What caused fixed investment to stagnate during the 1990s in Japan?: Evidence from panel data of listed companies

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Abstract: Taking considerable changes in the corporate finance behavior of listed Japanese companies during the 1990s into account, this paper empirically investigates the causes of the stagnation of the listed companies' fixed investment during the 1990s, using panel data from the companies' financial statements. Our findings include the following: (1) while positive cash flow sensitivity was detected for the companies listed during the 1990s, it was not necessarily a consequence of the binding of liquidity constraints; (2) declines in Tobin's q explain decreases in fixed investment throughout the 1990s; and (3) the holding of liquid assets acted as a buffer against liquidity shocks.

Key words: fixed investment, Tobin's q, cash flow sensitivity, liquid assets, irreversibility.
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1. Introduction There was a prolonged stagnation in fixed investment during the 1990s in Japan. Private fixed investment grew at annual rates of greater than 10% during the latter half of the 1980s. In contrast, it declined by 8.9% in 1992, by 10.3% in 1993, and by 5.2% in 1994. Even during the latter half of the 1990s, private fixed investment continued to stagnate, although it ceased to decrease (for example, see the Research and Statistics Bureau, Bank of Japan, 2003).

The economic environment surrounding the corporate finance sector changed dramatically during the 1990s. First, the corporate sector, which used to be composed of agents with financial deficits, changed to agents with financial surpluses in the latter half of the 1990s. Figures 1-1 to 1-3 plot the time-series of both cash flows and fixed investment of the private corporate sector based on *The Financial Statements Statistics of Corporations by Industry* compiled by the Ministry of Finance. According to Figure 1-1, for the entire corporate sector, fixed investment exceeded internal cash flows up to the fiscal year 1993. However, the relationship was reversed after that date. In particular, fixed investment has been far below cash flows since 1998. In regard to large companies (those with capital greater than one billion yen), internal cash flows exceeded fixed investment among manufacturing companies from 1993 onwards, and among non-manufacturing companies from 1998 onwards (see Figures 1-2 and 1-3).

Second, the usage of internal cash flows was diversified beyond fixed investment to include the repayment of debts and investment in liquid assets. As demonstrated in Figure 2, which shows the ratio of liquid assets relative to total assets, there were no significant withdrawals of liquid assets among large companies, except in 2000. This observation suggests that demand for liquid assets was not necessarily weak while fixed investment was stagnant.

Third, according to Figure 3, the ratio of outstanding debts relative to total assets declined substantially throughout the 1990s among large non-manufacturing companies. Among large manufacturing companies, this ratio began to decrease even during the latter half of the 1980s. Such a reduction in the dependence of large firms on bank borrowings substantially weakened the relationship between large companies and their main banks.[1]

Considering the above factors, this paper empirically investigates the causes of the stagnation of fixed investment during the 1990s. First, we investigate the extent to which internal cash flows impacted on fixed investment. As mentioned above, internal cash flows exceeded fixed investment from the mid-1990s, and the subsequent relationship between the two variables was no longer strong. In particular, such a tendency was noticeable among large manufacturing companies. However, even large non-manufacturing companies tended to use internal cash flows to finance repayment of outstanding debts, rather than for fixed investment. These observations indicate that the listed companies might not have been subject directly to liquidity constraints, and that any potential financial constraint might not have been driven by a simplistic static mechanism under which current fixed investment is primarily determined by current internal cash flows.

Recent theoretical research on fixed investment points out that there is no one-to-one correspondence between the cash flow sensitivity of fixed investment and the presence of liquidity constraints. For example, Kaplan and Zingales (1997) demonstrate that the relationship between cash flows and fixed investment relies heavily on functional forms of costs incurred in financing additional funds from outside investors.[2] Gomes (2001) presents several cases in which positive cash flow sensitivity is not necessarily related to the presence of liquidity constraints. He constructs one case where cash flow sensitivity is positive even in the absence of liquidity constraints, and another case where positive cash flow sensitivity is driven solely by measurement errors concerning Tobin's q.

Motivated by the above papers, this paper explores to what extent positive cash flow sensitivity can (or cannot) be interpreted as evidence for the binding of liquidity constraints,

[1] Another important feature of the corporate investment behavior during the second half of the 1990s, although not explored in this paper, is that manufacturing companies made actively foreign direct investment through overseas subsidiaries. According to Development Bank of Japan, the ratio of foreign direct investment relative to domestic fixed investment was around 30% among the companies that actually made foreign direct investment for the corresponding period.

[2] Fazzari, Hubbard, and Petersen (2000) claim that cash flow sensitivity is relevant evidence of financial constraints. Moyen (2004) presents a reconciling view on the argument between Kaplan and Zingales (1997) and Fazzari, Hubbard, and Petersen (2000).

if coefficients on cash flows are estimated to be significantly positive. For this purpose, we examine whether a sub-group of firms that are expected to be more subject to liquidity constraints according to the above hypothesis – for example, firms with large outstanding debts, high Tobin's q, or low dependency on main banks – do indeed yield higher cash flow sensitivity in the estimation of investment functions.

Second, this paper considers the relationship between fixed investment and Tobin's q, a relationship that has not necessarily been emphasized in the existing empirical literature on Japanese investment behavior. In contrast with the relationship between cash flows and fixed investment, the movements in aggregate fixed investment over time were broadly consistently with the movements of financial variables. Figures 4-1 and 4-2 plot the time series of the cross-sectional averages and standard deviations of the market-to-book ratios (often used as a proxy for Tobin's q) for the listed companies. The observation that the market-to-book ratio showed a tendency to decrease up to 1998 in both listed manufacturing and non-manufacturing companies indicates that productive investment opportunities were rather scarce during the 1990s. In addition, the market-to-book ratio was high, but with the large cross-sectional variation among non-manufacturing companies in both 1999 and 2000.

Third, this paper sheds light on the potential role played by the holding of liquid assets. Holding liquid assets is often seen as negative because it involves the loss of productive investment opportunities. However, as mentioned earlier, corporate demand for liquid assets was not weak when fixed investment stagnated. The listed companies may have had positive reasons for holding liquid assets. Following the theoretical implications of Holmström and Tirole (2001) and others, we investigate whether holding liquid assets helped to absorb liquidity shocks. If such a possibility is confirmed, then the financial constraint faced by individual firms is quite dynamic, in the sense that firms hold liquid assets in advance in order to relax not current, but future, liquidity constraints.

This paper is organized as follows. Section 2 examines the extent to which fixed investment was influenced by internal cash flows, whereas Section 3 analyzes the relationship between Tobin's q and fixed investment, and discusses the role played by holding liquid assets. Section 4 offers conclusions.

2. On the cash flow sensitivity of fixed investment

2.1. **Specification and data** Estimating a standard investment function, which consists of Tobin's q and internal cash flows as explanatory variables, this section examines the extent to which positive cash flow sensitivity is associated with the presence of liquidity constraints in the conventional sense. In particular, it investigates whether a sub-group of firms that are expected to be more subject to liquidity constraints according to the standard hypothesis, do indeed yield positive cash flow sensitivity in the estimation of investment functions.

Empirical specification Using panel data constructed from financial statements, this section estimates the following standard investment function by the fixed effects model, the random effects model, and the instrumental variable estimation (IV) with the fixed effects model:

$$\frac{I_{i,t}}{K_{i,t-1}} = \text{constant} + \beta_1 Q_{i,t} + \beta_2 \frac{F_{i,t}}{A_{i,t-1}} + \mu_i + e_{i,t}, \qquad (1)$$

where $I_{i,t}$ and $K_{i,t-1}$ denote the real gross investment of firm i in the fiscal year t, and the real amount of total fixed assets at the end of the previous fiscal year. $Q_{i,t}$ and $F_{i,t}$ represent the ratio of average Tobin's q and the nominal value of cash flows in the fiscal year t, respectively. $A_{i,t-1}$ denotes the nominal amount of total assets at the end of the previous fiscal year. In addition, μ_i and $e_{i,t}$ express a fixed effect specific to firm i, and an error term. In the above specification, nominal cash flows are standardized by nominal total assets.

According to the standard interpretation of the above equation, under the hypothesis that a neoclassical investment theory holds, a coefficient on Tobin's q (β_1) is positive, whereas a coefficient on cash flows (β_2) is zero. On the other hand, positive cash flow sensitivity ($\beta_2 > 0$) is usually interpreted to mean the presence of liquidity constraints, in the sense that current internal cash flows basically determine current fixed investment. In addition, a coefficient on Tobin's q (β_1) may lose its explanatory power because potential productive opportunities may fail to be exploited in the presence of liquidity constraints.

Whereas both fixed and random effects models (F/R models) are adopted in characterizing firm-specific components for the estimation, we report both results only for unbalanced panel data.[3] In the case of balanced panel data, on the other hand, we report either of the two estimation results according to the Hausman test. That is, when the Hausman test rejects the null hypothesis where there is no correlation between fixed effects and explanatory variables at the 10% level of significance, then we report the estimation result of the fixed effects model. Otherwise, we report the estimation result of the random effects model. In the case of the fixed effects model, the reported coefficient of determination (denoted as R^2) is based on the residuals of the least squares dummy variable model.

In the case of IV estimation, the fixed effects model specification is adopted. As instrumental variables, we use one-period lagged variables of Tobin's q, current variables of cash flows, a set of industry dummies, and a constant term, thereby controlling for the endogeneity of current Tobin's q. The over-identification test is passed successfully for all of the estimation results reported in this paper. As shown later, there are considerable differences between fixed effects models and IV, and the Hausman specification test rejects the fixed effects specification in most cases. That is, Tobin's q is subject to endogeneity.

Three ways of sub-grouping In this section, we examine not only whether cash flows currently determine fixed investment, but also whether positive cash flows indicate the presence of liquidity constraints. More concretely, we divide the whole sample into two sub-groups such that liquidity constraints are more binding, according to the standard hypothesis, in one sub-group than they are in the other sub-group. Then, we investigate whether the estimation results are indeed consistent with such predictions. Thereby, we reconsider the appropriateness of the standard hypothesis of liquidity constraints.

We construct three sets of sub-groupings as follows. First, we divide the whole sample

[3] A software package called *LIMDEP* we use for this empirical investigation can deal with not only balanced panel, but also unbalanced panel for both fixed and random effects models. The estimator with unbalanced panel is described more fully in the appendix.

into firms with high Tobin's q and firms with low Tobin's q. Firms with higher Tobin's q are interpreted as having more investment opportunities, and stronger demand for costly outside funding. Consequently, liquidity constraints are more likely to be binding in this sub-group than in the low Tobin's q sub-group. Hence, positive cash flow sensitivity is expected for firms with high q.[4]

Second, we group the sample according to debt ratios. The group with high debt ratios is less likely to have the ability to finance from outside investors than the group with low debt ratios. Alternatively, high debt ratios may represent a poor credit history. In either case, positive cash flow sensitivity is expected for firms with high debt ratios.

Third, the sample is split between firms with low dependency on main banks and firms with high dependency. As Hoshi, Kashyap, and Scharfstein (1991) and others discuss, the main-bank relationship may help to relax liquidity constraints by mitigating asymmetric information between lenders and borrowers. Therefore, firms with low dependency on main banks are expected to yield positive cash flow sensitivity. Although there are several ways to identify firms' dependency on main banks, we measure main-bank dependency in terms of the ratios of stock holdings by a main bank.

Data construction As a main dataset, this paper uses *The Corporate Financial Databank*, compiled by Development Bank of Japan, which covers all of the companies listed in both the first and second sections of the stock exchange of Tokyo, Osaka, and Nagoya. We exclude financial institutions from our dataset. The sample period covers the fiscal years between 1991 and 2000. Hori, Saito, and Ando (2004), a Japanese version of the current manuscript, describes the data construction in more detail.

In the case of **unbalanced panel** data, the sample size for the entire sample period is 13,125 firm-years for manufacturing companies and 8,356 for non-manufacturing companies. After observations with extremely high Tobin's q are removed from the full sample as described later, for the period between 1991 and 1995, the numbers are 6,375 and 3,786

[4] Alti (2003) presents an interesting case where, even in the absence of liquidity constraints, high cash flow sensitivity may emerge for firms with high growth opportunities and low dividend payout ratios, if Tobin's q involves serious measurement errors.

respectively, whereas for the period between 1996 and 2000, they are 6,732 and 4,555 respectively.

When the dataset is split according to company characteristics for empirical investigation, we use **balanced panel** datasets. In this case, after observations with extremely high Tobin's q are excluded, the number of companies covered by the sample is 1,228 (689) for the manufacturing (non-manufacturing) sector in the first half of the 1990s, whereas it is 1,264 (806) for the second half of the 1990s.

The real value of tangible fixed capital (excluding land) is calculated as follows. First, for each company, a fiscal year in which the oldest financial statement is available is chosen as a benchmark year at which a book value is assumed to be a real value. For a company that was listed prior to the fiscal year 1977, the benchmark year is 1977. Second, tangible fixed assets are classified into the following categories: (i) buildings, (ii) structures, (iii) machinery/equipment, (iv) ships, (v) autos/trucks, and (vi) tools/fixtures. Third, depreciation rates and wholesale price indexes are applied according to each of the six asset categories. Concretely, the depreciation rate is set at 0.0470 for buildings, 0.0564 for structures, 0.0949 for machinery/equipment, 0.1470 for both ships and autos/trucks, and 0.0884 for tools/fixtures. Fourth, the acquisition value of assets during a fiscal year is used as a proxy for the nominal value of gross investment for each of the six asset categories.[5] Then, this nominal gross investment is evaluated in real terms by a corresponding wholesale price index. Finally, given these assumptions, the real value of tangible fixed capital is calculated according to the permanent inventory valuation method.

[5] We define the nominal value of gross investment by the sum of (1) a one-year increase in book value of net capital stocks, (2) accounting depreciation during a fiscal year, and (3) remaining book value of retired assets. Unlike in the conventional definition in the literature, we include the last part (3) such that the valuation of nominal gross investment may not depend on the choice between the straight line method (with zero remaining value) and the declining balance method. As Hayashi and Inoue (1991) and Hori, Saito, and Ando (2004) discuss, this proxy for nominal gross investment (acquisition value of assets during a fiscal year) is overvalued relative to the true valuation. That is, the two differ by the remaining book value of the assets that are sold or damaged during a fiscal year before legal durable years are completed. Nevertheless, we use this proxy because (1) the above discrepancy may not be substantial, (2) it is impossible to obtain these discrepancies by asset categories even from formal financial statements, and (3) it is extremely difficult to construct corresponding price indexes properly. Suzuki (2001) discusses this issue in detail.

We construct the average Tobin's q for installed fixed capital as follows.[6] On the one hand, the denominator of Tobin's q (a replacement cost) corresponds to a nominally reevaluated value of the above-constructed real tangible fixed assets. For the numerator of Tobin's q, we subtract the book value of assets other than physical capital from the sum of the market value of outstanding stocks and the book value of interest-bearing debts. Here, interesting-bearing debts include short-term loans payable, straight bonds, long-term loans payable, and commercial papers.

Given the above construction of Tobin's q, some observations yield extremely high Tobin's q, because non-tangible assets might have contributed to the market evaluation among those firms. Other observations yields negative numerators in calculating Tobin's q, because the book value of land held by these companies was rather over-valued in particular during the second half of the 1990s.[7] We exclude observations whose Tobin's q deviates from the full-sample average by more than two standard deviations. Consequently, the sample size of the unbalanced panel dataset reduces by 18 observations for manufacturing companies, and by 15 observations for non-manufacturing companies. The sample size of the balanced panel dataset is almost intact even after the above exclusion.

Our construction of Tobin's q has both differences and similarities to existing research in several respects. Our construction differs from Hoshi and Kashyap (1990), Hayashi and Inoue (1991), and others, in that any effect of taxation is ignored. Like Asako et al. (1989), and Hayashi and Inoue (1990), we consider differences in wholesale price indexes among asset categories. Hayashi (2000) points out the empirical importance of using different whole price indexes according to asset categories in order to avoid measurement errors in Tobin's q.

In regard to other variables, for the derivation of nominal total assets, the book value of

[6] There are alternative measures of Tobin's q. Ogawa and Kitasaka (1998) point out the merits of the marginal Tobin's q over the average Tobin's q. By contrast, following Perfect and Wiles (1994), Miyajima, Arikawa, and Saito (2001) propose a market-to-book ratio as a reasonable proxy for the average Tobin's q.

[7] More precisely, the number of manufacturing companies with negative numerators was less than or equal to 13 each year up to the fiscal year 1996, but it was 101 (1997), 256 (1998), 228 (1999), and 311 (2000) respectively. Similarly, the number of non-manufacturing companies with negative numerators was less than or equal to 27 each year up to 1996, but it was 175 (1997), 293 (1998), 237 (1999), and 303 (2000).

tangible fixed assets is replaced by a nominally reevaluated value of the above-constructed real tangible fixed assets. The nominal value of cash flows includes after-tax net profits and depreciation expenses, but excludes dividends and directors' bonuses. The nominal value of liquid assets is defined as a book value of cash and marketable securities.

Finally, following Hoshi, Kashyap, and Scharfstein (1991), we define the main-bank dependency in terms of the capital, rather than the borrowing linkages between a company and its main bank. That is, the dependency of a company on its main bank is defined as the ratio of stock holdings by the bank. In this respect, we have identified the first private bank on the list of correspondent banks compiled by *The Quarterly Corporate Report* (published by Toyo Keizai Shinpo-sha) as the main bank. The share of shock holdings by the main bank is available from *The Corporate Financial Databank*. Hirota and Horiuchi (2001) argue that the above definition of main banks is not only operational, but also appropriate.

Table 1 reports descriptive statistics of major constructed variables for the samples before and after the exclusion of observations with extremely high Tobin's q.

2.2. **Estimation results**

Estimation results from the whole sample The first panels of Tables 2 and 3 report the estimation results for the whole sample period (between the fiscal years 1991 and 2000) using unbalanced panel datasets for manufacturing and non-manufacturing companies. According to the F/R estimation result, estimated coefficients on Tobin's q ($\widehat{\beta_1}$) were positive at 1% statistical significance in both manufacturing and non-manufacturing companies, whereas estimated coefficients on cash flows ($\widehat{\beta_2}$) were positive at 1% statistical significance in manufacturing companies, and were also significant in non-manufacturing companies (though less significant for the fixed effects model).

In the IV estimation result, estimated coefficients on both Tobin's q and cash flows were again significantly positive for manufacturing companies. In comparison with the F/R estimation, however, the IV estimation indicates that an estimated coefficient on Tobin's q is larger, while estimated cash flow sensitivity is smaller. The above comparison suggests that the positive cash flow sensitivity implied by the F/R estimation was driven to some extent by components shared with current Tobin's q, not by components specific to current cash flows. For non-manufacturing companies, on the other hand, estimated coefficients on both Tobin's q and cash flows were again significantly positive. But, the difference between the F/R and IV estimations is not so large as in manufacturing companies.

As discussed in the Introduction, the relationship between fixed investment and cash flows differed substantially between the first and second halves of the 1990s. Hence, we split the sample period equally in order to explore how estimated cash flow sensitivity changed between these sub-sample periods.[8]

We first examine the estimation results of manufacturing companies. As shown in the second and third panels of Table 2, the cash flow sensitivity from the F/R estimation was substantially lower in the second half of the 1990s ($\widehat{\beta_2} = 0.1306$ or 0.2281) than in the first half ($\widehat{\beta_2} = 0.2950$ or 0.4933). According to the IV estimation, on the other hand, cash flow sensitivity reduces from 0.2051 to 0.1258; in addition, an estimated coefficient is less significant in the second half.

In regard to non-manufacturing companies, the cash flow sensitivity available from the fixed effects estimation was not significantly positive in the first half of the 1990s, but it was slightly significantly positive in the second half (see the second and third panels of Table 3), while that from the random effects estimation was significantly positive in both halves. According to the IV estimation, cash flow sensitivity was insignificant in both first and second halves of the 1990s.

In sum, positive cash flow sensitivity of investment functions was observed in both manufacturing and non-manufacturing companies, although the IV estimation offers weak results relative to the F/R estimation. Below, we explore how the cash flow sensitivity was determined by examining the estimation results of the three sets of sub-groupings, whereas Section 3 discusses in more detail the estimation results with respect to coefficients on

[8] In fact, changes in the corporate investment behavior took place gradually through the 1990s. For example, the cash flow sensitivity of investment declined from the first half of the 1990s to the second half. According to the cross-sectional estimation reported in Hori, Saito, and Ando (2004), the cash flow sensitivity decreased slowly from the early 1990s.

Tobin's q.

Estimation results from the sub-grouped samples Tables 4 to 6 report the estimation results for both manufacturing and non-manufacturing companies by sub-grouping, as described in Section 2.1. As cash flow sensitivity differed substantially between the first half of the 1990s and the second half, as shown in the previous subsection, we split the sample period as before for the estimation by sub-grouping. More concretely, in each sub-grouping, the sample was divided equally based on an indicator of concern (Tobin's q, debt ratios, or dependency on a main bank) measured in the fiscal year 1990 for the sample period 1991–1995, and the fiscal year 1995 for the sample period 1996–2000. We have remarks on the above splitting by Tobin's q. On the one hand, the splitting method allows us to effectively control a possible contemporaneous correlation between a cash flow variable and an indicator of concern, in particular, between cash flows and Tobin's q. On the other hand, the splitting by a forward-looking variable such as Tobin's q may be subject to the sample selection bias.

Manufacturing: We first discuss the estimation results of manufacturing companies. According to the F/R estimation (the first panel of Table 4), in the first half of the 1990s, firms with high Tobin's q yielded positive cash flow sensitivity, whereas firms with low Tobin's q did not. In the second half of the 1990s, on the other hand, firms with low Tobin's q generated positive cash flow sensitivity, whereas firms with high Tobin's q did not. Hence, the result for the first half of the 1990s was consistent with the standard prediction about liquidity constraints, but the result for the second half was not. The IV estimation confirms the result from the F/R estimation.

Second, we split the full sample according to the debt ratio, which are defined by the ratio of the book value of interesting-bearing debts relative to the nominal value of total assets. As demonstrated in the F/R estimation results (the first panel of Table 5), in the first half of the 1990s, firms with high debt ratios yielded positive cash flow sensitivity, but firms with low debt ratios did not. Conversely, firms with lower debt ratios generated stronger cash sensitivity in the second half of the 1990s. As in the case of Tobin's q, the result for the first half of the 1990s was consistent with the standard prediction, whereas the result for the second half was not. According to the IV estimation results, however, the standard prediction did not hold in either the first or second half of the 1990s.

As shown in the F/R estimation results (the first panel of Table 6), in the first half of the 1990s, firms with lower dependency on main banks yielded stronger cash flow sensitivity. In other words, the standard prediction held. However, in the second half of the 1990s, firms with higher dependency on main banks generated stronger cash flow sensitivity, in contradiction to the standard prediction. The IV estimation results were similar to those of the F/R estimation.

Non-manufacturing: We now turn to the estimation results of non-manufacturing companies. According to the F/R estimation (the second panel of Table 4), in the first half of the 1990s, firms with high Tobin's q yielded significantly positive coefficients on cash flows. In contrast, firms with low Tobin's q generated negative cash flow sensitivity. In the second half of the 1990s, significantly positive cash flow sensitivity was observed for firms with low Tobin's q. In the IV estimation, in the second half of the 1990s, cash flow sensitivity was significantly positive for firms with low Tobin's q. However, significantly positive cash flow sensitivity was found in firms with high Tobin's q for the first half of the 1990s. Like in the case of manufacturing companies, these results of the F/R and IV estimations was consistent with the standard prediction for the first half of the 1990s, but inconsistent for the second half.

As demonstrated in the F/R estimation result (the second panel of Table 5), in the first half of the 1990s, coefficients on cash flows were significantly positive among firms with low debt ratios. In the second half, on the other hand, firms with higher debt ratios yielded stronger cash flow sensitivity. In contrast to the manufacturing companies, it follows from these results that the standard prediction was supported in the second half of the 1990s, but not in the first half. In the IV estimation, the results of the second half were again consistent with the standard prediction, as cash flow sensitivity was stronger in firms with high debt ratios than in firms with low debt ratios.

As shown in the F/R estimation (the second panel of Table 6), in the first half of the 1990s, cash flow sensitivity was negative for firms with lower main-bank dependency. In the second half of the 1990s, the finding that firms with lower main-bank dependency had stronger cash flow sensitivity was consistent with the standard prediction. However, the IV estimation indicates that, as for manufacturing companies, firms with high dependency on main banks yielded higher cash flow sensitivity, in contradiction to the standard prediction.

Discussion The above estimation results are significant in the interpretation of positive cash flow sensitivity. With respect to manufacturing companies, in the first half of the 1990s, the F/R estimation results based on sub-grouping by Tobin's q, debt ratios, and main-bank dependency were consistent with the standard predictions. Even after the endogeneity of Tobin's q was controlled by the IV estimation, such consistency still held for Tobin's q and main-bank dependency, although it disappeared for debt ratios. Thus, it is possible to broadly interpret positive cash flow as indicating the presence of liquidity constraints in these cases.

In the second half of the 1990s, on the other hand, even the F/R estimation results based on sub-grouping by the three types of indicators contrasted dramatically with the standard predictions associated with liquidity constraints. The IV estimation results basically confirmed the F/R estimation results. These findings implied that positive cash flow sensitivity, even if detected from estimations, should not be interpreted as evidence for liquidity constraints at all.

In the case of non-manufacturing companies, the F/R estimation results based on sub-grouping by both debt ratios and main-bank dependency were largely contrary to the standard predictions for the first half of the 1990s, while those based on Tobin's q were consistent. Although the F/R estimation results based on measures of main-bank dependency were consistent with the standard prediction in the second half of the 1990s, the IV estimation reversed this result. The only case consistent with the standard hypothesis for the second half was the IV estimation result based on sub-grouping by debt ratios.

In sum, it would be rather difficult to interpret positive cash flow sensitivity as indicating the presence of liquidity constraints in particular for the second half of the 1990s in the conventional sense.

3. Tobin's q, liquid assets, and fixed investment

3.1. **Tobin's q and fixed investment** In this section, we examine the relationship between Tobin's q and fixed investment in more detail. As demonstrated in Tables 2 and 3, even if the endogeneity of Tobin's q is controlled, the relationship between Tobin's q and fixed investment was statistically significant throughout the 1990s, except for the non-manufacturing companies listed during the second half of the 1990s. This observation suggests that the primary reason for declining fixed investment during the 1990s was the scarcity of productive investment opportunities.

As mentioned above, the standard relationship between Tobin's q and fixed investment breaks down only among the non-manufacturing companies in the second half of the 1990s. In this case, the coefficients on Tobin's q ($\widehat{\beta_1}$) from the F/R estimation were significantly positive, but the IV-estimated coefficient on Tobin's q was no longer significantly positive (see Table 3). A further interesting observation about the non-manufacturing companies of the second half is that, as shown in Table 4, a substantially weak sensitivity of Tobin's q took place among firms with high Tobin's q. According to the F/R (IV) estimation, the coefficient on Tobin's q for high q firms was 0.0008 (0.0081), whereas the coefficient for low q firms was 0.0260 (0.0245).

These observations are significant for the interpretation of the investment behavior of non-manufacturing companies in the late 1990s. As pointed out in the Introduction, Tobin's q was rather high on average among non-manufacturing companies, but with wide cross-sectional variations (see Figures 4-1 and 4-2). Together with the above estimation results, this suggests that firms with rising Tobin's q may have been relatively inactive in making fixed investments, whereas firms with declining Tobin's q may have reduced fixed investment in response to shrinking investment opportunities.

Another potentially important feature of the late 1990s was that the volatility of stock returns was increasing, particularly among non-manufacturing companies, as demonstrated in Figure 5 (the volatility of daily returns on the whole and classified Tokyo Stock Exchange Indexes, or TOPIXs). This implied that the uncertainty faced by companies was high during this time. As suggested by Dixit and Pindyck (1994), Abel and Eberly (1994), and others, given that fixed investment is irreversible to a large degree, increases in uncertainty reduce the sensitivity of fixed investment to Tobin's q. More precisely, due to an increase in uncertainty, the range of Tobin's q in which gross investment is inactive may be extended, although the sensitivity of investment to Tobin's q is independent of uncertainty for the active investment range. At firm levels, the gross investment may include not only irreversible projects, but also reversible ones. Therefore, a part of investment is still sensitive to Tobin's q even in the presence of irreversibility. Consequently, the gross investment as a whole will be made insensitive to Tobin's q. In this context, the degree of irreversibility depends on several factors including firm/industry specificity, developments of secondary markets, and regulation schemes.[9]

Our dataset indeed presents a circumstantial evidence for the presence of irreversible investment. That is, there were not a few manufacturing and non-manufacturing companies which made zero or near-zero gross investment (inactive investment) during our sample period (the 1990s). More concretely, the highest gross investment ratio ($\frac{I}{K_{-1}}$) ranged between 1% and 7% each fiscal year among the lowest 10% quantile of manufacturing companies. Among non-manufacturing companies, on the other hand, the same ratio ranged between 0.9% and 3% among the lowest 10% quantile; in particular, it was only 0.9% in both 1999 and 2000.

To investigate the impact of uncertainty on investment behavior, we split both the 1991–1995 sample and the 1996–2000 sample equally into two sub-groups, according to the standard deviations of daily returns on individual stocks during the corresponding sub-sample periods. Splitting sub-groups based on information recorded not prior to, but

[9] For example, an entry regulation may enhance the value of options to remain uncommitted to irreversible investment by easing competitive pressure.

during, sample periods potentially involves sample selection biases. As a result, the estimation results from this exercise should be taken as tentative.

According to the results reported in Table 7, coefficients on Tobin's q, consistent with the above prediction, were smaller in high-volatility firms than in low-volatility firms for the first half of the 1990s. The results for the second half is no longer consistent with the prediction; high-volatility firms yielded stronger sensitivity to Tobin's q. In this regard, against our original expectation, the presence of irreversible investment was not responsible for the determination of fixed investment during the second half of the 1990s.

3.2. **On the role of liquid asset holdings** As explored in detail in Section 2, even if positive cash flow sensitivity is observed, it cannot necessarily be interpreted as evidence of liquidity constraints. In particular, the F/R-estimated positive coefficients on cash flows for the manufacturing companies during the second half of the 1990s seriously contradict the standard hypothesis associated with binding liquidity constraints. What, then, is implied by such positive cash flow sensitivity?

In this section, we shed light on the role of liquid asset holdings in order to present an alternative story. As pointed out in the Introduction, demand for liquid assets was not necessarily weak throughout the 1990s. According to Holmström and Tirole (2000), and others, one possible reason for holding liquid assets is that they serve as a buffer against liquidity shocks. In other words, holding liquid assets in advance may help to relax future liquidity constraints.[10]

Motivated by the above possibility, we construct two sub-groups by dividing the whole sample equally according to the ratio of outstanding liquid assets relative to total assets, in the same manner as in Section 2; that is, the sample was divided equally based on the liquid asset ratio measured in 1990 (1995) for the sample period 1991-1995 (1996-2000). Here, the nominal value of liquid assets is defined as the book value of cash and marketable securities. If holding liquid assets does indeed help to relax future liquidity constraints,

[10] Almeida, Campello, and Weisbach (2004) present a theoretical case where liquidity demand is driven by the possibility of future liquidity constraints.

then cash flow sensitivity will be stronger in firms with low liquid asset ratios than in firms with high liquid asset ratios.[11] In other words, positive cash flow sensitivity may be interpreted as poor preparation for future liquidity constraints.

As demonstrated in Table 8, except for non-manufacturing companies during the first half of the 1990s, the F/R-estimated coefficients on cash flows were significantly positive for firms with less liquid assets. However, they are not significantly different from zero for firms with more liquid assets. The IV estimation results supported this tendency for both manufacturing and non-manufacturing companies during the first and second halves of the 1990s. In particular, the magnitude of cash flow sensitivity was quite large for non-manufacturing companies with less liquid assets during the second half. These findings suggest that holding liquid assets in advance assists in relaxing liquidity constraints.

4. Conclusion Giving consideration to the important changes in the economic environment surrounding the corporate sector, this paper has investigated the causes of fixed-investment stagnation during the 1990s in Japan. The major findings are summarized as follows.

First, while coefficients on cash flows were often estimated to be significantly positive for the companies listed during the 1990s, it would be rather hard to interpret this positive cash flow sensitivity as evidence for the binding of liquidity constraints at least in the conventional sense. The sub-groups of firms that were expected to be more subject to liquidity constraints (those with high Tobin's q, high debt ratios, or low dependency on main banks) often yielded statistically insignificant cash flow sensitivity. Conversely, the opposite sub-groups tended to generate stronger cash flow sensitivity.

Second, throughout the 1990s, we found a statistically significant relationship between Tobin's q and fixed investment. In other words, stagnant fixed investment primarily reflected a scarcity of productive investment opportunities. The only exception was the case

[11] Boyle and Guthrie (2003) present a contrasting case where high-liquidity firms yield large cash flow sensitivity when the possibility of future liquidity constraints lowers the option value of postponing irreversible investment.

of the non-manufacturing companies during the second half of the 1990s, for which the relationship between Tobin's q and fixed investment was rather weak. In addition, evidence for irreversible investment was found for the first half of the 1990s.

Third, firms holding less liquid assets in advance yielded stronger cash flow sensitivity in both manufacturing and non-manufacturing companies during the 1990s. This finding suggested that holding liquid assets in advance helped to relax future liquidity constraints and thereby assisted in absorbing liquidity shocks.

The above findings are useful not only in understanding why fixed investment stagnated during the 1990s, but also because they provide empirical examples of recent theories concerning corporate investment behavior. These include: (1) the relationship between the presence of liquidity constraints and cash flow sensitivity; (2) the impact of uncertainty on irreversible investment; and (3) the role of liquid assets as a buffer against liquidity shocks. The investment behavior of the Japanese listed companies during the 1990s offers an excellent empirical environment for examining these hypotheses.

Appendix: Estimation Procedures on the Unbalanced Panel

Fixed effects estimator on the unbalanced panel The software package called *LIMDEP* we use for our estimation computes the fixed and random effects estimator on the unbalanced panel according to the following procedures.[12] Suppose that the model is specified as the usual fixed effects model:

$$y_{it} = \mathbf{x}_{it}\beta + c_i + u_{it}, t = 1, ..., T, \tag{2}$$

where $\mathbf{x}_{it}$ is the $1 \times K$ vector, and β is the $K \times 1$ vector. u_{it} is an associated disturbance. In the case of the fixed effects model, c_i may be correlated with x_{it}.

Let $s_i \equiv (s_{i1}, ..., s_{iT})'$ to motivate the unbalanced panel structure, where $s_{it} = 1$ if $(\mathbf{x}_{it}, y_{it})$ is observed, and zero otherwise. The variation around group means is defined

[12] See Greene (2003) and Wooldridge (2002) for a more complete description of estimation procedures.

for both dependent and explanatory variables: $\ddot{\mathbf{x}}_{it} \equiv \mathbf{x}_{it} - \sum_{t=1}^{T} s_{ir}\mathbf{x}_{ir}/T_i$, and $\ddot{y}_{it} \equiv y_{it} - \sum_{t=1}^{T} s_{ir}y_{ir}/T_i$, where $T_i \equiv \sum_{t=1}^{T} s_{it}$. Then, the fixed effects estimator on the unbalced panel is written as

$$\hat{\beta} = \left(N^{-1}\sum_{i=1}^{N}\sum_{t=1}^{T} s_{it}\ddot{\mathbf{x}}_{it}'\ddot{\mathbf{x}}_{it}\right)^{-1}\left(N^{-1}\sum_{i=1}^{N}\sum_{t=1}^{T} s_{it}\ddot{\mathbf{x}}_{it}'\ddot{y}_{it}\right).$$

Let us make the following assumption:

Assumption 1: (a) $E(u_{it} \mid \mathbf{x}_i, \mathbf{s}_i, c_i) = 0,\ t = 1, 2, ..., T$; (b) $\sum_{t=1}^{T} E(s_{it}\ddot{\mathbf{x}}_{it}'\ddot{\mathbf{x}}_{it})$ is nonsingular; and (c) $E(\mathbf{u}_i\mathbf{u}_i' \mid \mathbf{x}_i, \mathbf{s}_i, c_i) = \sigma_u^2\mathbf{I}_T$.

Assumptions 1a and 1b ensure consistency of the fixes effects estimator on the unbalanced panel. Assumptions 1a through 1c, on the other hand, make standard inference procedures on the fixed effects estimator valid. In particular, the asymptotic variance of the fixed effects estimator is estimated as

$$\hat{\sigma}_u^2\left(N^{-1}\sum_{i=1}^{N}\sum_{t=1}^{T} s_{it}\ddot{\mathbf{x}}_{it}'\ddot{\mathbf{x}}_{it}\right)^{-1},$$

The fixed effects estimator reisdulas are difined as $\hat{u}_{it} = \ddot{y}_{it} - \ddot{\mathbf{x}}\hat{\beta}_{it}$ when $s_{it} = 1$. Then, $\hat{\sigma}_u^2$ is derived as follows:

$$\hat{\sigma}_u^2 = \left[\sum_{i=1}^{N}(T_i - 1)\right]^{-1}\sum_{i=1}^{N}\sum_{t=1}^{T} s_{it}\hat{u}_{it}^2 \tag{3}$$

In the case of the instrumental variable estimation on the unbalanced panel, a part of explanatory variables are replaced by instrumented explanatory variables (Tobin's q in our context). Then, we basically follow the same procedure as above.

Random effects estimator on the unbalanced panel We now turn to the random effects estimator on the unbalanced panel, in which c_i is not correlated with $\mathbf{x}_{it}$ in equation (2). The random effects estimator requires a much stronger assumtption to make the standard inference valid; that is, $\mathbf{s}_i$ and c_i are independent.

The data vector is defined as

$$\mathbf{y}_i = \begin{bmatrix} y_{i1} \\ y_{i2} \\ . \\ . \\ y_{iT_i} \end{bmatrix},$$

while the data matrix is defined as

$$\mathbf{X}_i = \begin{bmatrix} \mathbf{x}_{i1} \\ \mathbf{x}_{i2} \\ . \\ . \\ \mathbf{x}_{iT_i} \end{bmatrix}.$$

The generalized least squares estimator is

$$\hat{\beta} = \left(\sum_{i=1}^{N} \mathbf{X}_i' \mathbf{\Omega}_i^{-1} \mathbf{X}_i \right)^{-1} \left(\sum_{i=1}^{N} \mathbf{X}_i' \mathbf{\Omega}_i^{-1} \mathbf{y}_i \right)$$

$\mathbf{\Omega}_i^{-\frac{1}{2}}$ is defined as

$$\mathbf{\Omega}_i^{-\frac{1}{2}} = \mathbf{I}_{T_i} - \frac{\theta_i}{T_i} \mathbf{i}_{T_i} \mathbf{i}_{T_i}',$$

where

$$\theta_i = 1 - \frac{\sigma_u}{\sqrt{\sigma_u^2 + T_i \sigma_c^2}},$$

and $\mathbf{i}_{T_i}$ is a $T \times 1$ column vector of 1s.

Consistent estimators for σ_u^2 and σ_c^2 are computed as follows. The residual variance of the fixed effects estimator is a consistent estimator of σ_u^2, and is given by equation (3). The residual of the group means estimator is defined as $\hat{v}_i$ ($\hat{\mathbf{v}}$). Then, a consistent estimator of σ_c^2 is

$$\hat{\sigma_c}^2 = \frac{\hat{\mathbf{v}}' \hat{\mathbf{v}}}{N} - Q \hat{\sigma_u}^2,$$

where $Q = \frac{1}{N}(\frac{1}{T_1} + \frac{1}{T_2} + ... + \frac{1}{T_N})$.

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Table 1: Descriptive statistics of major variables

Panel A

	Manufacturing				Non-manufacturing			
	Average	Standard Deviation	Maximum	Minimum	Average	Standard Deviation	Maximum	Minimum
Tobin's q (Q)	2.85	47.45	5347.2	-15.38	14.45	440.92	35628.7	-31.15
cash flow ratio (F/A_{-1})	0.030	0.051	1.100	-1.230	0.028	0.076	3.260	-0.800
fixed investment ratio (I/K_{-1})	0.128	0.219	9.620	0.000	0.166	0.401	13.080	0.000

Panel B

	Manufacturing				Non-manufacturing			
	Average	Standard Deviation	Maximum	Minimum	Average	Standard Deviation	Maximum	Minimum
Tobin's q (Q)	2.28	4.36	86.63	-15.38	5.70	21.65	481.2	-31.15
cash flow ratio (F/A_{-1})	0.030	0.051	1.100	-1.230	0.028	0.076	3.260	-0.800
fixed investment ratio (I/K_{-1})	0.128	0.215	9.620	0.000	0.165	0.401	13.080	0.000

(1) Panel A refers to the sample before the exclusion of observations with extremely high Tobin's q, while Panel B refers to the sample after the exclusion. The sample size for Panel A is 13,125 for manufacturing companies and 8,356 for non-manufacturing companies, while the sample size for Panel B is 13,107 for manufacturing companies and 8,341 for non-manufacturing companies.

(2) Q, F, A, I, and K denote Tobin's q, nominal cash flows, nominal total assets, real fixed investment, and real capital stocks respectively.

Table 2: Estimation results of investment functions using unbalanced panel data (manufacturing)

Year	Model	$\widehat{\beta_1}$		$\widehat{\beta_2}$		R^2	Number of Observations
91-2000	Fixed	0.0149	***	0.2635	***	0.1637	13107
		(0.0011)		(0.0349)			
	Random	0.0085	***	0.3881	***		
		(0.0005)		(0.0400)			
	Fixed with I.V.	0.0236	***	0.1858	***		
		(0.0011)		(0.0466)			
91-95	Fixed	0.0319	***	0.2950	***	0.2978	6375
		(0.0030)		(0.0999)			
	Random	0.0145	***	0.4933	***		
		(0.0008)		(0.0841)			
	Fixed with I.V.	0.0395	***	0.2051	***		
		(0.0025)		(0.1032)			
96-2000	Fixed	0.0053	***	0.1306	***	0.2566	6732
		(0.0013)		(0.0336)			
	Random	0.0042	***	0.2281	***		
		(0.0006)		(0.0455)			
	Fixed with I.V.	0.0099	***	0.1258	**		
		(0.0018)		(0.0509)			

(1) $\widehat{\beta_1}$ and $\widehat{\beta_2}$ indicate estimated coefficients on Tobin's q and ones on cash flows respectively. The figures in parentheses are standard errors.

(2) The reported coefficient of determination (R^2) is based on the residuals of the least squares dummy variable model for the fixed effects model.

(3) In the row called "Fixed," the estimation results are based on the fixed effects model, while in the row called "Random," those are based on the random effects model.

(4) In the row called "Fixed with I.V." the estimation results are based on the fixed effects model with instrumental variables. A set of instrumental variables includes one period lagged Tobin's q, current cash flows, industry dummies, and a constant term.

(5) The estimation results are based on unbalanced panel data.

(6) *, **, and *** indicate statistical significance at 10%, 5%, and 1% levels respectively.

Table 3: Estimation results of investment functions using unbalanced panel data (non-manufacturing)

Year	Model	$\widehat{\beta_1}$		$\widehat{\beta_2}$		R^2	Number of Observations
91-2000	Fixed	0.0032	***	0.3971	*	0.1523	8341
		(0.0006)		(0.2279)			
	Random	0.0026	***	0.4708	***		
		(0.0002)		(0.0784)			
	Fixed with I.V.	0.0049	***	0.3470	***		
		(0.0007)		(0.1062)			
91-95	Fixed	0.0032	***	-0.0434		0.2322	3786
		(0.0008)		(0.7884)			
	Random	0.0030	***	0.3442	**		
		(0.0004)		(0.1729)			
	Fixed with I.V.	0.0050	***	-0.0821			
		(0.0012)		(0.2170)			
96-2000	Fixed	0.0023	**	0.4596	*	0.2751	4555
		(0.0010)		(0.2687)			
	Random	0.0024	***	0.1886	**		
		(0.0003)		(0.0761)			
	Fixed with I.V.	0.0071		0.3407			
		(0.0102)		(0.2847)			

(1) $\widehat{\beta_1}$ and $\widehat{\beta_2}$ indicate estimated coefficients on Tobin's q and ones on cash flows respectively. The figures in parentheses are standard errors.

(2) The reported coefficient of determination (R^2) is based on the residuals of the least squares dummy variable model for the fixed effects model.

(3) In the row called "Fixed," the estimation results are based on the fixed effects model, while in the row called "Random," those are based on the random effects model.

(4) In the row called "Fixed with I.V." the estimation results are based on the fixed effects model with instrumental variables. A set of instrumental variables includes one period lagged Tobin's q, current cash flows, industry dummies, and a constant term.

(5) The estimation results are based on unbalanced panel data.

(6) *, **, and *** indicate statistical significance at 10%, 5%, and 1% levels respectively.

Table 4: Estimation results of investment functions classified by Tobin's q

Industry	Year	Group	Model	$\widehat{\beta_1}$		$\widehat{\beta_2}$		R^2
Manufacturing	91-95	High Q	Random	0.0105	***	0.5222	***	
				(0.0011)		(0.1182)		
			Fixed	0.0227	***	0.3085	**	
			with I.V.	(0.0025)		(0.1497)		
		Low Q	Fixed	0.1100	***	0.0871		0.3222
				(0.0101)		(0.1009)		
			Fixed	0.1413	***	-0.0317		
			with I.V.	(0.0127)		(0.1264)		
	96-2000	High Q	Fixed	0.0057	***	0.0720		0.2286
				(0.0011)		(0.0744)		
			Fixed	0.0076	***	0.0683		
			with I.V.	(0.0018)		(0.0745)		
		Low Q	Random	0.0058		0.3191	***	
				(0.0041)		(0.0696)		
			Fixed	0.0175	*	0.2900	***	
			with I.V.	(0.0105)		(0.0834)		
Non-manufacturing	91-95	High Q	Random	0.0020	***	1.4764	***	
				(0.0006)		(0.3736)		
			Fixed	0.0044	***	1.0623	**	
			with I.V.	(0.0016)		(0.5041)		
		Low Q	Random	0.0519	***	-0.2075		
				(0.0041)		(0.1477)		
			Fixed	0.1295	***	-0.5912	***	
			with I.V.	(0.0256)		(0.1748)		
	96-2000	High Q	Fixed	0.0008		0.1797		0.2253
				(0.0008)		(0.1272)		
			Fixed	0.0081	***	-0.1462		
			with I.V.	(0.0018)		(0.2120)		
		Low Q	Random	0.0260	***	0.3475	**	
				(0.0044)		(0.1647)		
			Fixed	0.0245		1.1513	***	
			with I.V.	(0.0189)		(0.2247)		

(1) The estimation results are based on balanced panel data. The number of firms of the sample period between 1991 and 1995 is 1228 for manufacturing companies, and 689 for non-manufacturing companies respectively. The number of firms of the sample period between 1991 and 1995 is 1264 for manufacturing companies and 806 for non-manufacturing companies respectively.

(2) $\widehat{\beta_1}$ and $\widehat{\beta_2}$ indicate estimated coefficients on Tobin's q and ones on cash flows respectively. The figures in parentheses are standard errors.

(3) The reported coefficient of determination (R^2) is based on the residuals of the least squares dummy variable model for the fixed effects model.

(4) In the row called "Fixed," the estimation results are based on the fixed effects model, while in the row called "Random," those are based on the random effects model.

(5) In the row called "Fixed with I.V." the estimation results are based on the fixed effects model with instrumental variables. A set of instrumental variables includes one period lagged Tobin's q, current cash flows, industry dummies, and a constant term.

(6) *, **, and *** indicate statistical significance at 10%, 5%, and 1% levels respectively.

Table 5: Debt ratios and fixed investment

Industry	Year	Group	Model	$\widehat{\beta_1}$		$\widehat{\beta_2}$		R^2
Manufacturing	91-95	High D	Fixed	0.0231	***	0.3177	***	0.2405
				(0.0051)		(0.0900)		
			Fixed with I.V.	0.0360	***	0.2375	**	
				(0.0035)		(0.1012)		
		Low D	Fixed	0.0257	***	0.3044		0.2512
				(0.0044)		(0.2423)		
			Fixed with I.V.	0.0205	***	0.4245	**	
				(0.0027)		(0.2017)		
	96-2000	High D	Fixed	0.0073	***	0.1301	**	0.2218
				(0.0020)		(0.0668)		
			Fixed with I.V.	0.0100	***	0.1316	**	
				(0.0038)		(0.0669)		
		Low D	Random	0.0038	***	0.2620	***	
				(0.0008)		(0.0798)		
			Fixed with I.V.	0.0072	***	0.2170	**	
				(0.0018)		(0.0983)		
Non-manufacturing	91-95	High D	Random	0.0064	***	0.1093		
				(0.0012)		(0.1624)		
			Fixed with I.V.	0.0076	***	-0.3506	*	
				(0.0021)		(0.2026)		
		Low D	Random	0.0019	***	1.2482	***	
				(0.0006)		(0.4614)		
			Fixed with I.V.	0.0043	**	0.8630		
				(0.0017)		(0.5963)		
	96-2000	High D	Random	0.0138	***	0.2819	**	
				(0.0028)		(0.1333)		
			Fixed with I.V.	0.0186	**	0.6469	***	
				(0.0094)		(0.1766)		
		Low D	Fixed	0.0007		0.3163		0.2254
				(0.0010)		(0.2253)		
			Fixed with I.V.	0.0079	***	-0.4530		
				(0.0017)		(0.3414)		

(1) The estimation results are based on balanced panel data. The number of firms of the sample period between 1991 and 1995 is 1228 for manufacturing companies, and 689 for non-manufacturing companies respectively. The number of firms of the sample period between 1991 and 1995 is 1264 for manufacturing companies and 806 for non-manufacturing companies respectively.

(2) $\widehat{\beta_1}$ and $\widehat{\beta_2}$ indicate estimated coefficients on Tobin's q and ones on cash flows respectively. The figures in parentheses are standard errors.

(3) The reported coefficient of determination (R^2) is based on the residuals of the least squares dummy variable model for the fixed effects model.

(4) In the row called "Fixed," the estimation results are based on the fixed effects model, while in the row called "Random," those are based on the random effects model.

(5) In the row called "Fixed with I.V." the estimation results are based on the fixed effects model with instrumental variables. A set of instrumental variables includes one period lagged Tobin's q, current cash flows, industry dummies, and a constant term.

(6) *, **, and *** indicate statistical significance at 10%, 5%, and 1% levels respectively.

Table 6: Main bank dependence and fixed investment

Industry	Year	Group	Model	$\widehat{\beta_1}$		$\widehat{\beta_2}$		R^2
Manufacturing	91-95	Close	Random	0.0203	***	0.3695	**	
				(0.0025)		(0.1627)		
			Fixed with I.V.	0.0493	***	0.0365		
				(0.0059)		(0.2098)		
		Not Close	Fixed	0.0195	***	0.5390	***	0.2720
				(0.0035)		(0.1422)		
			Fixed with I.V.	0.0165	***	0.5775	***	
				(0.0020)		(0.1257)		
	96-2000	Close	Fixed	0.0049	***	0.3431	***	0.2199
				(0.0012)		(0.0736)		
			Fixed with I.V.	0.0034		0.3465	***	
				(0.0029)		(0.0821)		
		Not Close	Fixed	0.0012		0.1761	**	0.2093
				(0.0013)		(0.0727)		
			Fixed with I.V.	0.0032		0.1717	*	
				(0.0022)		(0.0881)		
Non-manufacturing	91-95	Close	Random	0.0110	***	0.0838		
				(0.0020)		(0.3782)		
			Fixed with I.V.	0.0229	***	-0.2710		
				(0.0040)		(0.5579)		
		Not Close	Random	0.0016	**	-0.3975	**	
				(0.0007)		(0.1873)		
			Fixed with I.V.	0.0019		-0.7955	***	
				(0.0012)		(0.2263)		
	96-2000	Close	Random	0.0051	***	0.1010		
				(0.0019)		(0.2211)		
			Fixed with I.V.	0.0063		0.8873	***	
				(0.0045)		(0.2728)		
		Not Close	Fixed	0.0004		0.6879	***	0.2407
				(0.0008)		(0.2573)		
			Fixed with I.V.	0.0122	**	0.3274		
				(0.0052)		(0.2405)		

(1) The estimation results are based on balanced panel data. The number of firms of the sample period between 1991 and 1995 is 1113 for manufacturing companies, and 569 for non-manufacturing companies respectively. The number of firms of the sample period between 1991 and 1995 is 1150 for manufacturing companies and 650 for non-manufacturing companies respectively. The sample size reduces slightly because a main bank relationship cannot be identified for some listed companies by *The Quarterly Corporate Report*.

(2) $\widehat{\beta_1}$ and $\widehat{\beta_2}$ indicate estimated coefficients on Tobin's q and ones on cash flows respectively. The figures in parentheses are standard errors.

(3) The reported coefficient of determination (R^2) is based on the residuals of the least squares dummy variable model for the fixed effects model.

(4) In the row called "Fixed," the estimation results are based on the fixed effects model, while in the row called "Random," those are based on the random effects model.

(5) In the row called "Fixed with I.V." the estimation results are based on the fixed effects model with instrumental variables. A set of instrumental variables includes one period lagged Tobin's q, current cash flows, industry dummies, and a constant term.

(6) *, **, and *** indicate statistical significance at 10%, 5%, and 1% levels respectively.

Table 7: Uncertainty and fixed investment

Industry	Year	Group	Model	$\widehat{\beta_1}$		$\widehat{\beta_2}$		R^2
Manufacturing	91-95	High V	Fixed	0.0231	***	0.0434		0.2879
				(0.0015)		(0.0997)		
			Fixed with I.V.	0.0188	***	0.0820		
				(0.0022)		(0.1009)		
		Low V	Fixed	0.0397	***	0.4959		0.2296
				(0.0070)		(0.3263)		
			Fixed with I.V.	0.0495	***	0.2107		
				(0.0060)		(0.3646)		
	96-2000	High V	Fixed	0.0099	***	0.0681		0.2369
				(0.0015)		(0.0727)		
			Fixed with I.V.	0.0201	***	0.0473		
				(0.0035)		(0.0733)		
		Low V	Fixed	0.0028	**	0.6465	***	0.2092
				(0.0013)		(0.1616)		
			Fixed with I.V.	0.0041	*	0.6915	***	
				(0.0023)		(0.1406)		
Non-manufacturing	91-95	High V	Random	0.0025	***	0.2970		
				(0.0006)		(0.2386)		
			Fixed with I.V.	0.0041	***	-0.0081		
				(0.0013)		(0.3824)		
		Low V	Fixed	0.0130	***	-0.3426		0.2022
				(0.0043)		(1.5125)		
			Fixed with I.V.	0.0077	*	-0.3188		
				(0.0041)		(0.3006)		
	96-2000	High V	Random	0.0030	***	0.3977	**	
				(0.0007)		(0.1736)		
			Fixed with I.V.	0.0139	***	0.5171	*	
				(0.0040)		(0.2725)		
		Low V	Fixed	0.0028	***	0.3043	*	0.2340
				(0.0009)		(0.1672)		
			Fixed with I.V.	0.0058	***	0.2206		
				(0.0021)		(0.2251)		

(1) The estimation results are based on balanced panel data. The number of firms of the sample period between 1991 and 1995 is 1089 for manufacturing companies, and 610 for non-manufacturing companies respectively. The number of firms of the sample period between 1991 and 1995 is 1148 for manufacturing companies and 725 for non-manufacturing companies respectively. The sample size reduces slightly because the historical data of daily equity returns cannot be obtained for some listed companies.

(2) $\widehat{\beta_1}$ and $\widehat{\beta_2}$ indicate estimated coefficients on Tobin's q and ones on cash flows respectively. The figures in parentheses are standard errors.

(3) The reported coefficient of determination (R^2) is based on the residuals of the least squares dummy variable model for the fixed effects model.

(4) In the row called "Fixed," the estimation results are based on the fixed effects model, while in the row called "Random," those are based on the random effects model.

(5) In the row called "Fixed with I.V." the estimation results are based on the fixed effects model with instrumental variables. A set of instrumental variables includes one period lagged Tobin's q, current cash flows, industry dummies, and a constant term.

(6) *, **, and *** indicate statistical significance at 10%, 5%, and 1% levels respectively.

Table 8: Liquid assets and fixed investment

Industry	Year	Group	Model	$\widehat{\beta_1}$		$\widehat{\beta_2}$		R^2
Manufacturing	91-95	High L	Random	0.0175	***	0.2363	*	
				(0.0014)		(0.1378)		
			Fixed with I.V.	0.0248	***	0.2180		
				(0.0026)		(0.1683)		
		Low L	Fixed	0.0323	***	0.3416	***	0.2857
				(0.0045)		(0.1132)		
			Fixed with I.V.	0.0216	***	0.4477	***	
				(0.0035)		(0.1084)		
	96-2000	High L	Fixed	0.0068	***	0.0951		0.2188
				(0.0023)		(0.1169)		
			Fixed with I.V.	0.0103	***	0.0738		
				(0.0023)		(0.1023)		
		Low L	Fixed	0.0025		0.1888	***	0.2245
				(0.0022)		(0.0670)		
			Fixed with I.V.	0.0017		0.1882	***	
				(0.0025)		(0.0603)		
Non-manufacturing	91-95	High L	Random	0.0025	***	1.8140	***	
				(0.0006)		(0.3233)		
			Fixed with I.V.	0.0030	**	1.5881	***	
				(0.0012)		(0.4364)		
		Low L	Random	0.0016	**	-0.3616	*	
				(0.0008)		(0.2081)		
			Fixed with I.V.	0.0527	*	-0.9556	**	
				(0.0296)		(0.4418)		
	96-2000	High L	Fixed	0.0004		0.2887		0.2232
				(0.0010)		(0.1942)		
			Fixed with I.V.	0.0086	***	-0.3824		
				(0.0018)		(0.3027)		
		Low L	Random	0.0092	***	0.3460	**	
				(0.0019)		(0.1567)		
			Fixed with I.V.	0.0039		0.7153	***	
				(0.0073)		(0.1810)		

(1) The estimation results are based on balanced panel data. The number of firms of the sample period between 1991 and 1995 is 1228 for manufacturing companies, and 689 for non-manufacturing companies respectively. The number of firms of the sample period between 1991 and 1995 is 1264 for manufacturing companies and 806 for non-manufacturing companies respectively.

(2) $\widehat{\beta_1}$ and $\widehat{\beta_2}$ indicate estimated coefficients on Tobin's q and ones on cash flows respectively. The figures in parentheses are standard errors.

(3) The reported coefficient of determination (R^2) is based on the residuals of the least squares dummy variable model for the fixed effects model.

(4) In the row called "Fixed," the estimation results are based on the fixed effects model, while in the row called "Random," those are based on the random effects model.

(5) In the row called "Fixed with I.V." the estimation results are based on the fixed effects model with instrumental variables. A set of instrumental variables includes one period lagged Tobin's q, current cash flows, industry dummies, and a constant term.

(6) *, **, and *** indicate statistical significance at 10%, 5%, and 1% levels respectively.

Figure 1-1: Fixed Invetment and Cash Flows
the entire corporate sector
data source: *The Financial Statements Statistics of Corporations by Industry*

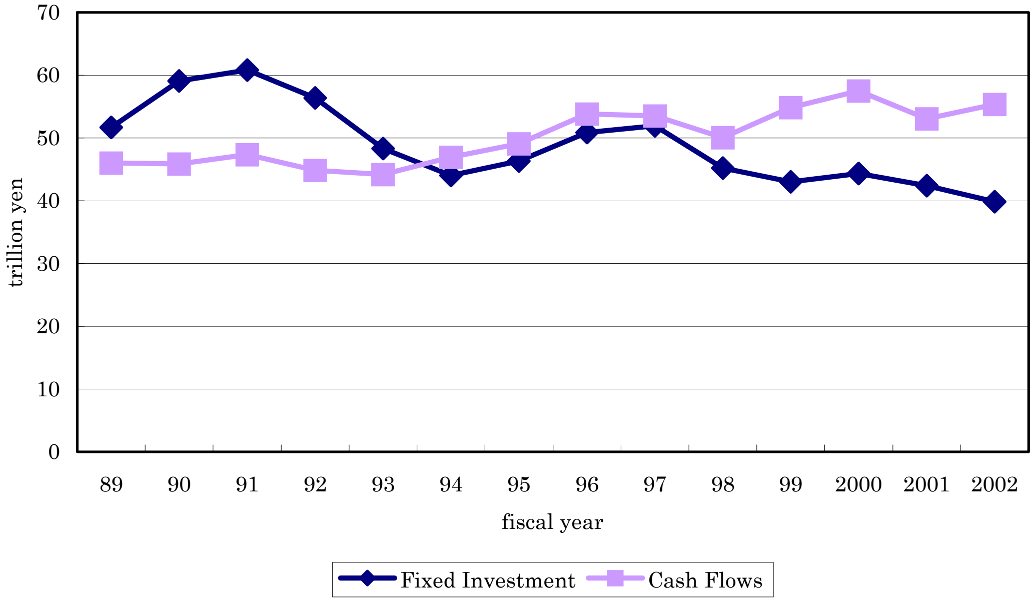

Figure 1-2: Fixed Investment and Cash Flows
large manufacturing firms (with capital larger than one billion yen)
data source: *The Financial Statements Statistics of Corporations by Industry*

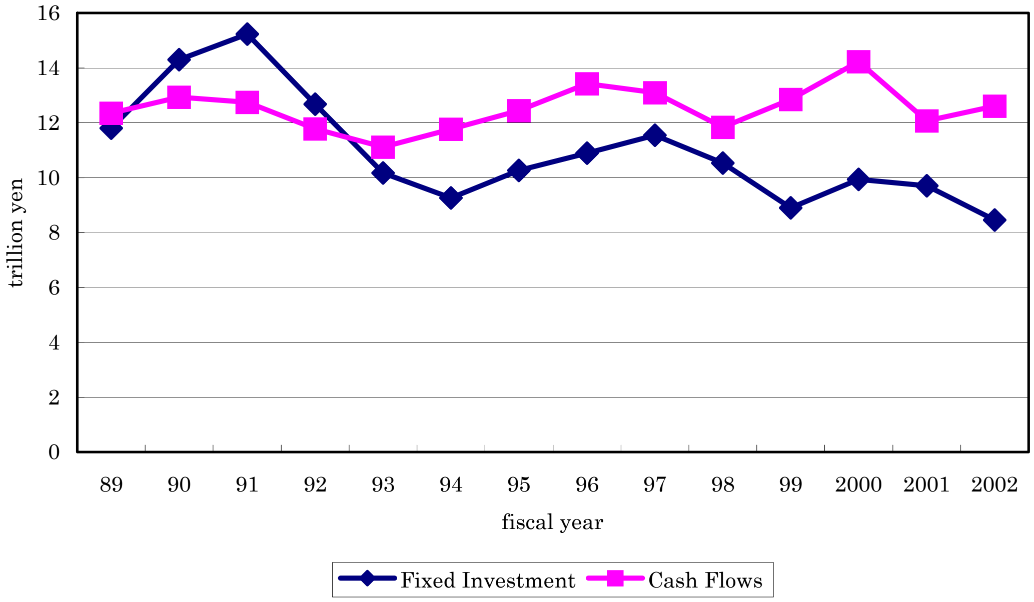

Figure 1-3: Fixed Invetment and Cash Flows
large non-manufacturing firms (with capital larger than one billion yen)
data source: *The Financial Statements Statistics of Corporations by Industry*

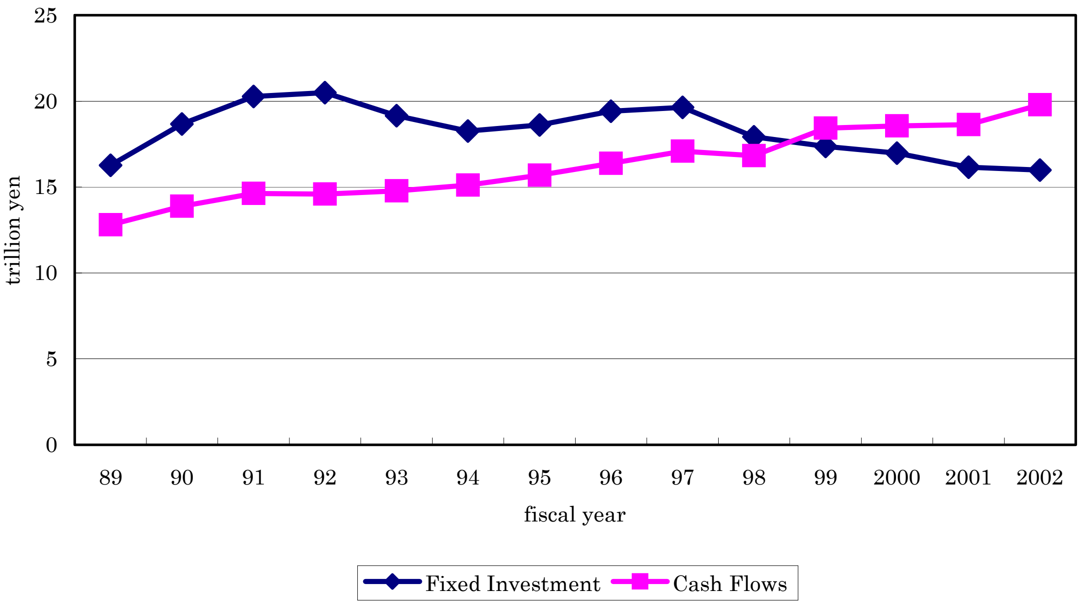

Figure 2: Cash Flows and Investment in Liquid Assets
large manufactruing and non-manufacturing firms
(capital larger than one billion yen)
data source: *The Financial Statements Statistics of Corporations by Industry*

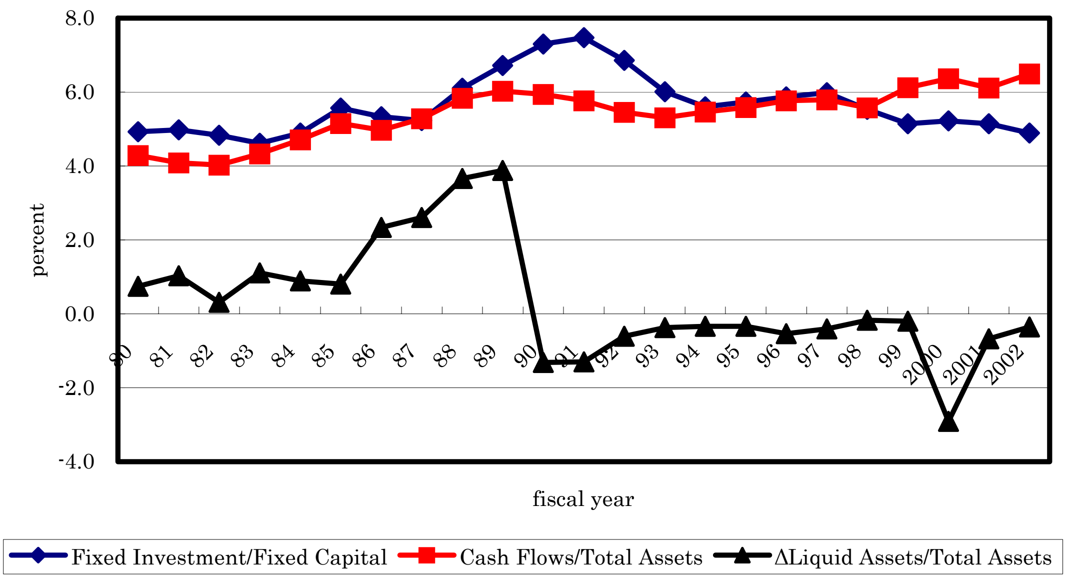

Figure 3: Debt/Asset Ratios
large firms (capital larger than one billion yen)
data source: *The Financial Statements Statistics of Corporations by Industry*

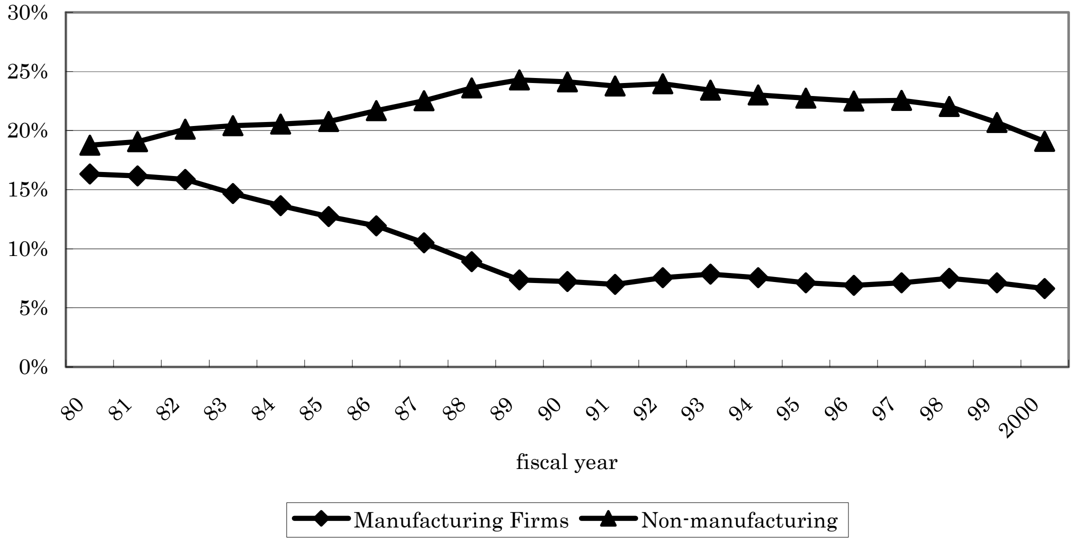

Figure 4-1: The Average of Market-to-Book Ratios of Listed Companies
data source: the authors' calculation

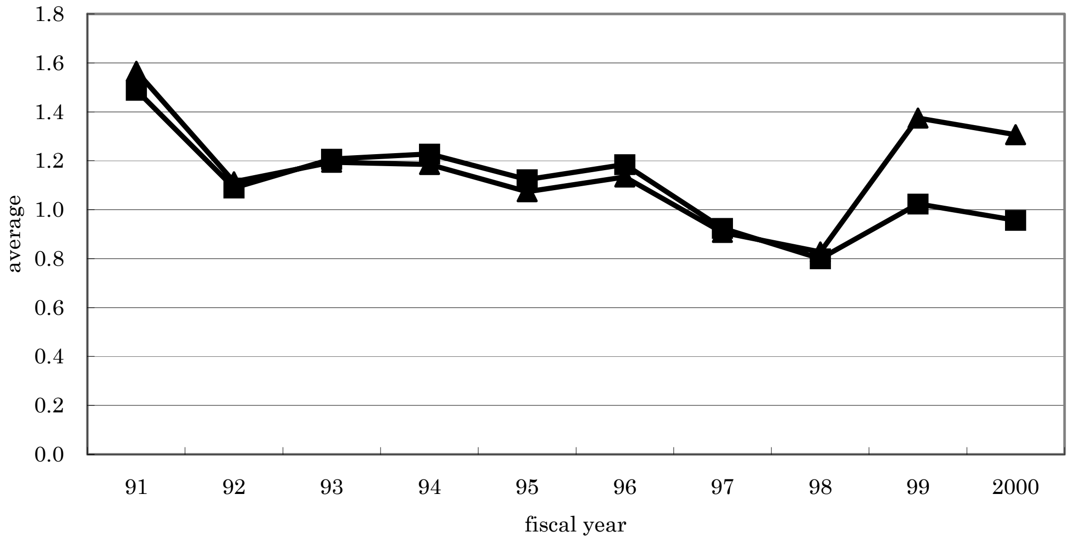

Figure 4-2: The Standard Deviation of Market-to-Book Ratios of Listed Companies

data source: the authors' calculation

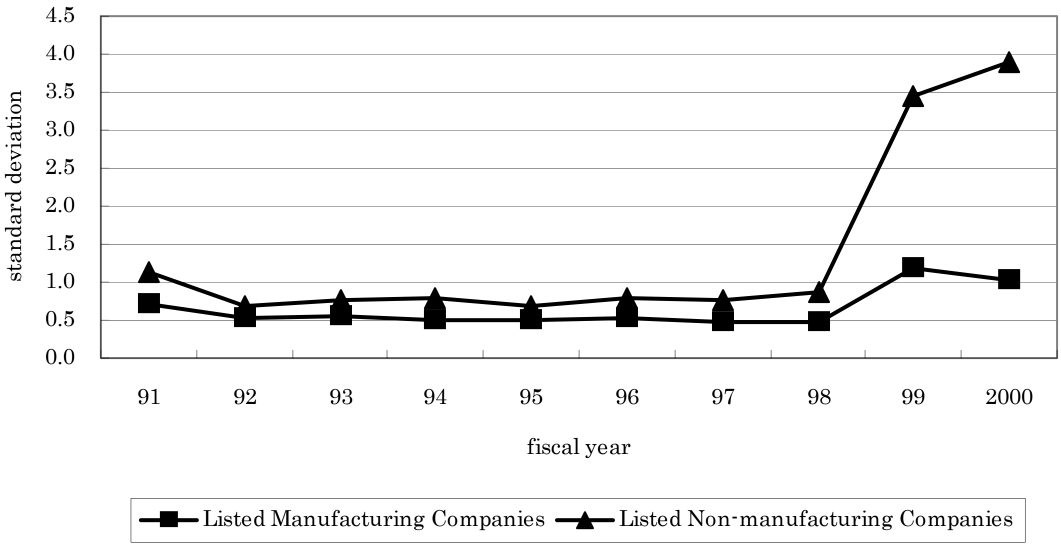

Figure 5: The Standard Deviation of Daily Returns on the Stock Price Indexes Listed at the Tokyo Stock Exchange