The Main Bank System and Corporate Investment: An Empirical Reassessment

by

Fumio Hayashi
Tokyo University

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ABSTRACT

This paper examines whether the sensitivity of corporate investment to internal funds depends on the firm's access to a main bank, using the sample of Japanese manufacturing firms constructed by Hayashi and Inoue (1991). For either of two classifications of firms by their access to a main bank, there is no evidence that main bank ties mitigate the sensitivity of investment to the firm's liquidity. The large effect of main bank ties reported in Hoshi, Kashyap, and Scharfstein (1991) is most likely due to the relatively poor quality of their capital stock estimate.

Author's address: Department of Economics, Tokyo University, Tokyo 113, Japan
email: hayashi@e.u-tokyo.ac.jp

1. Introduction

There is a large theoretical and empirical literature exploring the link between corporate investment and internal funds. In the idealized world of no information asymmetries and no taxes, it is immaterial how investment is financed. If future profitability is properly controlled for, by including Tobin's q in an equation explaining investment, investment should not be sensitive to the firm's liquidity. There are two explanations for why investment can be excessively sensitive to the firm's liquidity. The traditional explanation is that there is a pecking order in the source of investment finance. With taxes providing the interest deductibility for debt finance at the corporate level and preferential treatment of capital gains over dividends at the personal level, retention is the cheapest source of finance, followed by debt and then new share issues. Investment will be excessively sensitive to the firm's liquidity because the cost of investment finance depends on the level of investment.[1] The more modern explanation is the agency models featuring the incentive problem faced by managers or the information asymmetry between managers and shareholders.[2]

It is an increasingly popular view that the Japanese main bank system, with its intensive monitoring of the firm's activities, is an institution to overcome the information problems.[3] The view leads to the prediction that corporate investment for firms with strong ties to a main bank should be less sensitive to liquidity than for those without. The most widely-known empirical evidence is the q-based equation estimated in Hoshi, Kashyap, and Scharfstein (1991).[4] They examine two sets of firms derived from

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[1] For a q model of investment with the pecking order of corporate finance, see Hayashi (1985).

[2] See, for example, Myers and Majluf (1984).

[3] See, Aoki, Patrick, and Sheard (1994) for a survey of the literature on the main bank system.

[4] Okazaki and Horiuchi (1992) report for a sample of 38 Japanese firms that the effect of liquidity is smaller (but not significantly so) for firms with main bank ties. The investment equation they estimate, however, does not include q.

Nakatani's (1984) study of *Keiretsu*: those firms affiliated with Japanese *Keiretsu* (which they called group firms) and those that have no such affiliation (independent firms). They argue that the close bank relationship enjoyed by group firms is likely to mitigate the inform problem. Consistent with this view, they find evidence for the differential liquidity effect, namely that investment is much less sensitive to measures of liquidity for group firms than for independent firms. Their sample period is 1977-82, the period before the substantial liberalization of the stunted Japanese corporate bond market.

Hayashi and Inoue (1991), too, examined the liquidity effect in a *q*-based investment equation using micro data on Japanese firms. They find that the liquidity effect exists only for domestic firms producing non-traded goods, which is consistent with the view that the apparent liquidity effect is merely proxying the firm's market power. As will be explained in the next section, there are good reasons to believe that the data set used by Hayashi and Inoue is of much higher quality than that used by Hoshi *et. al.* (1991). Hayashi and Inoue, however, did not divide the sample according to main bank ties. The main purpose of this paper is to see whether the large differential effect reported in Hoshi *et. al.* (1991) can be found in the data set used by Hayashi and Inoue (1991) for the same sample period of 1977-82.

The content of the paper is as follows. Section 2 describes the two micro data sets on firms to be used in this study. One is the Hayashi-Inoue data set just mentioned. The other is the data set described in Hoshi and Kashyap (1990). The sample used in Hoshi *et. al.* (1991) is a subset of an earlier version of this second data set. Because some of the independent firms in Nakatani's (1984) classification may well have main bank ties, we will entertain an alternative and more direct classification of firms, used in Campbell and Hamao (1994) and described briefly in Section 2, which checks whether the bank with the largest loan share for the firm in question is one of the city, trust, or long-term credit banks. In Section 3, we estimate a *q*-based investment equation for subsamples divided according to the classifications of Nakatani and Campbell-Hamao. Our results based on the Hayashi-Inoue sample indicate that the differential liquidity effect between group and independent firms is much smaller than is reported in Hoshi *et. al.* (1991) and disappears completely if extreme cases are removed. The large differential effect is indeed found for the Hoshi-Kashyap sample, but the result should be discounted because of its small sample size and the allegedly poor quality of the investment data. These and other conclusions are contained in Section 4.

2. The Data

2.1. Two Micro Data Sets on Japanese Manufacturing Firms

In this study we use two existing micro data sets on Japanese manufacturing firms for estimating the investment equation for 1977-1982. The first is the data set used in Hayashi and Inoue (1991). Their sample consists of 687 manufacturing firms. It is a subset of the 942 manufacturing firms listed on the Tokyo Stock Exchange (TSE) in 1977. The subset is obtained by eliminating (i) those that ceased to be listed by 1986 (62 firms), (ii) those whose stocks were suspended for trading around the beginning of accounting year between 1977 and 1986 (2 firms), (iii) those that changed the fiscal year by 1986 (142 firms), (iv) those that acquired other traded firms (48 firms), and (v) one firm (Fuji Kosan) with a massive change in the capital stock between 1977 and 1986.

Hayashi and Inoue constructed the variables for analysis (such as investment, the capital stock, Tobin's *q*) from the company reports compiled by Japan Development Bank (JDB). The JDB data base is very detailed on the composition of the company's assets, which allows us to obtain the following information needed to carry out the perpetual inventory calculation of the capital stock. First, the change in the gross capital stock can be divided between new acquisition of assets and sales of existing assets, and there is enough information to estimate the reproduction value of those assets sold by the firm. Therefore, investment can be calculated as new acquisitions of physical assets less the reproduction value of assets sold.[5] Second, investment can be broken down between five asset types. From this information, Hayashi and Inoue (1991) construct the capital stock for each asset type by the perpetual inventory method calculation. The physical depreciation rates for the calculation are taken from Hulten and Wykoff (1979), the standard source for depreciation rates. The starting year of the calculation is 1962 (or the year the firm is first listed if it comes after 1962). The sample statistics for selected variables are reported in Table 1 along with a fairly detailed definition of those variables.

The other micro data set is the one described in Hoshi and Kashyap (1990). Their sample consists of 580 manufacturing firms. It is a subset of the 972 manufacturing firms listed on the TSE in 1989. The subset is obtained by eliminating (i) those that were not continuously listed between 1964 and 1989, (ii) those that were involved in mergers or spin-off, (iii) those whose shares were suspended for trading around the beginning of accounting years, and (iv) those that have had an absolute value of their estimate of Tobin's *q* greater than 50. Hoshi and Kashyap constructed the variables for analysis from the Nikkei Financial Data tapes, which have much less information about the asset composition than available from the JDB data base. A very indirect method must be used to estimate investment because there is no data on gross capital stock. Also, total investment cannot be broken down between asset types. Thus we would expect the capital stock estimates in the Hoshi-Kashyap data set to be far less reliable than those in Hayashi and Inoue (1991).

There are 197 firms that are in the Hayashi-Inoue sample but not in the Hoshi-Kashyap sample. This is mainly because requirement (i) in the Hoshi-Kashyap sample is considerably stronger than (i) in the Hayashi-Inoue sample. On the other hand, there are 90 firms in the Hoshi-Kashyap sample that are not in the Hayashi-Inoue sample. This is because of the requirement for the Hayashi-Inoue sample that there be

[5] For more details, see the Appendix of Hayashi and Inoue (1991).

no change in the fiscal year. The intersection of the two samples has 490 firms. For those 490 firms, both the Hayashi-Inoue data set and the Hoshi-Kashyap data set have information on *I/K*, Tobin's *q*, and the cash flow rate. To compare the quality of the two data sets, Table 2 show the sample statistic for those three common variables. Because the definition of cash flow cannot be much different between the two data sets, the difference in the estimate of the cash flow rate (the ratio of cash flow to the capital stock) is due to the different capital stock estimates. The high mean cash flow rate in the Hoshi-Kashyap data set must mean that its capital stock is much smaller on average than in the Hayashi-Inoue data set. The reason that the mean of Tobin's *q* is slightly *higher* in Hayashi-Inoue despite its larger capital stock estimate is probably due to the difference in the way tax adjustment on *q* is performed.[6] Despite the fact that the mean is similar between the two data sets, the standard deviation of *q* is much larger in Hoshi-Kashyap, which strongly suggests that the capital stock in the Hoshi-Kashyap data set is poorly measured. This conclusion is reinforced by the fact that the Hoshi-Kashyap sample was obtained after dropping those firms whose *q* is less than 50 in absolute value.

2.2. Two Classifications by Main Bank Status

To estimate the investment equation for various sub-samples distinguished by the firm's access to the main bank, we need information about the firm's main bank status. We use two different classifications. Campbell and Hamao (1994) determine whether the firm has a main bank or not based on the bank loan information. For each firm, they find the bank with the largest outstanding loan balance. If the bank with the largest loan share is one of the 19 city, trust, and long-term credit banks, the firm is presumed to have main bank ties. Otherwise the firm has no main bank. We use their classification for 1983/84. This

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[6] Apart from the tax adjustment due to accounting depreciation, the *q* in Hayashi-Inoue inflates the ratio of the market value of the firm to the reproduction cost of the firm by a factor of $1/(1-\tau)$, where τ is the corporate tax rate. See their formula (2.18) with (2.2).

dichotomous classification will be referred to as the *Hamao classification*.

The second classification is derived from Nakatani's (1984) study of *Keiretsu*. Those firms deemed by Nakatani to belong to one of the six *Keiretsu* (Mitui, Mitsubishi, Dai-Ichi, Sumitono, Fuyo, Sanwa) will be referred to as the *group firms*. Those deemed independent will be referred to as the *independent firms*. The remaining firms in the Nakatani classification are either subsidiaries or those deemed unclassifiable. Hoshi *et. al* (1991) examined the difference in investment behavior between group firms and independent firms.

For those firms included in the Hayashi-Inoue sample, the relationship between the two classification schemes is as in the cross-tabulation in Table 3. For group firms, there are far more firms with main bank ties than those without. This is what we would expect, because *Keiretsu* is centered around a big bank having strong ties with the other firms in the same *Keiretsu* in the form of loans and cross-share holdings. It is noteworthy, however, that a substantial fraction of independents have a main bank according to the Hamao classification.

3. Main Bank Ties and Investment

3.1. Investment Equation

In this section, we examine investment behavior for various subsets of firms defined by the two classification schemes just described. The investment equation we estimate is of the standard variety:

$$I_{it}/K_{it} = \alpha_t + \beta q_{it} + \gamma CF_{it} + u_{it} \quad (t = 1977,\ldots, 1982),$$

where I_{it} is investment for firm i in year t, K_{it} is the capital stock at the beginning of the year, q_{it} is Tobin's q at the beginning of the year, CF_{it} is the cash flow rate, and u_{it} is the error term. A more detailed definition of the variables is in the note to Table 1. In particular, the firm's cash flow is defined as after-tax earnings plus accounting depreciation less dividends. This is a standard measure of the firm's liquidity. The cash flow rate *CF* is the ratio of cash flow to the capital stock. If dividends were not deducted from cash flow, *CF* would be equal to the gross profit rate. The intercept in the investment equation is allowed to vary over time while the coefficients are constrained to be the same over time.

The investment equation with $\gamma = 0$ can be derived from the standard *q*-theory of investment with adjustment costs and perfect competition. In the *q*-theory, the error term *u* is an unobservable variable that shifts the adjustment cost schedule. Given this *u*, optimal investment depends only on *q*, which summarizes all the information about future profitability relevant to the firm's investment decision. However, even if the model is correct, the OLS estimate of the *CF* coefficient in the regression of I/K on *q* and *CF* can be significant for a number of reasons.[7] First, the error term *u* affects adjustment costs and hence profits and cash flow. So cash flow is a function of *u* and can be correlated with *u*. Second, for the same reason, *q* can be correlated with *u*. Even if the cash flow rate *CF* were uncorrelated with *u*, it can pick up a significant coefficient through its correlation with *q*. Third, if, as is highly likely in micro data, *q* is measured with error, the classical errors-in-variables problem arises and *q* is correlated with *u*. Again, *CF* can enter the equation with a significant coefficient. This point -- that the liquidity variable can be significant under the *q*-theory -- is not sufficiently well appreciated in the literature, but is duly noted by Hoshi *et. al.* (1991). They don't claim that the mere significance of *CF* is evidence for the liquidity effect. They claim, correctly, that the *differential* effect of the liquidity variable *CF* between the two sets of firms facing different information and incentive problems can be taken as evidence for the liquidity effect.

3.2. Group vs. Independent Firms

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[7] See Hayashi and Inoue (1991) for a fuller discussion.

Following Hoshi *et. al.* (1991), we first examine the group and independent firms, the two distinct subsets in the Nakatani classification. As shown in Table 3, of the 687 firms in the Hayashi-Inoue sample, there are 191 group firms (that is, the intersection of Nakatani's group firms and the Hayashi-Inoue sample has 191 firms) and 55 independent firms. Table 4 displays the simple statistics. Measured by the size of the capital stock, independent firms are on average larger than group firms. The (gross) profit rate is higher for independents, which corroborates the point made by Nakatani (1994). Also, the independent firms grow faster (as indicated by the higher mean of I/K) and have higher q.

Table 5 displays the estimated investment equation for the two subsamples (for the time being, ignore the last column). For each subsample, two estimation techniques are used. The first is the straight pooled OLS. The OLS standard errors, however, can be biased because the method does not take into account the serial correlation in the error term (the correlation between u_{it} and u_{is} for $t \neq s$). The OLS standard errors reported in the table incorporates the serial correlation (see the Appendix for the formula). The second method is the standard fixed-effects estimator.

It is useful to start with the fixed-effects estimates, because that is the estimation technique used by Hoshi *et. al.* (1991) in their estimation of the investment equation. For group firms both q and the cash flow rate (*CF*) are significant, while for independents *CF* dominates q. The *CF* coefficient for group firms of 0.3826 is substantially higher than that for independents of 0.2051. The t value for the difference is 2.1, significant at 5%.[8] Therefore, the qualitative result of Hoshi *et. al.* (1991) -- that the liquidity effect is stronger for independents than for group firms -- is reproduced in the Hayashi-Inoue sample, although the magnitude of this differential effect of liquidity is not as great as might be expected from their fixed-effects

[8] Since the two samples are independent, the (asymptotic) variance of the difference is the sum of the variance of the point estimate from group firms and the variance of the point estimate from independents. Thus the asymptotic standard deviation of the difference is the square root of the sum of standard errors.

estimate of their investment equation shown in Table II of Hoshi *et. al.* (1991).

This result, however, is a fragile one. If the estimation method is the pooled OLS, the opposite result emerges. The liquidity effect, measured by the coefficient of the cash flow rate, is now *weaker* for independent firms. For either group, q is no longer significant.

Why the choice of estimation technique makes so much difference for coefficient estimates, particularly for independents? For independents, the sample size is only 55, so only a few extreme firms may be pulling the regression coefficients in strange directions and this may be more serious in the fixed-effect estimation. To address this concern, Figure 1 plots I/K against the cash flow rate CF for independents, treating firm-years as observations (so the sample size is 330 (= 55×6)). Figure 2 is a plot of the deviation of the firm-year from the time average, which is the transformation for the fixed-effects estimation.[9] As clear from the plot, there are four extreme firm-years. To illustrate the influence of those extreme cases, the last column of Table 5 shows the parameter estimates for independents excluding the three firms (which are: the Green Cross, Chuo Paperbound, and Kato Works) that produced the four extreme firm-years in Figure 2. The large liquidity effect in the fixed-effects estimation disappears. Now, for both the OLS estimate or the fixed-effect estimate, the liquidity effect is *lower* for independents. Mechanically, it is easy to see from the plot why the parameter estimates are so sensitive: the extreme firm-years lying far above the other observations pull the regression line up. But for those firm-years the firm was able to finance large investment when liquidity was low, a strong sign that the firm was not constrained by liquidity. Indeed, these three firms have a main bank according to the Hamao classification. It would be of some interest to examine how these three firms financed the large investment outlays. It is ironic that the very evidence for the lack of the liquidity effect helps raise the cash flow rate coefficient.

[9] For example, the transformed value of the cash flow rate is CF_{it} - ($CF_{i,77}$ +...+ $CF_{i,82}$).

It is possible that those firms with large investment expenditure despite relatively low cash flow were able to finance investment out of liquid assets. Unfortunately, the Hayashi-Inoue data set does not have the variable designated in the firm's financial statements as liquid assets. It does have information on financial assets excluding stocks of affiliates. If the liquidity measure is the sum of cash flow and financial assets excluding affiliates' stocks at the beginning of the period and if *CF* is redefined as the ratio of this measure to the capital stock, then the OLS estimate of the *CF* coefficient is 0.0031 (standard error = 0.0027) for the 191 group firms and 0.0062 (standard error = 0.0023) for the 55 independents. The fixed-effects estimate is 0.0898 (standard error = 0.0070) for group firms and 0.0695 (standard error = 0.0082) for independents. Again, there is no significant differential effect of liquidity, although we hasten to add that not all of the firm's financial assets may be liquid.

The evidence presented so far casts serious doubts on the robustness of the results reported in Hoshi *et. al.* (1991). In their investment equation, Hoshi *et. al.* (1991, Table II) include as measures of liquidity not only the cash flow rate (*CF*) but also the stock of short-term securities. We include only the cash flow rate because it is a more standard specification of the literature and also because graphical analysis as done above is easier with just one measure of liquidity. The other difference between our analysis and that of Hoshi *et. al.* is, of course, that we are using different (and, in all likelihood, better) data.

We don't have the same data set used by Hoshi *et. al.* (1991), but we can create something close to it from the Hoshi-Kashyap data set of 580 firms described briefly in the previous section. If, as in Hoshi *et. al.* (1991), we require the end of the firm's fiscal year to be March, there are 104 group firms and 25 independents.[10] Sample statistics for I/K, q, *CF* and the ratio of the stock of short-term securities to the

[10] The sample used by Hoshi *et. al.* (1991) has 121 group firms and 24 independents. The difference arises from the fact that the sample from which these firms are extracted is an earlier version of the Hoshi-Kashyap data set (according to a private communication with Takeo Hoshi).

capital stock (which are all the variables included in the Hoshi-Kashyap data set made available to me) are shown in Table 6. As in Table 4, independents grow faster and are more profitable, but unlike in Table 4 and somewhat puzzling, *q* is higher for group firms.

Parameter estimates of the investment equation by the pooled OLS and the fixed-effects technique are in Table 7. Now the differential effect of liquidity is much more pronounced than in Table 5, particularly for the fixed-effect estimate. The plot of *I*/*K* against *CF* is in Figure 3. There are no obvious extreme cases, but still for a large number of firm-years investment exceeds cash flow.

3.3. Sample Split by Hamao's Classification of Main Bank Ties

The presumption in the use of the Nakatani classification is that group firms should have stronger main bank ties than indpendents. Probably a better measure of main bank ties is the Hamao classification, which is based on bank loans. Of the 687 firms in the Hayashi-Inoue sample, 678 are also in Hamao's sample (see Table 3). Sample statistics for those with and without a main bank are shown in Table 8. Here, in contrast to the sample split by the Nakatani classification shown in Table 4, those without a main bank are smaller in terms of both sales and the capital stock, but as in Table 4 for independent firms, they are growing faster, and more profitable. Despite the substantial differences in the average characteristics, the parameter estimates of the investment equation are very similar between the two subsamples, as shown in Table 9. This is true for both the pooled OLS and the fixed-effects estimates. There is absolutely no evidence for the differential effect of liquidity between those with and without a main bank.

4. Conclusion

We have examined whether the excess sensitivity of investment to liquidity depends on the firm's access to a main bank. For either of the two main bank classifications we examined, there is no evidence for the differential liquidity effect. The large differential effect found for the Hoshi-Kashyap sample is most likely due to its poor quality of the capital stock estimate.

This does not mean that liquidity does not play any role for investment. It probably does. The message of this paper is that access to a main bank neither increases nor decreases the excess sensitivity of investment to liquidity. This can be interpreted in two ways. It is probably not the case that the main bank system is an institution to overcome the failure of the capital markets. Rather, the system is an alternative to the capital markets. It, too, has to deal with the incentive problem arising from asymmetric information, albeit in a different way. The other interpretation is that the traditional reasons having to do with taxes are more important than the incentive story for explaining the excess sensitivity. The two interpretations are not necessarily mutually exclusive.

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Table 1

Sample Statistics, Hayashi-Inoue Sample (*n* = 687), 1977-82

	mean	s.d.	min	max
Sales, in billion 1982 yen	112.9	267.1	1.0	3261.0
Cash flow, in billion 1982 yen	6.0	17.8	-34.4	327.8
capital stock, in billion 1982 yen	38.1	136.1	0.2	2624.6
I/K (investment-capital ratio)	0.108	0.124	-0.801	1.336
q (Tobin's q)	0.426	1.298	-10.115	18.279
Gross profit rate	0.185	0.170	-0.780	2.343
CF (cash flow rate)	0.155	0.152	-0.780	2.251

Note: Sales, cash flow, and the capital stock are converted into real terms by the GDP deflator. Cash flow is defined as after-tax earnings plus accounting depreciation less dividends. The capital stock is the beginning-of-the-year value of depreciable assets (structures, buildings, transportation equipments, machinery, and instruments & tools). In the notation of Hayashi and Inoue (1991), it is the sum over assets of $PK \cdot (1-\delta)K$, where K is the real capital stock of the asset at the end of previous period, PK is the tax-unadjusted price of the asset, and δ is the physical depreciation rate. q is defined as (2.18) of Hayashi and Inoue (1991). The gross profit rate is the ratio of the sum of after-tax earnings and accounting depreciation to the capital stock. The cash flow rate, CF, is the ratio of cash flow to the capital stock. The difference between the gross profit rate and the cash flow rate, therefore, is the dividend to capital ratio.

The sample is pooled across years. Therefore, the sample size for the statistics are 4,122 (= 687×6).

Table 2

Intersection of Hayashi-Inoue and Hoshi-Kashyap Samples (*n* = 490), 1977-82

	Hayashi-Inoue				Hoshi-Kashyap			
	mean	s.d.	min	max	mean	s.d.	min	max
I/*K*	0.113	0.123	-0.708	1.336	0.178	0.214	-0.518	3.465
q	0.399	1.102	-7.250	10.958	0.348	4.377	-31.104	37.363
CF (cash flow rate)	0.157	0.138	-0.695	1.363	0.303	0.249	-1.637	2.109

Note: See note to Table 1 for the definition of the variables. As in Table 1, the statistics are for the sample pooled across the sample years 1977-82.

Table 3

How Two Classifications Cut Hayashi-Inoue Sample

	Hamao Classification			
	Has Main Bank	No Main Bank	In Hayashi-Inoue but not in Hamao	total
Nakatani Classification				
group firms	162	28	1	191
independents	31	24	0	55
subsidiaries	14	2	0	16
unclassifiable	298	115	7	420
In Hayashi-Inoue but not in Nakatani	4	0	1	5
total	509	169	9	687

Table 4

Group Firms and Independents in the Hayashi-Inoue Sample

	Group Firms (n = 191)				Independents (n = 55)			
	mean	s.d.	min	max	mean	s.d.	min	max
Sales	183.3	292.8	5.2	2473.5	189.0	470.1	8.1	3261.0
Cash flow	9.4	17.7	-34.4	179.1	11.8	37.4	-3.1	327.8
Capital Stock	57.5	129.2	1.4	1716.2	79.0	333.0	2.1	2624.6
I/K	0.100	0.102	-0.557	1.061	0.118	0.127	-0.184	1.106
q	0.308	1.052	-7.250	10.539	0.751	1.414	-1.542	10.958
gross profit rate	0.167	0.131	-0.628	0.748	0.241	0.215	-0.297	1.576
CF (cash flow rate)	0.141	0.118	-0.692	0.677	0.200	0.183	-0.297	1.363

Note: The statistics are for the sample pooled across the sample years 1977-82.

Table 5
Parameter Estimates of the Investment Equation

	Subsample		
	Group firms *n* = 191	Independents *n* = 55	Independents *n* = 52
Parameter estimates by OLS			
Coefficient of *q*	0.0042 (0.0033)	0.0071 (0.0056)	0.0052 (0.0079)
Coefficient of *CF*	0.3044 (0.0296)	0.2462 (0.0477)	0.2297 (0.0501)
Parameter estimates by the Fixed-Effects Method			
Coefficient of *q*	0.0114 (0.0045)	-0.0094 (0.0104)	0.0294 (0.0092)
Coefficient of *CF*	0.2051 (0.0417)	0.3826 (0.0744)	0.1895 (0.0607)

Note: Year dummies are also included in the regression to account for time-dependent intercepts. The sample of independents in the last column excludes the three firms (the Green Cross, Chuo Paperbound, Kato Works) which produced the extreme firm-years in Figures 1 and 2.

Table 6
Group Firms and Independents in the Hoshi-Kashyap Sample

	Group Firms (n = 104)				Independents (n = 25)			
	mean	s.d.	min	max	mean	s.d.	min	max
I/K	0.160	0.171	-0.305	1.596	0.197	0.231	-0.078	1.454
q	0.465	4.184	-14.763	19.820	0.341	3.714	-6.640	16.551
CF (cash flow rate)	0.279	0.244	-0.879	1.400	0.383	0.317	-0.052	2.109
Short-term securities divided by capital	0.733	0.672	0.082	9.231	0.812	0.730	0.080	3.897

Note: The statistics are for the sample pooled across the sample years 1977-82.

Table 7
Parameter Estimates of the Investment Equation

	Subsample	
	Group firms n = 104	Independents n = 25
Parameter estimates by OLS		
Coefficient of q	0.0014 (0.0019)	-0.0019 (0.0054)
Coefficient of *CF*	0.2697 (0.0307)	0.3308 (0.0599)
Parameter estimates by the Fixed-Effects Method		
Coefficient of q	0.0113 (0.0038)	-0.0141 (0.0092)
Coefficient of *CF*	0.0605 (0.0368)	0.6235 (0.1091)

Note: Year dummies are also included in the regression to account for the time-dependent intercept.

Table 8

Firms with and without a Main Bank in the Hayashi-Inoue Sample

	Has Main Bank (*n* = 509)				No Main Bank (*n* = 169)			
	mean	s.d.	min	max	mean	s.d.	min	max
Sales	123.3	287.6	1.0	3261.0	83.8	197.8	1.1	2473.5
Cash Flow	6.3	19.6	-34.4	327.8	5.1	11.3	-1.6	133.5
Capital Stock	44.9	156.3	0.2	2624.6	19.1	34.5	0.4	242.0
I/*K*	0.103	0.118	-0.801	1.106	0.124	0.142	-0.708	1.336
q	0.346	1.142	-10.115	10.958	0.692	1.641	-4.720	18.279
gross profit rate	0.166	0.148	-0.780	1.576	0.239	0.215	-0.695	2.343
CF	0.141	0.134	-0.780	1.363	0.198	0.190	-0.695	2.251

Note: The statistics are for the sample pooled across the sample years 1977-82.

Table 9

Parameter Estimates of the Investment Equation

	Subsample	
	Has Main Bank *n* = 509	No Main Bank *n* = 169
Parameter estimates by OLS		
Coefficient of *q*	0.0087 (0.0021)	0.0062 (0.0038)
Coefficient of *CF*	0.3261 (0.0180)	0.2865 (0.0315)
Parameter estimates by the Fixed-Effects Method		
Coefficient of *q*	0.0064 (0.0029)	0.0104 (0.0056)
Coefficient of *CF*	0.2854 (0.0224)	0.2887 (0.0437)

Note: Year dummies are also included in the regression to account for the time-dependent intercept.

Appendix: Calculation of Standard Errors

The investment equation for six years for firm i can be written compactly as

$$\mathbf{y}_i = \mathbf{X}_i \boldsymbol{\delta} + \mathbf{u}_i \quad (i = 1,\ldots, n),$$

where n is the number of firms in the sample and

$$\mathbf{y}_i = \begin{bmatrix} I_{i,77}/K_{i,77} \\ \vdots \\ I_{i,82}/K_{i,82} \end{bmatrix}, \ \mathbf{u}_i = \begin{bmatrix} u_{i77} \\ \vdots \\ u_{i,82} \end{bmatrix}$$

$$\underset{(6\times 8)}{\mathbf{X}_i} = \begin{bmatrix} 1 & & 0 & q_{i,77} & CF_{i,77} \\ & \ddots & & \vdots & \vdots \\ 0 & & 1 & q_{i,92} & CF_{i,82} \end{bmatrix}, \ \hat{\boldsymbol{\delta}} = \begin{bmatrix} \alpha_{77} \\ \vdots \\ \alpha_{82} \\ \beta \\ \gamma \end{bmatrix}.$$

The pooled OLS estimate of $\boldsymbol{\delta}$ can be written as

$$\hat{\boldsymbol{\delta}} = \left(\sum_{i=1}^{n} \mathbf{X}_i{}'\mathbf{X}_i \right)^{-1} \sum_{i=1}^{n} \mathbf{X}_i{}'\mathbf{y}_i .$$

Let $\hat{\mathbf{u}}_i \equiv \mathbf{y}_i - \mathbf{X}_i\hat{\boldsymbol{\delta}}$ be the residual vector associated with this estimator. The 6×6 variance matrix $Var(\mathbf{u}_i)$ can be estimated as

$$\hat{\ } = \frac{1}{n}\sum_{i=1}^{n} \hat{\mathbf{u}}_i\hat{\mathbf{u}}_i{}'.$$

The asymptotic variance of $\hat{\boldsymbol{\delta}}$ can be consistently estimated by

$$\text{asymptotic variance of } \hat{\boldsymbol{\delta}} = \left(\frac{1}{n}\sum_{i=1}^{n} \mathbf{X}_i{}'\mathbf{X}_i \right)^{-1} \left(\frac{1}{n}\sum_{i=1}^{n} \mathbf{X}_i{}' \hat{\ } \mathbf{X}_i \right) \left(\frac{1}{n}\sum_{i=1}^{n} \mathbf{X}_i{}'\mathbf{X}_i \right)^{-1}.$$

The standard errors are the square root of $\frac{1}{n}$ times the diagonal elements of this matrix.