ is the ratio of cash flow to capital; $BANK_i$ is a vector of dummy variables identifying the health of the firm's main bank; α and β are parameters, γ is a vector of parameters, and ϵ_i is a mean-zero residual reflecting mismeasurement of Q, optimization error, and other omitted factors affecting a firm's investment. Industry dummy variables are included in the regression to control for industry-specific effects on investment, which could be correlated with Q. The same regression equation was estimated in Gibson (1995), and the pitfalls of estimating such an equation are discussed there.

I constructed a dataset to estimate (1) for fiscal years ending in April 1994–March 1995. Investment, cash flow, and Q were constructed using the Japan Development Bank Corporate Finance Data Bank.[2] A firm's main bank was identified as the bank listed first under the heading "Bank References" in the Japan Company Handbook, Spring 1995.[3] The *BANK* vector, capturing main bank health, will be specified two ways, as in Gibson (1995). In the first specification, the *BANK* vector captures the credit rating of the firm's main bank. *BANK* consists of six dummy variables, corresponding to Moody's credit ratings Aa3–Baa2.[4] In the second specification, the BANK vector consists of thirty dummy variables, one for each bank in the sample. This specification allows banks with the same credit

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[2]For details of the data construction, see the appendix.

[3]See Gibson (1995), pp. 288-290, for an evaluation of alternative ways of identifying a main bank.

[4]Credit ratings were provided by Moody's and are as of the end of March 1994.

rating to have different impacts on the investment of affiliated firms.[5] Summary statistics of the regression variables are shown in Table 1.[6]

The results from estimating (1) on a sample of 1,682 Japanese firms over 1994-95, using credit ratings to proxy for bank health, are shown in Table 2. The coefficients of the credit rating dummy variables are constrained to sum to zero when weighted by the number of firms whose main bank has that credit rating. The constraint implies each coefficient should be interpreted as the effect of having a main bank with that credit rating compared with having a hypothetical "neutral" bank as main bank. None of the credit rating dummy variables have a statistically significant coefficient. In economic terms, the estimated coefficients are small, with the largest coefficient, for main banks rated Baa2, representing a little more than ten percent reduction in average investment. I conclude that, in 1994-95, there was no effect of bank health on investment in the full sample of 1,682 firms.

These results contrast with the results in Gibson (1995), which used the same regression specification but looked at data from 1991-92. There, a statistically and economically significant decline of 30 percent in investment was found for firms that dealt with the lowest-rated banks. Comparing the two results suggests that economic conditions have changed in the intervening three years in a way that reduces the effect of bank health on investment.

Results from estimating (1) using the second specification of the *BANK* vector, dummy variables identifying a firm's main bank, are shown in Table 3. Again, the weighted sum of the coefficients of the dummy variables is constrained to equal zero. The results do not support the hypothesis that having a weak main bank was depressing investment in 1994-95. Coefficients that are statistically significantly

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[5]As it turns out, restricting the coefficients of banks with the same credit rating to be equal is not rejected by the data (p-value = 0.52).

[6]Seven outliers were dropped from the sample.

different from zero at the 5 percent level[7] are present for only two banks; Industrial Bank of Japan has a positive coefficient while Mitsubishi Bank has a negative coefficient. However, both banks are considered healthy banks and are among the highest-rated Japanese banks (rated Aa3). The position of Mitsubishi Bank and Bank of Tokyo at the bottom of the list is curious, since in March 1995 those two banks announced a plan to merge, effective April 1, 1996, creating the world's largest bank. However, it is hard to see how the upcoming mega-merger could have had a depressing effect on the investment of firms that deal with Mitsubishi Bank and Bank of Tokyo during the time period included in the regression, which ended in March 1995 when the merger was announced.

Again, the results in Table 3 contrast with those in Gibson (1995). In that paper, when main bank dummy variables were used to capture bank health in 1991-92, there were statistically significantly negative effects on investment from two low-rated banks, and other low-rated banks had negative, but not statistically significant, effects on investment of affiliated firms. Comparing the same regression at different points in time again leads to the conclusion that economic conditions have changed from 1991-92 to 1994-95 in a way that reduces the effect of main bank health on investment.

Table 4 shows results for sub-samples of "bank-dependent firms" and "non-bank-dependent firms." I define a firm as bank-dependent if it has never issued bonds. As Table 4 shows, the effect of bank health on investment is quite different for the two sub-samples. Looking only at bank-dependent firms, a relationship between bank health and investment appears to exist. Having a main bank rated A3 or Baa2 reduces the investment of a bank-dependent firm by over 50 percent; however, having a main bank rated Baa1 has no statistically significant effect on investment.[8] For non-bank-dependent firms, there is no negative effect of a weak main bank on investment. In fact, there is a small negative effect of having

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[7]Using a two-tailed test, which is appropriate when the null hypothesis of no effect is compared to an "unsigned" alternative.

[8]I also ran the regressions in Table 4 constraining the industry dummy variable coefficients to be the same across equations, and the results were unaffected.

a highly rated main bank on investment, which is probably related to the negative coefficient on Mitsubishi Bank in Table 3, discussed above.

These results contrast with Gibson (1995), where no important difference was found between bank-dependent firms and non-bank-dependent firms.[9] Looking only at the sub-sample of non-bank-dependent firms over 1991-92, Gibson (1995) found a negative effect of a weak main bank on investment similar to the effect found for the full sample. In contrast, using data from 1994-95, I find that whether or not a firm had access to bond markets makes a big difference in whether a firm's investment is sensitive to weakness at its main bank. Conditions in the Japanese economy have changed in the intervening three years so only bank-dependent firms reduce their investment when their main bank is weak. Because only 26 percent of listed firms are bank-dependent, by my definition, the aggregate effect on the economy is much smaller in 1994-95 than in 1991-92.[10]

One result has persisted over the two sample periods. The coefficient on cash flow in the investment regression is higher for non-bank-dependent firms in both samples. In Gibson (1995), the cash flow coefficient was 0.28 for non-bank-dependent firms and 0.15 for bank-dependent firms.[11] Here, the cash flow coefficient is 0.11 for non-bank-dependent firms and 0.06 for bank-dependent firms. Hoshi, Kashyap, and Scharfstein (1991) found that the coefficient on cash flow in a similar regression for Japanese firms was larger for firms with looser ties to their main bank, which they interpreted as evidence of tighter liquidity constraints at firms without looser main bank ties. A similar interpretation of my results would conclude that liquidity constraints are tighter at firms that have issued bonds and looser at firms that rely on banks for all their debt finance. An alternative interpretation, viewing the cash flow coefficient as

[9]See Gibson (1995), Tables 8-11 and accompanying text.

[10]22 percent of firms in my sample are bank-dependent, compared to 26 percent of listed firms. I dropped newly listed firms because they lack sufficient historical data to allow me to estimate the replacement cost of capital; of course, newly listed firms are more likely to be bank-dependent.

[11]Gibson (1995), p. 302.

a measure of agency costs rather than liquidity constraints, would suggest that firms that borrow solely from banks suffer from smaller agency costs, perhaps because of better monitoring by banks.[12]

In Gibson (1995), five checks were done on the robustness of the results to various assumptions implicit in the above approach. The five robustness checks were: excluding firms that may have more than one main bank, since my approach assumes each firm has a single main bank; excluding firms that may have no main bank; adding regional dummy variables to the regression to control for regional shocks to investment that may be correlated with the identity of the firm's main bank; repeating the estimation procedure with a random bank identified as main bank, to see if the initial results were spurious; and splitting the sample by firm performance, to make sure that reverse causality, from firm performance to bank health, was not driving the results. None of the five robustness checks gave a reason to doubt the results.

Here, I provide two additional robustness tests. First, I exclude from the regression firms that are majority-owned by another firm. The relationship between main bank health and investment may be different at majority-owned firms if the majority owner, and not the bank, is expected to bear the burden of supporting the firm in case of financial distress. If that were the case, investment would depend more on the health of the majority owner than on the health of the main bank.

I dropped the 119 firms whose largest shareholder owned more than 50 percent of the shares and re-estimated (1). I also re-estimated (1) for the subsamples of bank-dependent and non-bank-dependent firms. The conclusions I came to above are unchanged without the 119 majority-owned firms.[13]

The second robustness test investigates whether the effect of bank dependence is merely a function of firm size. Bank-dependent firms are smaller firms, so it could be the case that by splitting the sample

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[12]Lichtenberg and Pushner (1994) find that firms with high ownership by financial institutions have higher productivity and profitability than firms with low ownership by financial institutions, consistent with superior shareholder monitoring of management at firms with high ownership by financial institutions.

[13]A table with the results of these regressions is available upon request from me.

according to whether or not a firm has issued bonds, I am picking up an effect of firm size rather than a true bank-dependence effect. To investigate this possibility, I split the sample by size and compared the results to the results when the sample is split by bank-dependence. I use the market value of tangible fixed assets to measure firm size, and I split the sample at the 25th percentile. The subsample of small firms contains 421 firms, compared with 372 firms in the bank-dependent subsample.

Table 5 shows results of estimating (1) separately for the small and large firm subsamples. Comparing the results for the subsample of small firms with the results in Table 4 for bank-dependent firms, the results are broadly similar, as they must be given the strong correlation of bank dependence with firm size. However, only for the subsample of bank-dependent firms does a statistically significantly negative coefficient on the A3 and Baa2 credit rating dummy variables exist. If bank dependence mattered only because it was picking up an effect that was truly stemming from firm size, the effect of bank health on investment would be stronger, not weaker, for the subsample of small firms compared to the subsample of bank-dependent firms. I conclude that bank-dependence does a better job than firm size of identifying a subgroup of firms for which bank health appears to matter for investment behavior.

Additional Evidence

Three additional pieces of evidence support my conclusion that, in 1994-95, weakness of Japanese banks was not depressing business investment. Businesses did not perceive bank credit to be tight, according to the responses to the Bank of Japan's Tankan survey, shown in Figure 1. According to the 700 large non-financial firms surveyed, the lending attitude of financial institutions was much more accommodative in 1994-95 than in 1991, during the Japanese recession. Consistent with this, I do not find a significant effect of bank health on investment in 1994-95, but Gibson (1995) did find such an effect in 1991-92.

Investment at small firms may depend more strongly on bank health, as the results for bank-dependent firms discussed above suggests. Figure 2 addresses this question by comparing investment of small and large firms. Investment of small and large firms moved in the same direction over the 1990-94 fiscal years, encompassing the time period covered in this study as well as that covered in Gibson (1995). However, there is a divergence in investment forecast for the current fiscal year. A greater dependence on bank finance is only one of many ways in which small firms differ from large firms, but the marked difference suggests that something, perhaps the poor health of the banking sector, is restraining investment by small firms. This does not necessarily contradict the regression results presented above, which include only firms listed on a stock market, or the Tankan survey data in Figure 1, which includes responses from large firms.

Table 6 shows how the investment of the private nonfinancial corporate sector has been financed since 1989. Using flow of funds data, I calculated the percentage of fixed and inventory investment financed from various sources. Although everything in the table is to some extent endogenous, including the amount of investment to be financed, internal funds and desired investment should be thought of as determined first, according to a firm's prior profitability and future business prospects. The firm would then look to raise external funds to finance the gap between desired investment and internal funds, perhaps reducing its desired investment if external funds were not available at an acceptable interest rate.

Three aspects of Table 6 are worth noting. First, in 1994 internal funds (line 1) exceeded investment. The aggregate investment of the nonfinancial corporate sector was certainly not constrained by a lack of external finance, though individual firms may have been. Second, firms reduced their net borrowing from private financial institutions in 1994 (line 2) while continuing to borrow substantial amounts from the public financial institutions (line 3) which recycle postal savings deposits and to some extent substitute for private bank finance. Third, throughout the 1990s, as private bank loans became a less important source of finance, firms did not, on balance, increase the share of finance from public debt or equity securities (lines 4 and 5). Had banks been unwilling or unable to lend to firms, firms could have issued debt or equity, although the low levels of equity financing are at least partially due to the Ministry of Finance's informal moratorium on equity issuance by most listed firms since 1990. Together, these three points suggest that desired investment has been declining faster than the availability of private bank loans in recent years.

Conclusions

In 1994-95, the poor health of Japanese banks was not a drag on business investment at most stock-market-listed firms. Firms that depend on banks for all debt finance are the exception; at those firms, having a main bank rated Baa2 (the lowest of any Japanese bank in my sample) meant investment was 50 percent lower than having a "neutral" main bank. Since bank dependent firms are small and few, the aggregate effect on the Japanese economy of the poor health of Japanese banks was tiny.

Because bank lending and main bank relationships are concentrated at the "big six" city banks, only a severe problem at one of them would have a measurable, though still small, effect on the Japanese economy. For example, if a "big six" city bank were downgraded to Baa2 (a drop of three to five credit ratings, depending on the bank), the regression results for bank-dependent firms predict a drop in the aggregate investment of bank-dependent firms in the sample of 0.3-0.7 percent. This would be a small decline relative to Japan's recent history. (Business investment in Japan fell 21 percent from its peak in 1991 to the first quarter of 1995.) I conclude that the problems in the banking sector are unlikely to have an important negative effect on business investment in Japan. Whether the incipient Japanese recovery will be affected by the condition of the banks is left as a topic for future research.

Table 1. Summary statistics of the full sample (N = 1,682)

Variable	Mean	SD
Investment/K	.05	.08
Q	.85	2.96
Cash flow/K	.08	.16
K (million ¥)	99,106	339,950

Table 2. Results using credit ratings to pick up bank-specific effects

Independent variables	Dependent variable: Investment / K		
	Coefficient	*t*-statistic	Number of firms
Q	.001	1.3	
Cash flow / K	.088	6.6	
Credit rating dummies:			
Aa3	−.003	1.1	472
A1	.001	0.3	546
A2	.004	1.3	414
A3	−.002	0.3	114
Baa1	.001	0.1	80
Baa2	−.006	0.6	56
Standard error of the estimate	.075		
Adjusted R^2	.05		

Note: The weighted sum of the credit rating dummy variable coefficients was constrained to equal zero (when weighted by the number of firms). The regression included 18 industry dummy variables.

Table 3. Results using dummy variables to pick up bank-specific effects

Independent variables	Coefficient	t-statistic	Number of firms
	Dependent variable: Investment / K		
Q	.001	1.6	
Cash flow / K	.082	6.0	
<u>Main bank dummy variables</u>			
Industrial Bank of Japan	.015	2.0	111
Hachijuni Bank	.045	1.7	9
Fuji Bank	.008	1.4	184
Japan Development Bank	.016	1.1	29
Asahi Bank	.009	1.0	71
Sakura Bank	.005	0.9	201
Sumitomo Trust and Banking	.012	0.7	22
Chugoku Bank	.018	0.6	6
Shizuoka Bank	.010	0.4	10
Hiroshima Bank	.008	0.4	11
Daiwa Bank	.004	0.4	49
Mitsui Trust and Banking	.006	0.3	17
Sumitomo Bank	.001	0.2	162
Long-term Credit Bank of Japan	.002	0.1	25
Hokkoku Bank	.000	0.0	8
Ogaki Kyoritsu Bank	−.008	0.2	5
Hokkaido Takushoku Bank	−.009	0.3	8
Hokuriku Bank	−.008	0.5	17
Ashikaga Bank	−.016	0.5	5
Tokai Bank	−.003	0.5	121
Yasuda Trust and Banking	−.019	0.6	5
Bank of Fukuoka	−.016	0.6	7
Nippon Credit Bank	−.016	0.6	8
Bank of Yokohama	−.010	0.6	22
Mitsubishi Trust and Banking	−.011	0.6	20
Sanwa Bank	−.004	0.7	174
Norinchukin Bank	−.024	1.0	10
Dai Ichi Kangyo Bank	−.008	1.4	183
Bank of Tokyo	−.042	1.6	8
Mitsubishi Bank	−.014	2.5	169
Standard error of the estimate	.077		
Adjusted R^2	.04		

Note: The weighted sum of the main bank dummy variable coefficients was constrained to equal zero (when weighted by the number of firms). The regression included 18 industry dummy variables. Only banks with five or more firms were included; five firms were dropped as a result.

Table 4. Split the sample between bank-dependent firms and non-bank-dependent firms

	Dependent variable: Investment / K					
	Bank-dependent			Not bank-dependent		
Independent variables	Coeff.	*t*-statistic	Number of firms	Coeff.	*t*-statistic	Number of firms
Q	.002	1.5		.001	0.6	
Cash flow / K	.061	2.7		.113	5.8	
Credit rating dummies:						
Aa3	.008	1.0	98	−.006	2.0	374
A1	−.004	0.6	109	.002	0.8	437
A2	.010	1.2	92	.002	0.7	322
A3	−.030	1.9	30	.009	1.2	84
Baa1	.011	0.6	27	−.002	0.2	53
Baa2	−.036	1.6	16	.002	0.2	40
Number of firms	372			1310		
Standard error of the estimate	.089			.075		
Adjusted R^2	.08			.05		

Note: The weighted sum of the credit rating dummy variable coefficients was constrained to equal zero (when weighted by the number of firms) in each regression. Each regression included 18 industry dummy variables.

Table 5. Split the sample between small firms and large firms

	Dependent variable: Investment / K					
	Small firms			Large firms		
Independent variables	Coeff.	*t*-statistic	Number of firms	Coeff.	*t*-statistic	Number of firms
Q	.001	0.8		−.0004	0.4	
Cash flow / K	.046	2.6		.208	8.0	
Credit rating dummies:						
Aa3	.006	0.9	124	−.006	1.9	328
A1	−.006	0.9	119	.002	0.8	427
A2	.004	0.6	119	.002	0.7	295
A3	−.023	1.4	26	.007	1.0	88
Baa1	.024	1.2	18	−.004	0.5	62
Baa2	−.021	1.0	15	−.000	0.0	41
Number of firms	421			1261		
Standard error of the estimate	.085			.070		
Adjusted R^2	.05			.07		

Note: The weighted sum of the credit rating dummy variable coefficients was constrained to equal zero (when weighted by the number of firms) in each regression. Each regression included 18 industry dummy variables.

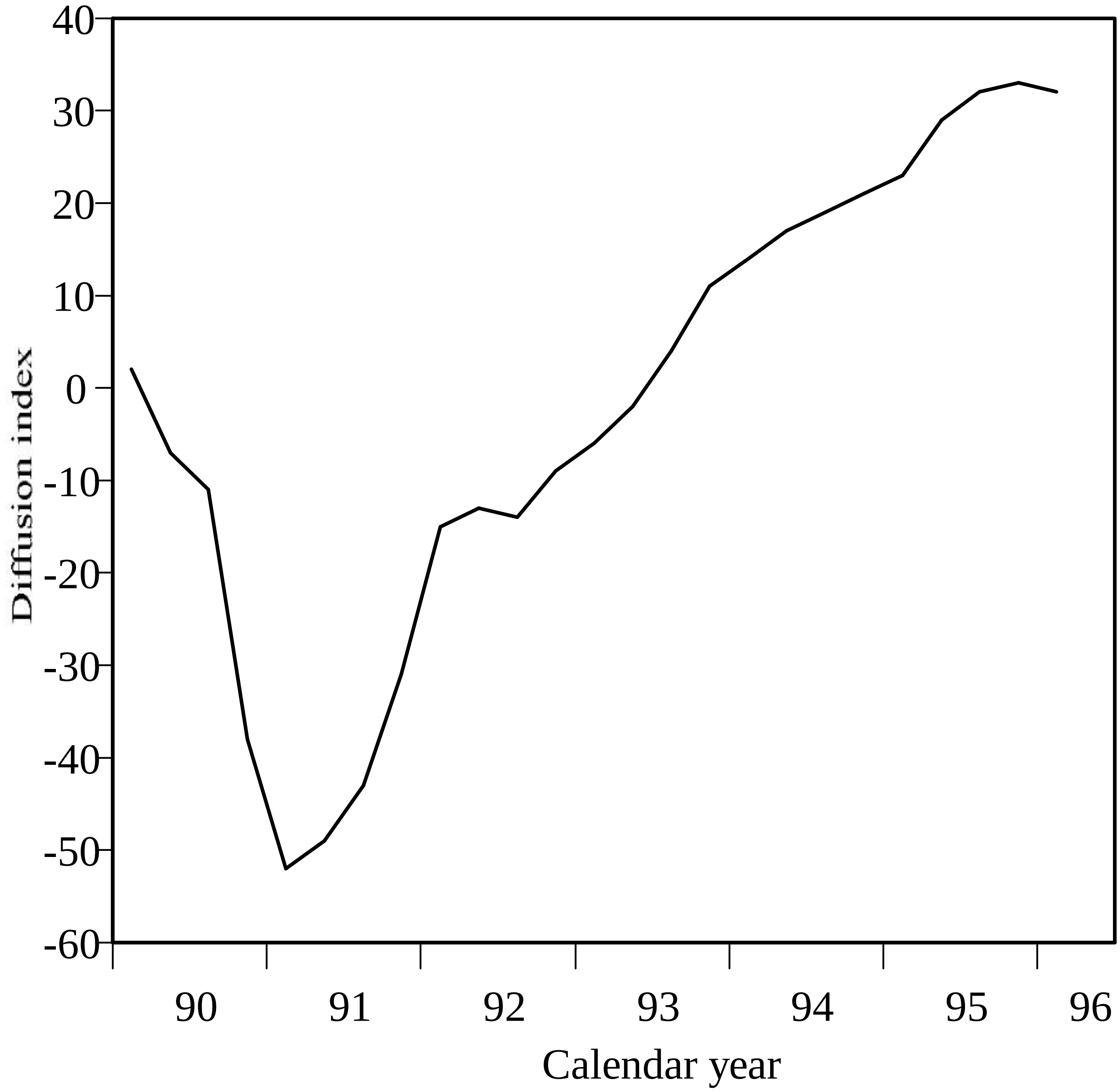
Table 6. Net Sources of Investment Finance for Nonfinancial Corporations (percent)

		1989	1990	1991	1992	1993	1994
1	Internal funds	63	55	64	65	77	107
2	Private financial institutions	15	36	28	16	10	-12
3	Public financial institutions	8	7	7	11	12	11
4	Debt securities*	16	4	7	7	3	3
5	Equity*	8	2	3	1	-2	8
6	Other (including trade credit)	-10	-4	-9	0	-1	-17
7	Memo: Investment (trillion yen)	80	92	89	76	63	57

Source: Bank of Japan, Flow of Funds in Japan

* convertible bonds are included in debt securities when issued and in equity upon conversion

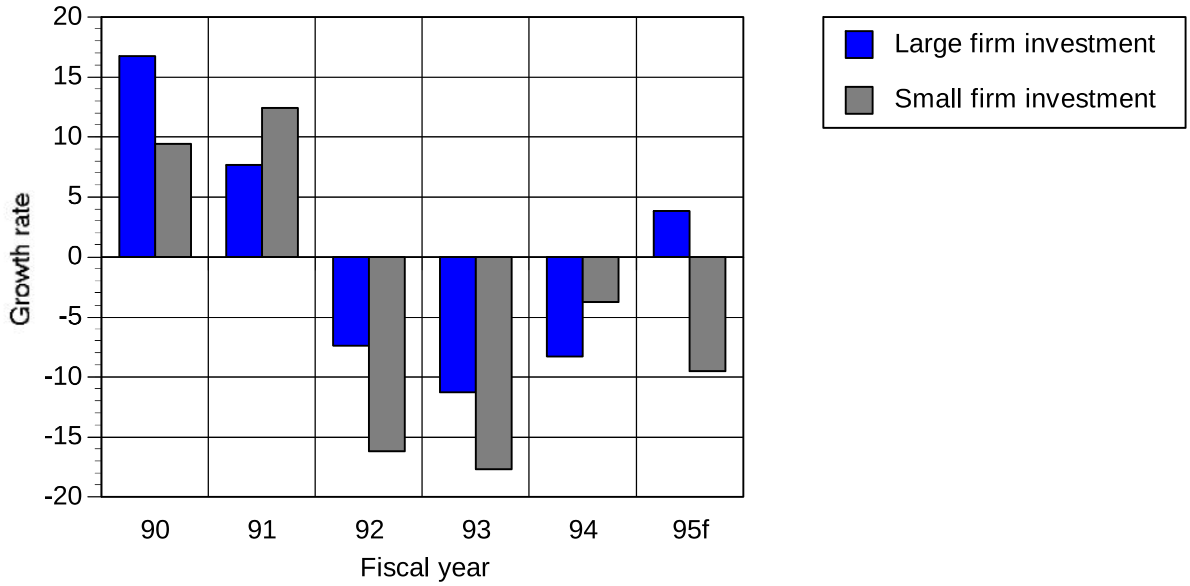
Figure 1. Lending attitude of financial institutions



Diffusion index: percentage of firms answering "accommodative" minus percentage of firms answering "severe"

Source: Bank of Japan, Short-term economic survey of enterprises (Tankan survey)

Figure 2. Investment growth (percent)



Data for fiscal years beginning in April.
1995 is a forecast as of February 1996.
Large: more than 1000 employees; small: 50–299 employees.

Source: Bank of Japan, Short-term economic survey of enterprises (Tankan survey)

Appendix

The regression variables I/K, Q, and CF/K were constructed using the Japan Development Bank Corporate Finance Data Set, which contains balance sheet and income statements for stock-market-listed non-financial Japanese firms. The main obstacle to be overcome is to convert the capital stock from book value, as it appears in the dataset, to replacement value. Hayashi and Inoue (1991) used the same data set, they faced the same obstacle, and I follow their methodology closely. I will describe in general terms how I proceeded and where my methodology varied from theirs; refer to their paper for additional details.

The dataset divides reproducible tangible fixed assets into five categories: buildings, structures, machinery and equipment, vehicles, and tools. Following Hayashi and Inoue (1991), for each category, I performed a perpetual inventory calculation to estimate replacement cost using accounting data on book value, accumulated depreciation, and asset sales/retirements, along with a depreciation rate and price index specific to that category of assets. I began the perpetual inventory calculation in 1970 (or whenever a firm joined the dataset) by assuming that book value and replacement cost were equal. Investment is computed as the acquisition of new assets less the replacement cost of sold or retired assets. Replacement cost of sold or retired assets was not given in the dataset, but was estimated by multiplying the book value of sold or retired assets by the ratio of market value to book value for the asset category. I dropped firms that joined the database after March 1990, because the initializing assumption that replacement cost and book value are equal would be too influential for those firms.

The replacement cost of land, still following Hayashi and Inoue (1991), was also estimated with a perpetual inventory calculation. However, since assuming that book value equaled replacement cost in the initial year of the perpetual inventory calculation would be unrealistic, I initialized the perpetual inventory calculation by assuming the replacement cost of the firm's land holdings in the first year for which book value data was available was equal to its book value multiplied by the ratio of market value to book value for the entire corporate sector.

Inventories were broken down into three categories: final goods, work in process, and raw materials. Hayashi and Inoue used different price indices for firms in different industries; I did not. For finished goods inventories, I used the wholesale price index for final goods. For raw materials inventories, I used the wholesale price index for raw materials. For work-in-process, I averaged the finished goods and raw materials price indices. The replacement cost of inventories was estimated differently, depending on which accounting method the firm used. A perpetual inventory calculation was only necessary when a firm used FIFO accounting. When a firm reported more than one accounting method for an inventory category, I used the average value of inventories under all methods it reported.

For other assets, the replacement cost is assumed to be book value. Although this assumption is undoubtedly wrong for some assets, not enough information was available to make a better estimate of replacement cost than book value. The one exception is stocks of affiliates, which are often held on the balance sheet at a very low value. As an imperfect estimate of replacement cost, and following Hayashi and Inoue, I estimated replacement cost by dividing dividends received from affiliates by the average dividend-price ratio for all firms listed on the first section of the Tokyo Stock Exchange.

Mergers were handled in two ways. For mergers where the merging firms were included in the data set before the merger and the successor firm was included in the data set after the merger, I added the pre-merger financial data of the non-surviving firms to that of the surviving firm and performed the perpetual inventory calculation as if the combined data had always represented a single company. Before April 1982, this was done by the Japan Development Bank when they generated the data set; in April 1982, they stopped combining pre-merger records, so for mergers in or after April 1982, I combined pre-merger records manually. For mergers involving firms not included in the data set, the preceding method does not work. For these mergers, I dropped all pre-merger data and set the replacement value of the capital stock at the time of the merger equal to its book value multiplied by the average ratio of market value to book value for the industry in which the merged firm operates. I dropped firms that merged after 1990.

The sum of reproducible tangible fixed assets and land equals the capital stock, denoted as K in the text. Investment is computed as the change in K, taking price changes into account. Cash flow is computed as income before tax plus depreciation, less taxes paid. Tobin's Q is defined as the ratio of the market value of the firm's tangible fixed assets to their replacement cost. The numerator of Q is computed as the sum of the book value of the firm's debt and the market value of the firm's equity (stock price times number of shares outstanding) less the market value of all assets except for tangible fixed assets (inventories, stocks of affiliates, and other assets). The denominator of Q is the capital stock, K. Because Q is measured with a great deal of error, some values of Q take on extreme values, including negative values. I prefer not to drop firms with an implausible value for Q, since measurement error is so large. Instead, I check thoroughly for outliers and influential observations, as described in the text.

Industry classifications are made on the basis of Japan Development Bank Industry Codes at the equivalent of the two-digit SIC level. Examples of industry groupings are: food manufacturing (101 firms), textile manufacturing (75), wood, pulp, and paper manufacturing (31), chemical manufacturing (167), etc.

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